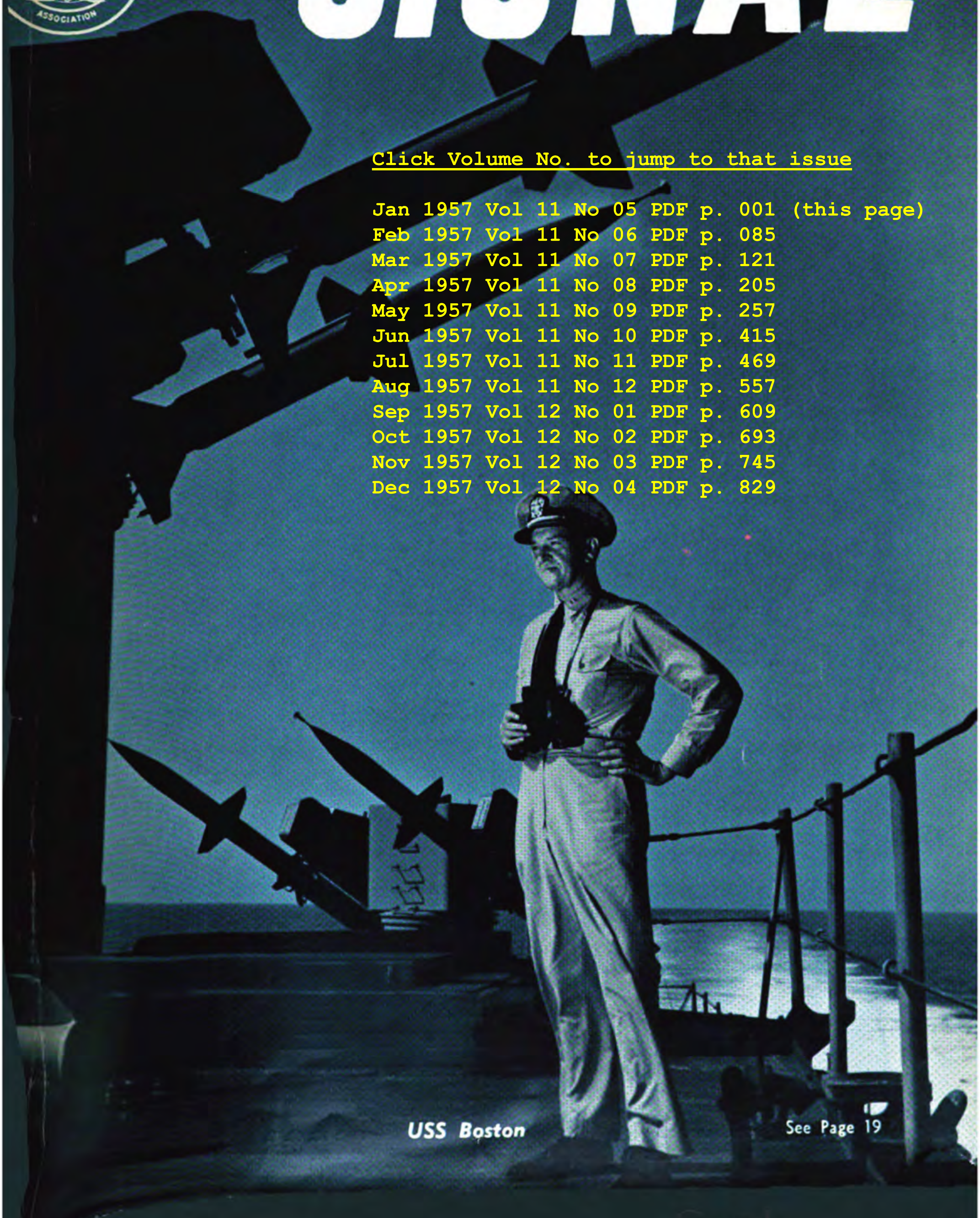
anuary 1957

Communications—Electronics—Photography

# SIGNAL



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## HERMETIC SUB-MINIATURE AUDIO UNITS

*These are the smallest hermetic audios made.*

Dimensions . . . 1/2 x 11/16 x 29/32 . . . Weight.8 oz.

### TYPICAL ITEMS

| Type No. | Application | MIL Type | Pri. Imp. Ohms | Sec. Imp. Ohms | DC in Pri MA | Response ±2 db (Cyc.) | Max. level dbm |
|---|---|---|---|---|---|---|---|
| H-30 | Input to grid | TF1A10YY | 50* | 62,500 | 0 | 150-10,000 | +13 |
| H-31 | Single plate to single grid, 3:1 | TF1A15YY | 10,000 | 90,000 | 0 | 300-10,000 | +13 |
| H-32 | Single plate to line | TF1A13YY | 10,000* | 200 | 3 | 300-10,000 | +13 |
| H-33 | Single plate to low impedance | TF1A13YY | 30,000 | 50 | 1 | 300-10,000 | +15 |
| H-34 | Single plate to low impedance | TF1A13YY | 100,000 | 60 | .5 | 300-10,000 | + 6 |
| H-35 | Reactor | TF1A20YY | 100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms. | | | | |
| H-36 | Transistor Interstage | TF1A15YY | 25,000 | 1,000 | .5 | 300-10,000 | +10 |

*Can be used with higher source impedances, with corresponding reduction in frequency range and current

## COMPACT HERMETIC AUDIO FILTERS

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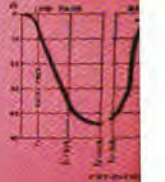

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MQE units provide high Q, excellent stability and minimum hum pickup in a case only 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz.

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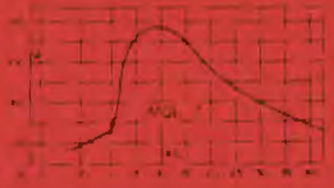
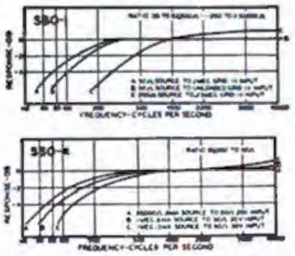
| Type No. | Inductance | | DC Max. |
|---|---|---|---|
| MQE-1 | 7 | mhy | 135 |
| MQE-3 | 20 | mhy | 80 |
| MQE-5 | 50 | mhy | 50 |
| MQE-7 | 100 | mhy | 35 |
| MQE-10 | 4 | hy | 17 |
| MQE-12 | 9 | hy | 12 |
| MQE-15 | 28 | hy | 7.2 |



## SUB-SUBOUNCER AUDIO UNITS



UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in
size. Constructional details assure maxim
bility. SSO units are 7/16 x 3/4 x 43/64 . .
1/50 lb.

| Type | Application | Level | Pri. Imp. | MA D.C. in Pri. | Sec. Imp. | Pri. Res. |
|---|---|---|---|---|---|---|
| *SSO-1 | Input | + 4 V.U. | 200<br>50 | 0 | 250,000<br>62,500 | 13.5 |
| SSO-2 | Interstage /3:1 | + 4 V.U. | 10,000 | 0-.25 | 90,000 | 750 |
| *SSO-3 | Plate to Line | +20 V.U. | 10,000<br>25,000 | 3<br>1.5 | 200<br>500 | 2600 |
| SSO-4 | Output | +20 V.U. | 30,000 | 1.0 | 50 | 2875 |
| SSO-5 | Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res. | | | | | |
| SSO-6 | Output | +20 V.U. | 100,000 | .5 | 60 | 4700 |
| *SSO-7 | Transistor Interstage | +10 V.U. | 20,000<br>30,000 | .5<br>.5 | 800<br>1,200 | 850 |

* Impedance ratio is fixed, 1250:1 for SSO-1,1:50 for SSO-3.
Any impedance between the values shown may be employed.

## OUNCER (WIDE RANGE) AUDIO UNITS

Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

### TYPICAL ITEMS

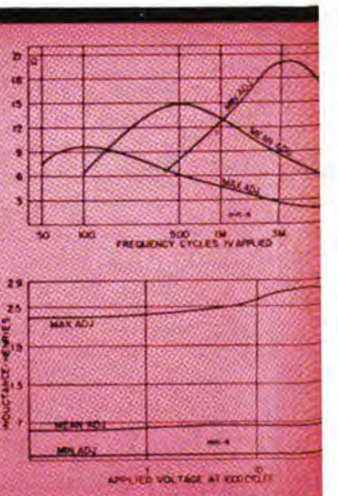
| Type No. | Application | Pri. Imp | Sec. Imp |
|---|---|---|---|
| O-1 | Mike, pickup or line to 1 grid | 50, 200/250, 500/600 | 50,000 |
| O-4 | Single plate to 1 grid | 15,000 | 60,000 |
| O-7 | Single plate to 2 grids, D.C. in Pri. | 15,000 | 95,000 |
| O-9 | Single plate to line, D.C. in Pri. | 15,000 | 50, 200/250, 500/600 |
| O-10 | Push pull plates to line | 30,000 ohms plate to plate | 50, 200/250, 500/600 |
| O-12 | Mixing and matching | 50, 200/250 | 50, 200/250, 500/600 |
| O-13 | Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms | | |

## HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50 - 10,000 cycles with exceptional stability. Wide inductance range (10 - 1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 . . . Weight 2 oz.

### TYPICAL ITEMS

| TYPE No. | Min. Hys. | Mean Hys. | Max. Hys. | DC Ma |
|---|---|---|---|---|
| HVC-1 | .002 | .006 | .02 | 100 |
| HVC-3 | .011 | .040 | .11 | 40 |
| HVC-5 | .07 | .25 | .7 | 20 |
| HVC-6 | .2 | .6 | 2 | 15 |
| HVC-10 | 7.0 | 25 | 70 | 3.5 |
| HVC-12 | 50 | 150 | 500 | 1.5 |



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"A big part of the job," he says, "is to keep trouble off the lines. For every one of those calls is important to someone. And some can be very important.

"Not only personal calls, but fire alarms, burglar alarms, radio programs and even newspaper pictures go through this same equipment."

Each Sunday Byron teaches a class for boys. Many evenings and week ends are devoted to Boy Scout work.

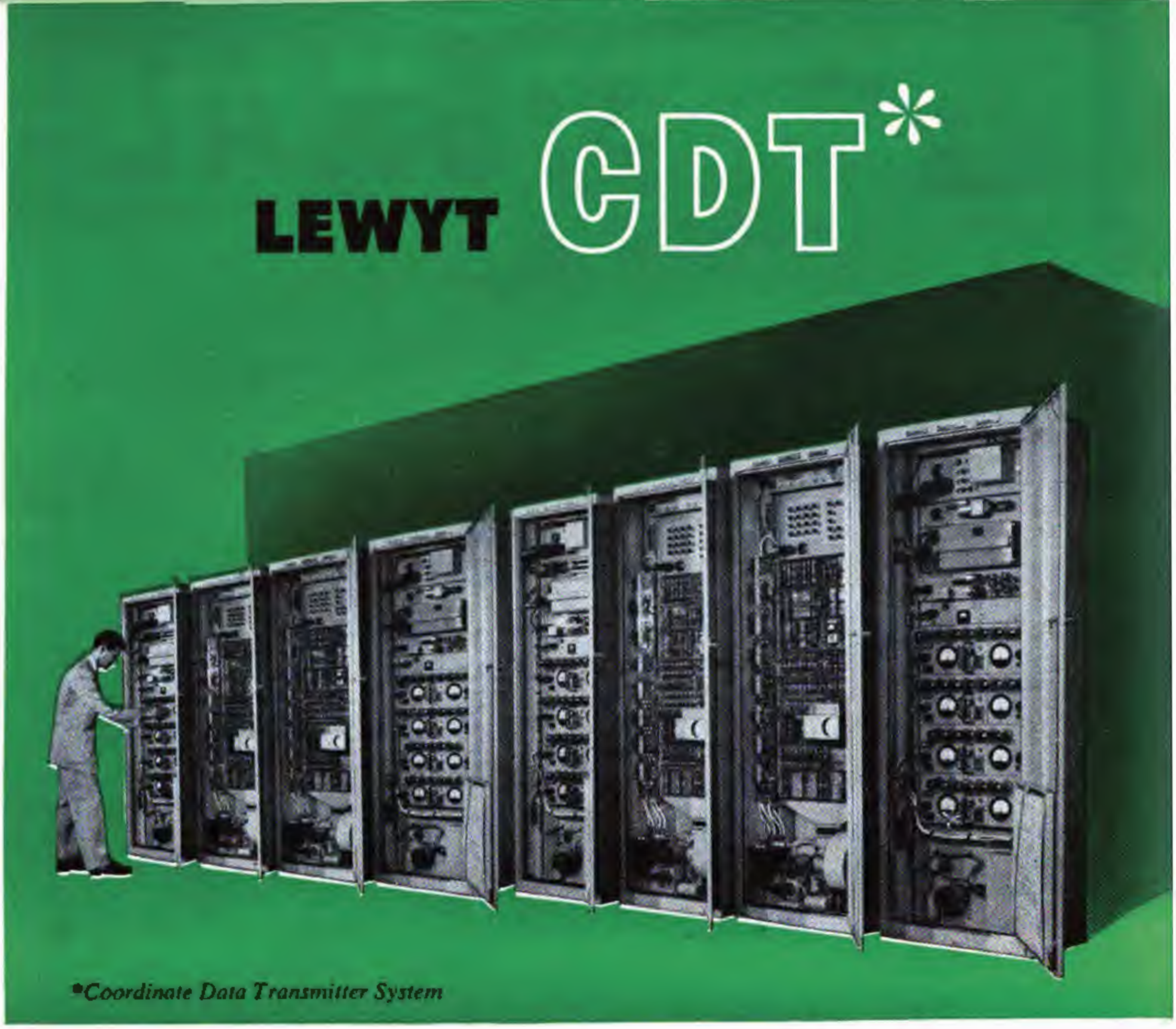
For a person who enjoys helping others, he finds his telephone work particularly satisfying.

"Whenever I watch those dial switches work," he says, "I get the feeling I'm at the nerve center of the community."

**Instructing Boy Scouts.** Byron, a troop chairman, shows scouts how to orient themselves with a map and compass in the beautiful Wasatch Range near Provo, Utah.

*Working together to bring people together*

**BELL TELEPHONE SYSTEM**



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**LEWYT**

Gift
Fred Anderegg
1-28-59

# SIGNAL

v. 11, no. 5—
v. 12, no. 4

**Communications-Electronics-Photography**

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# Mobile communication . . .
# Rock-of-Gibraltar type

The short-wave radio transmitter and receiver illustrated above is known as GRC-19, and we build it for the U. S. Army Signal Corps.

Satisfactory production of such equipment is a matter of more than precise engineering and manufacture. Two other things contribute to the fact that a very large percentage of our facilities is devoted to making products for the military.

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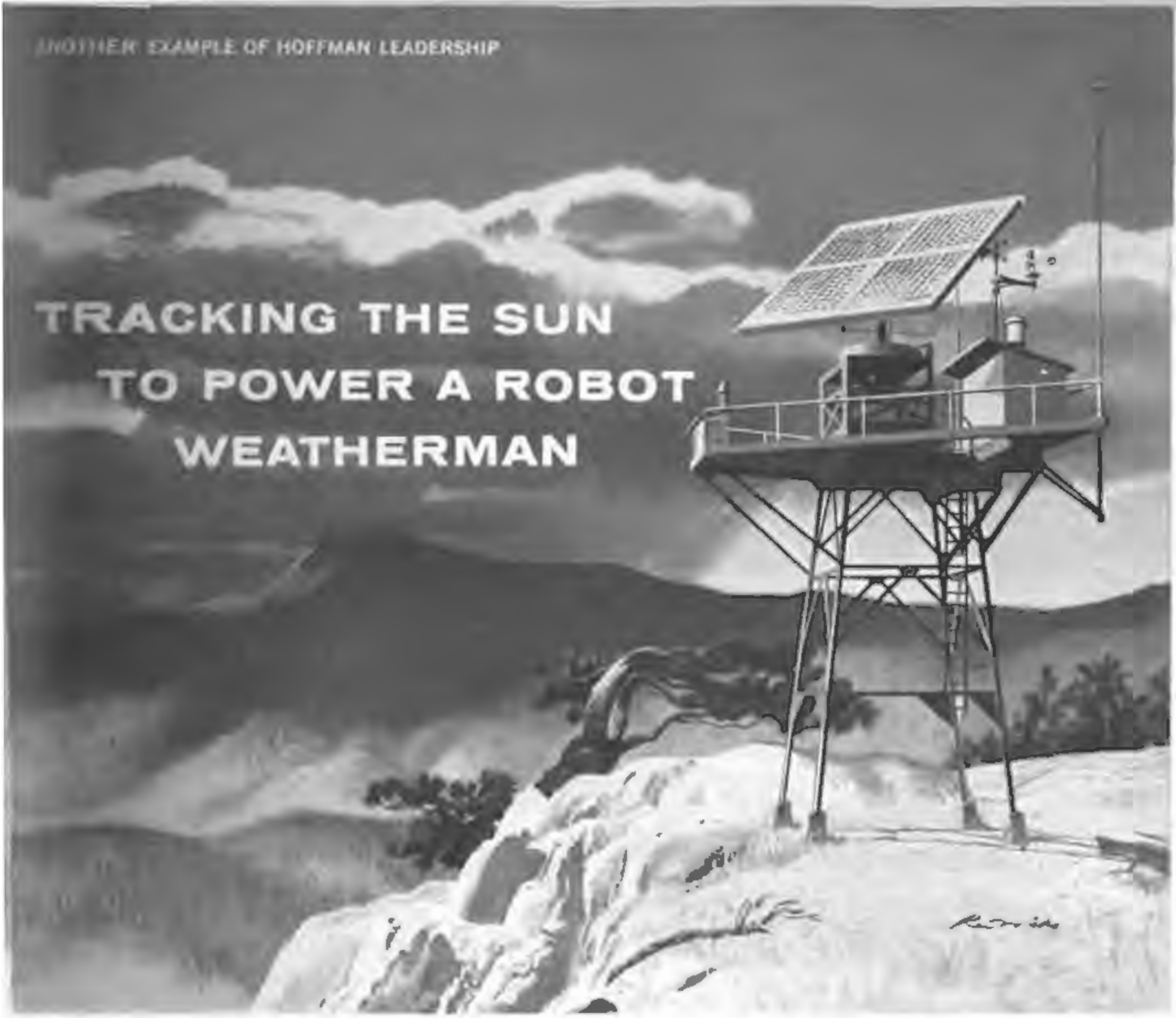

# TRACKING THE SUN TO POWER A ROBOT WEATHERMAN

The world's first experimental sun-tracking solar energy converter has been developed by Hoffman to "follow" the sun across the sky for maximum utilization of the sun's pewer. In a robot weather station, a solar energy unit could supply power for the automatic and continuous transmission of vital data to a distant Weather Central for analysis; would never require attention, except for periodic inspection.

As a result of this new breakthrough in solar energy achieved by Hoffman with vastly improved 120C Rectangular Solar Cells, the sun's energy can be harnessed to power not only robot weather stations, but also transistorized radio receivers and transmitters, untended telephone relay stations and satellite signalling equipment.

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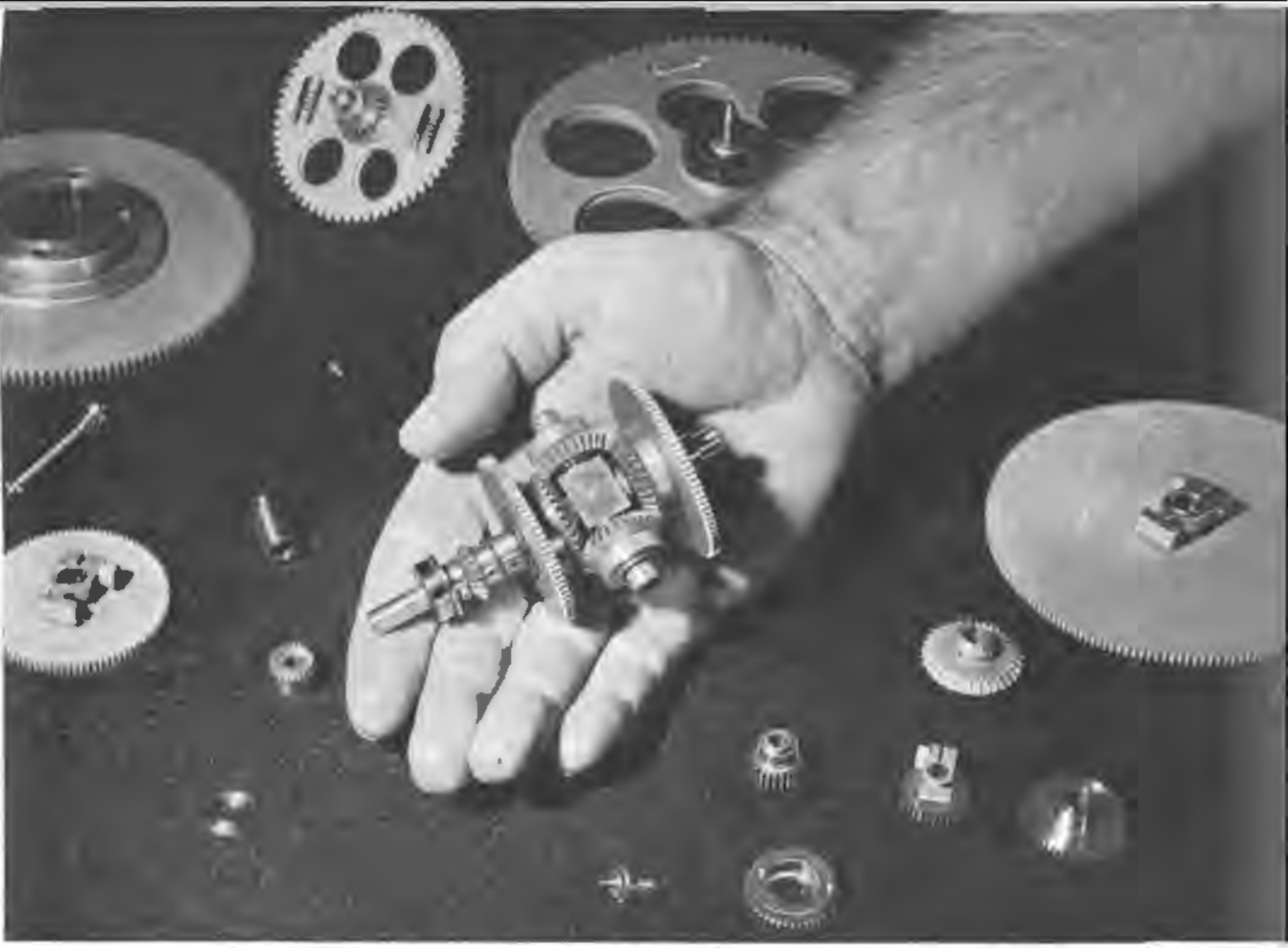

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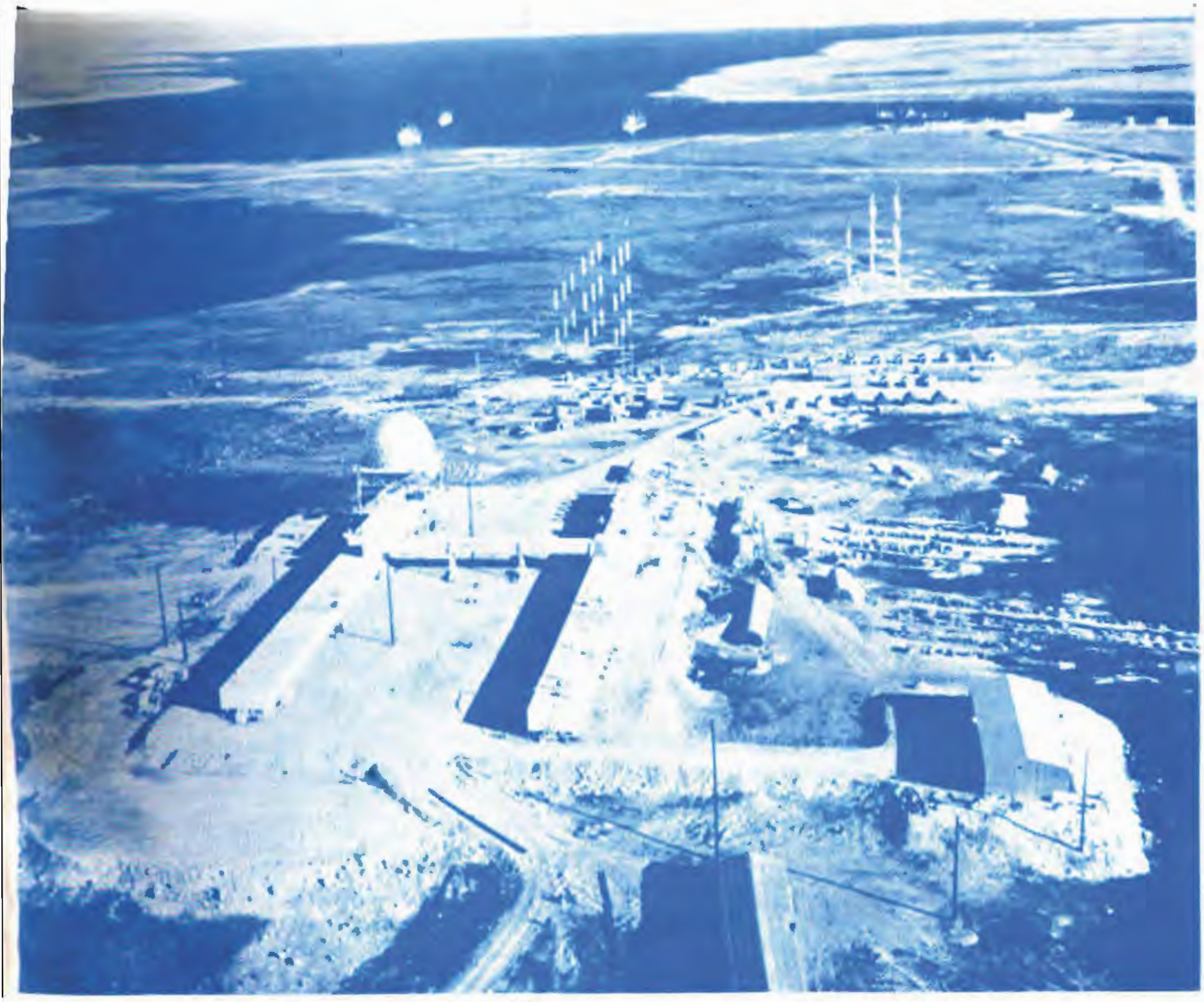


# the DEW LINE Story

**by Arthur B. Goetze**
PRESIDENT, WESTERN ELECTRIC CO.

BY NOW THE DEW LINE, OR DIStant Early Warning Line, has become a "by-word," not only among the people of Bell System, but among the majority of people in the United States and Canada as well. However, quite naturally it has different significance to different groups. To the general public it is a chain of radar stations somewhere "way up north." To those thousands of men—both American and Canadian—who have been directly associated with the project, it carries an entirely different connotation. These men have experienced the "blood, sweat, and tears" of the DEW Line stretching from the northernmost tip of Alaska to the Baffin Island Coast on the eastern end of Canada. In between these two groups are the scientifically-minded men and women who have a genuine interest in a project such as this, because of its technical involvements, its size and scope, and its importance to the protection of the American way of life. It is to this third group that my discussion here is directed.

The readers of SIGNAL recognize of course that security considerations limit the scope and nature of the information concerning this project that can be published. There can be no disclosure of classified information. After all, security measures have been designed to defend from internal threats the same freedoms which the DEW Line is being established to protect against external attack. For this reason, my discussion, of necessity, must be conducted in very general terms.

The objective of the DEW Line is to provide a detection and communi-

Mr. Goetze has been president of the Western Electric Co. since September, 1956, and a director of the company since 1953. He has served in many key posts in the communications field.

cation system capable of furnishing reliable warnings of crossings of the line by airborne objects of the types now existing or expected to exist in the near future. All phases of the design and operation of the line have been developed around the fundamental principle of augmenting and supporting this basic requirement.

Detection is accomplished by radar systems of both search and non-rotating types, thereby providing two basically different and complementary means of obtaining the desired information. Communications systems are of the VHF ionospheric and UHF tropospheric scatter types and are, of necessity, employed both for lateral communication across the line and for rearward communication to defense bases.

Clearing snow from ice landing strip

All equipment has been designed and developed to emphasize the accepted practices of automatic operation, ease of accessibility of components to facilitate maintenance problems, and a low false alarm rate. Its uniqueness—in those cases where standard types of equipment could not be used—lies in the fact that it is designed for reliable and uninterrupted operation for long periods under extreme Arctic conditions and temperatures. Antennas and other outside plant equipment have been constructed to withstand extreme cold, snow, rain, ice, and high-velocity winds, all of which are common experiences in an Arctic environment. Only one item of material which is normally considered as outside plant has been provided with protection from the elements—the search radar antenna. This has been housed in a rigid plastic radome, 55 feet in diameter, a very ingenious assembly of some 361 pieces of plastic of only 5 basic shapes.

### *Problems of Construction*

Once this system had been conceived in the minds of some of our country's greatest scientists, the task became one of establishing and supporting it in the Arctic region. This chapter of the DEW Line story has presented problems which are as fascinating as they are unique and difficult. Imagine, for example, the construction of buildings and the installation of complex electronic gear in the middle of a bleak, treeless Arctic waste where nothing but frigid white barrenness meets the eye in any direction you turn. Imagine the planning necessary to support more than 7,000 construction people, to do it quickly, and at a time when there wasn't a nail, or a board for a piece of equipment to start with. It has been a stupendous task—vastly different from any other in our history—and stands as a splendid example of teamwork between the United States and our good Canadian neighbors.

But let's start at the beginning. First, extensive survey work was carried on during 1953 and 1954 by the Western Electric Company and its teams of specialists from the Bell System Companies, and a number of possible routes across the Arctic were studied in great detail. Aerial reconnaissance at low levels was performed, both in winter and summe and something on the order of 80,00 photographs were taken, to be an lyzed and evaluated along with va ous reports which were available co ering the areas being considered.

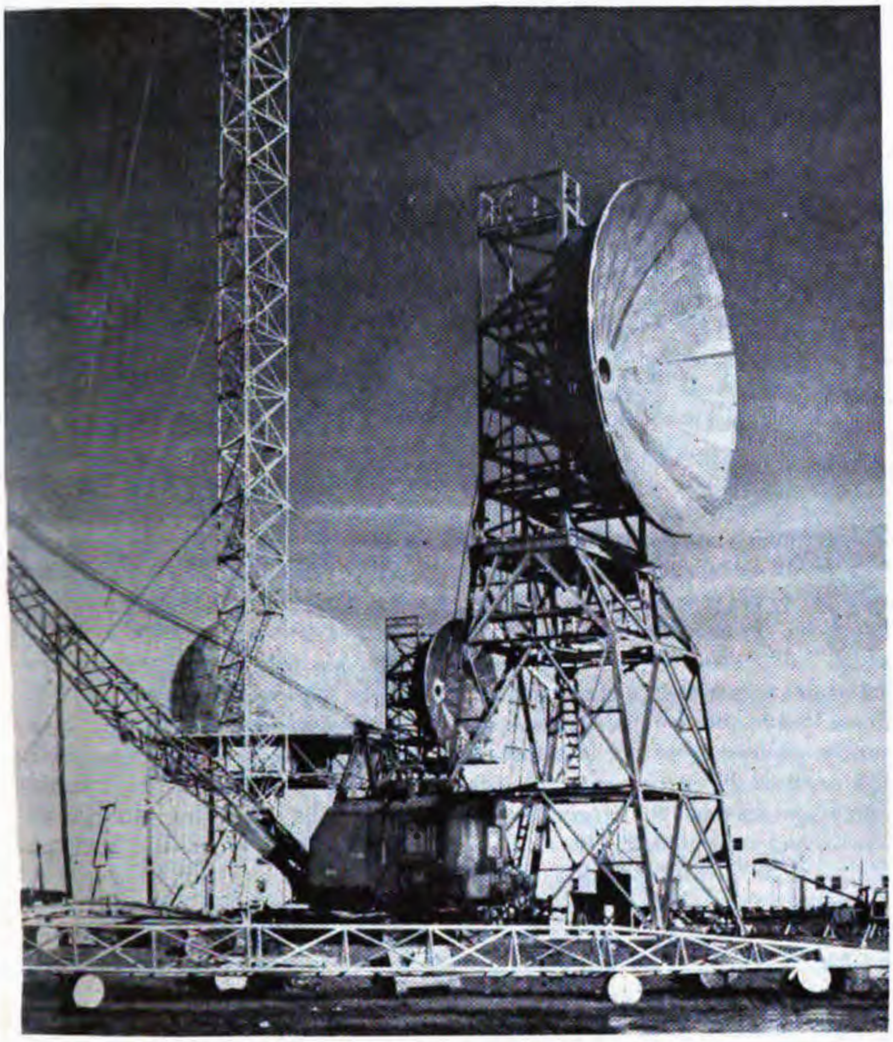
Discussions were carried on wit both United States and Canadia citizens who had had first-han knowledge of the areas, and valuabl experience was obtained by actua participation in various sea resuppl missions throughout the area. Dat gathered by all these means wer compiled and evaluated, giving specific regard to detection capabilities, construction, logistics, and operating problems. Finally, after painstaking analysis, an optimum route was recommended.

### *Choosing Sites*

Final site locations depended upon "on the ground" surveys in order that maximum advantage could be taken of local terrain conditions. Construction schedules already established required that these surveys be conducted during some of the most severe weather conditions encountered in the Arctic. Siting engineers landed by bush plane in the middle of nowhere, lived in tents, slept in their clothes in 50-degree-below-zero cold, and endured wind that scrapes like a file and a whiteness that makes the human eye beg for relief. And as if the job were not already sufficiently unpleasant, there was always the threat of polar bears—a possibility which time proved it was never safe to disregard. Yet the men stuck to the job and developed the information which was needed to determine the location of the stations of the DEW Line System.

Overlapping some of the final siting activities, path testing operations were carried on in order to determine transmission characteristics between proposed station locations. Most radio transmission people are familiar with these problems in normal conditions within the boundaries of the temperate zones. But in the perishing cold of a region, virtually unmapped, the task of developing dewpoint readings is transformed into a mighty tough job.

Much of this activity was carried on during the long Arctic winter when sunlight was only a memory.



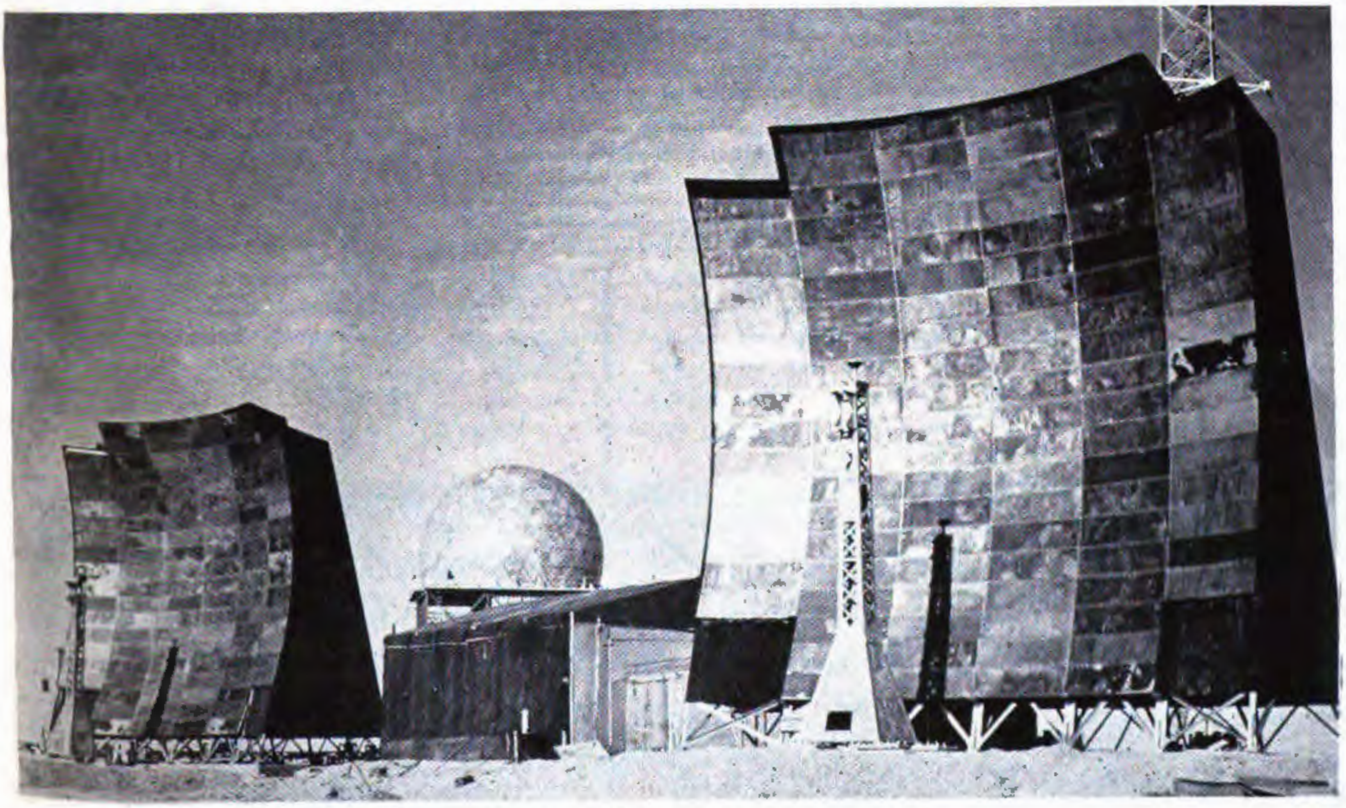
30' UHF parabolic reflector used in lateral communications

Carrying a flashlight in bitter cold weather is a nuisance, but when it is too dark, even at high noon, to read a psychrometer, it becomes a very necessary nuisance. Extreme care also had to be taken when siting with a theodolite to keep frost crystals from gathering on the lens at one end, and to keep one's own eyelid from freezing fast to the eye-piece at the other.

Still another source of frustration stems from the fact that siting is largely a trial and error activity. A station location can be determined as scientifically as the present state of the art will permit, but a subsequent radiowave "fix" for orientation of the equipment may indicate that another three hundred yards to the east would probably be a better spot. And interspersed with all these problems is the ever present human need to "get in out of the cold" at frequent intervals to avoid permanent damage from frostbite.

Also overlapping siting activities comes the matter of detail design and the preparation of engineering specifications. This phase of the project has required the preparation of thousands of drawings, all of which had to be checked, approved, and cata-

(*Continued on page* 12)



60' parabolic antenna used for DEW Line communications logued, and lists of materials developed. The work represented by the drawings had to be scheduled and phased together in accordance with the latest available information with regard to developmental work, manufacturing intervals, transportation requirements, sea and airlift facilities, and the availability of manpower.

### *Placing the Orders*

Next came the procurement phase which started us on the long trail of locating qualified suppliers and placing orders. The DEW Line is not a system of Western Electric, or Bell System equipment. *Thus far, nearly 3,400 separate suppliers in the United States and Canada have been manufacturing DEW Line items under a continuous stream of some 64,000 separate purchase orders.* A big half of these orders have been placed with Canadian suppliers, a fact which contributes immeasurably toward easing transportation problems by shortening the supply routes to the northern sites.

Some Western Electric Company materials are used, but it is as the prime contractor for the Air Force that our contribution to the project is made. It is in this capacity that we act as the central control in a total effort requiring more items than any combination of a thousand different companies is equipped to produce. The tremendous number of suppliers and manufacturers cannot be listed here, but they include all the familiar names in the field of electric and electronic communications industries, as well as many, many others not so well known, but who have nonetheless played an important role in equipping the DEW Line.

Finding a source of supply for each needed item was a big job. Transporting it from where we found it to where we needed it turned out to be an equally big job. Transportation is sometimes a knotty problem right here in the United States, but just consider this sort of a situation, if you will—a trip involving transportation of many tons of equipment from Buffalo to Edmonton, Canada, and then to Grimshaw by rail; from Grimshaw to Hay River by truck; from Hay River to Tuk Tuk by barge; down the Mackenzie River by barge; and finally across the tundra by cat train to the DEW Line sites. Then insert a few of the oft-encountered problems such as ice in the lakes and soft mud in the land routes and you get an idea of the recurring torture that transportation people were required to face.

Much of the transportation activity has been accomplished by sea and airlift in addition to the barge and cat train operations just mentioned. Some idea of the scope of the activity can be gleaned from the fact that it has required 200 deep sea vessels, 80 lighterage vessels, 20 barges, 1,000 trucks, and more than 25,000 aircraft flights. The airlift operation alone, including 24,950 commercial and 500 U. S. Air Force flights, has covered a total of 26,000,000 air miles—enough to send a squadron of 100 planes 10 times around the world!

### *Providing for Material*

Once the material is on its way north, the next problem is the provision of airstrips, roads, beaching area, and storage space to bring it into the actual site location, and the construction of the buildings which will permanently house it. In connection with the first of these requirements, it has been said that the DEW Line is a "gravel economy." The facts bear this out. Enough gravel has been used on the project to construct a road 18 feet wide and 1 foot thick, clear across our continent. Buildings for the DEW Line sites have been designed to meet three basic requirements: first, they must be comfortable, adequate, and sufficiently flexible to meet personnel and equipment needs; second, they must be resistant to fire, wind, cold, storm, and deterioration, and third, they must be simple and economical to transport, construct and maintain at Arctic sites.

Extensive studies were carried out in connection with various types of concrete, metal, metal-clad, and wooden structures before the final decision was made to use a series of modular units assembled from prefabricated insulated plywood panels. This modular technique has proven highly successful. Modules have been assembled and outfitted at convenient locations and transported in finished form as much as 200 miles for assembly into the building train at their final location.

With the material on site, and the buildings to accommodate it, the next phase of the job is the actual installation and testing of the equipment prior to its being turned over to the Air Force, ready for operation. Manpower for this effort has been drawn from all over the Bell System, trained at the prototype installations in Illinois, outfitted with Arctic gear, and transported to the DEW Line sites.

A number of the buildings already have been accepted by the Air Force. The installation of equipment at many locations is well along and testing activities are being carried on. Soon, the full story can be told—a complete account of the adventures of thousands of Americans and Canadians (and we would be remiss if we failed to recognize, too, the splendid contribution of the Eskimos)—all of whose efforts and skills have played so important a part in establishing the DEW Line.

Corner reflectors used in rearward communications

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|---|---|---|---|
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| vibration | 100 to 1000 cps at 10 G | 3 cycles, each x, y, and z plane | $I_{CO} = 2\mu A$ maximum at 5V<br>$h_{ob} = 2\mu$mhos maximum<br>$h_{fb} = -0.88$ minimum for 2N117<br>$h_{fb} = -0.94$ minimum for 2N118 |
| vibration fatigue | 60 cps at 10 G | 32 hours, each x, y, and z plane | |
| shock | 40 G, 11 milliseconds | 3 shocks, each x, y, and z plane | |
| temperature cycle | −55°C to +150°C | 10 cycles | |
| moisture resistance | MIL-STD-202 | 240 hours | |
| life, intermittent operation | $P_c = 150$ mW, $V_c = 30$V | 1000 hours, accumulated operating time | |
| life, storage | 150° C, ambient | 1000 hours | |
| salt spray | MIL-STD-202 | 50 hours | no mechanical defects interfering with operation |

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# the Role of Communications in Air Traffic Systems

**by**

**Captain Donald B. Nowakoski, USAF**

CHIEF, SUPPORT SYSTEMS BRANCH
OFFICE OF FUTURE SYSTEMS
AIRWAYS and AIR COMMUNICATIONS SERVICE, MATS

THE AIR TRAFFIC SYSTEM CONSISTS OF A MYRIAD OF closely interlaced sub-systems, any one of which is inadequate in itself. The sub-system under discussion here is the communications network which supports the entire Air Traffic Systems structure. It is not the intent of this article to revolutionize Air Traffic concepts, but to point out the urgent need for keeping pace with the state of the art involving communications. Further, it becomes necessary to view the capability of the traffic system from the standpoint of information flow from aircraft to ground to aircraft and ground station to ground station. It follows that the overall system capability is only as effective as the communications which makes the system possible. Loss of even a small amount of this talk power requires realignment of numerous procedures and control standards, to the detriment of traffic flow.

Obviously, the ability to communicate faster and increase the amount of intelligence which may be passed in a given time period, lessens to a great extent the processing time of any given traffic condition. Aircraft in steadily increasing numbers are flying higher, farther and faster. So fast, in fact, that we cannot communicate at a rate comparable to the flight situations. The philosophy that high speed aircraft may be flown at extreme altitudes with relative safeness in the absence of air traffic regulation is short sighted. At high altitudes and high speeds, there is no such thing as Visual Flight Rules. In reality the term VFR is fast disappearing from the air traffic scene. Since instrument flight can be conducted only in the presence of adequate communications, it goes without saying that the communications system supporting these flights must be vast in scope, extremely reliable, versatile and capable of evolution. Automaticity provides the only means by which we may accelerate and expand our systems capability.

### *Expanded Communications Needed*

What is needed to reach this happy state of semi-automatic operation placing us in readiness for fully automatic systems? Communications—in expanded, modified, improved and vastly new forms. Some of these imposing requirements will be mentioned, realizing full well that this system will be tremendously expensive. Understanding that approximately 125,000 aircraft will be flying in the United States in 1975 and that these aircraft will make three to ten times as many flights per aircraft as they do today, and the fact that control technique is obsolete by today's standards, so called "improvements" using yesterday's communications is a step to the rear. The following assumptions are made after careful consideration of civilian and military capability and current state of the art.

1. (1) Intercenter communications system employing teletype or voice is too slow and lacks required capacity.
2. (2) Air to ground and ground to air voice is cumbersome, slow and inadequate. Its use must diminish but will never quite disappear.
3. (3) Manual display of electronically derived data is archaic and only introduces further delay in electronic data processing.
4. (4) The use of spectrum for air ground which allows line of sight coverage in terminal areas of restricted airspace configuration is not good sense. Airport surface communications, for example, require a maximum coverage of 1 or 1.5 miles.

### *Revision of Basic Concepts*

Modernization of the Air Traffic Systems and providing a built in evolution capability will require revision of certain basic concepts and realignment of our air traffic thinking. In order of importance, let's look at some of aspects that have been considered at length and the conclusions which may be reached.

(1) The rate at which aircraft control may be exercised, which determines the scope of the control, rests with the ability to tell someone something or have someone tell us something. We know that 90 percent of our problem is linked with this condition. Speed of transmission, reception, and processing must be vastly increased and this can only be accomplished electronically.

(2) Communications, then, is indispensable to the Air Traffic System. How much we do and how well we do it rests with our ability to communicate.

(3) Pure talk ability even in its most sophisticated form is only a small part of the overall problem. We must do something with the information which flows in fantastic quantities within the system. This information must be displayed in a convenient, dynamic form, allowing the decision-maker uninterrupted concentration on his primary job—maintaining safe air operation. The display facility and any electronic processing equipment is a part and parcel of the communications system, to no lesser degree than the radio transmitter itself.

The barrier preventing the immediate transition to a semi-automatic Air Traffic System is the lack of means of providing adequate intelligence at rapid rates to the system. It has been proposed that as a first step the teletype be used to pass the flight plan information and process automatically a flight strip identical to that in use today. At 100 word per minute transmission speeds, considering that between 50 and 75 percent of the transmitted message is blank to provide for numeral or character positioning on the flight trip, too much time is consumed sending the required information. Unacceptable transmission delays result as backlogs develop on busy circuits and the flight plan of the aircraft due at a terminal first may not arrive prior to the flight plan on an aircraft due some time later.

The first step then, in providing "information" to the controller in a timely manner is conversion of the entire Air Traffic System's intercommunications network from teletype to high speed data. A number of satisfactory data transmission systems are in use today for passing airline reservation information, collecting voluminous status type reports and others.

As conversion to data is affected, weather, flight plans, airport condition and much other information may be exchanged rapidly and accurately.

So far, however, we have not improved the means of making use of this data. The existing methods of displaying the flight plan and other data to the controller requires that a person or persons manually insert the flight strip into a holder and then position it in a suitable flight progress board. All of these functions may be performed automatically with the flight plan mechanically or electronically displayed instantaneously in its appropriate position before the controller when received. The controller should not be required to collect, disseminate, or dispose of flight plan data, but should be left free to concentrate on decision making by monitoring his traffic display and forecasting sensitive situations before they occur.

Providing automatic display helps us but does not solve the entire problem. What does the controller spend his time doing? Studies have proven beyond any shadow of doubt that 90 percent of the time is consumed not by decision making but by communicating. We must reduce the talk time and provide more decision making capability per controller. To accomplish this, more concise, rapid communications are essential from ground to air and air to ground.

### *Use of Electronic Storage*

The air-ground data link is capable of doing this job swiftly and effectively. Essential air derived information may be transmitted to the ground automatically as well as on an interrogation basis. The interval between automatic air to ground reporting may be established at that which is most convenient for the flight path being flown, the interval being somewhat longer during the en route portion of the flight than during the terminal area transition. When received at the ground station, this data may be scanned by electronic means and processed automatically to appropriate recipients via the inter-center data link system and displayed as required.

It is reasonable to envisage information processed via the data link and read-out for visual display to a controller anywhere in the system or transmitted to an aircraft. This places a demand upon the system for compatibility of the ground to ground and ground to air to ground data link, an entirely conceivable and desirable characteristic.

To facilitate rapid flow of the required information and curb the entry of unnecessary data into the Air Traffic Data Communications System, as well as insure the availability of information when required, electronic storage and computation may be used. Several master storage-computer (SC) stations would be required to adequately process the vast amount of information in use. All intelligence processed by the Data Communications System would terminate in one of the master storage facilities initially. It could then be read out to the appropriate agencies, instantly in the case of initial flight plans or as required in the case of weather.

### *Desirable Operations*

In sophisticated form the storage computer facilities interconnected by the Data Communications System would allow a multitude of highly desirable operations. For example, insertion of a proposed flight plan at the point of departure would trigger a series of events automatically, all intended to insure a firm flight plan, approach slot, and terminal airport handling facilities. This may be accomplished by processing the flight plan to the master storage-computer center having basic jurisdiction and causing it to interrogate all agencies involved in the flight, en route and terminal, to include such items as airspace reservations, airport congestion, alternate airport facilities, passenger facilities and many others. Assuming that all conditions are favorable, the SC would consolidate and insure appropriate take-off time, approach times, routes, altitudes and set up the automatic position reporting times and locations. During the flight, automatic position reports would be referred back to the original assigned flight plan, compared with the assignments and passed to the appropriate controller display. If a conflict or variation is detected a revised flight plan may be computed by interrogating automatically all stations concerned and commanding the change to the aircraft by ground air data link.

### *Economy Will Govern Rate of Modernization*

The controller, thus relieved of the burdensome responsibility of verbally processing the position reports and command changes in flight attitude, may concentrate his full attention to decision making.

What form will this communications network take for which we have stated a need? In the first place, no startling changes will be made overnight. The system will evolve in accordance with a systematic, progressive program common to civilian and military. The rate of modernization will be governed by economics, not communications state of the art. Nothing herein outlined is beyond that which is possible to attain or already in use. Several steps follow which must be taken without delay to provide the communications foundation for the Air Traffic System needed, *not in 1975, but today*. Realizing that much is needed to implement such a system improvement, every consideration has been given to projected communications system capability based upon existing equipments as well as techniques just now being perfected.

(1) Expand, as required, the intercenter communications facilities and immediately commence conversion to full data transmission capability.

(2) The military services have already reached agreement on the technical make up of one way air-ground data link. Expand this agreement to duplex systems and arrive at satisfactory military-civil common data link standards as for air-ground-air.

(3) Accelerate program implementation of military-civil air fleet and ground station data link in the U.S. as well as appropriate locations overseas.

(4) Develop and place into operation suitable display equipment which will accept data remotely or locally and present it in appropriate form to the controller.

(5) Plan, engineer, and place into operation suitable storage-computer centers based upon the geographic air traffic configuration. The storage-computer facilities to be capable of accepting, storing, analyzing and transmitting any and all data fed to the intercenter Data Communications System from ground or air derived sources.

(6) Insure overall system compatibility by providing entry to the system by any form of communications intelligence, accepting, and processing any source derived position data on aircraft be it air derived, ground radar derived or Air Defense.

(7) Expand the Data Communications System to include processing of the myriad of information on airport condition, passenger facilities, weather, air movement, alternate airport data etc., to allow implementation of a scheduling traffic system. This system to rely upon the storage-computer center having jurisdiction over the airport of departure interrogating en route sectors and destination facilities to compile and assign route, departure and arrival time, altitudes, reporting times and positions, alternate airports, ramp times, etc.

(8) Exploit existing communications art to conserve spectrum space for ground-air communications. Reserve line of sight frequencies for applications requiring such range and provide SHF, perhaps millimetric, communications for very short range requirements.

### *Without Communications—No System*

In relation to Air Traffic, it may be simply stated that without communications there is no system. Large amounts have been and continue to be spent for communications, yet the figure is surprisingly small when compared with the preciousness of the end result of the expenditure. Unfortunately, in the past we have not kept pace with the capability offered us by the electronics field. Happily, we may look forward to improvements and expansion which will keep pace with the ever growing need for expanded Air Traffic Systems. Communications makes itself felt everywhere, in the U. S., and abroad. It cries out to be allowed to do our jobs for us because nothing can do these jobs better. The past bleak years have taught us that we cannot possibly hope to command Air Traffic leadership without large scale modernization of the communications networks and techniques which makes this possible.

# From the President

Dear Member:

As an association, AFCEA can be of incalculable value to the national defense. Communications and electronics are the backbone of military operations. Those whose business it is to manufacture or operate communications and electronics equipment are a vital part of our defense system. The responsibility for the safety of the United States falls equally on the shoulders of industry and the military. Approximately three quarters of a billion dollars will be spent in this fiscal year on the procurement of communications and electronics equipment by the Armed Forces and an additional five billion for research and development. The importance of the industries which AFCEA represents to the national defense effort is self-evident. Not only do the members of AFCEA participate in production and operation, but they are represented in the highest councils of the Nation.

AFCEA is not a trade association, nor is it a manufacturers association. It is a patriotic organization composed of group and individual members dedicated to a common cause.

As individuals, we are often prone to place too much emphasis on the last part of the stated objective of AFCEA, i.e., fostering the spirit of fellowship among industrial and service personnel. While fostering this spirit of fellowship is an important ingredient of our mission, it should not be considered an end in itself. In the words of one of our prominent directors, "We have passed the marching and chowder stage. AFCEA has come of age and the more serious aspects of our mission should not be neglected."

The primary objective of AFCEA is to maintain and improve the cooperation between the Armed Forces and industry in the design, production, maintenance and operation of communications, electronics, and photographic equipment in time of peace as well as in time of war.

How can the individual member assist in fulfilling this obligation? First by participation in chapter activities. Membership in a chapter brings to the individual the opportunity to maintain close professional contact with other members, both in industry and the Armed Forces. These contacts should be more than social. The chapter serves as a forum from which constructive ideas can be discussed and a better appreciation of the problems confronting the Industry-Armed Forces partnership can be gained. Collectively, the chapter can and should exercise a definite influence in its community. Individually, the chapter member contributes to the collective effectiveness of the chapter.

There are many individuals, however, who, for one reason or another, cannot either belong to a chapter or participate in chapter activities. These members, too, are important to AFCEA. By their very membership they lend their support to the objectives of the Association.

Membership in AFCEA is not a one way street. Your Association has much to offer you as an individual. The comradeship born of association with others of your profession in a common cause is one of the benefits. SIGNAL, the official magazine of the Association, is another. SIGNAL is a continuing contact with the profession of communications and electronics. Through its editorial pages and its advertising, SIGNAL provides a means of keeping in touch with trends and major developments of professional interest. It is a magazine worth reading. It is a publication worth keeping.

The strength of the Association and its ability to carry out its objectives depends upon the continuing interest and support of its members. Its effectiveness is reflected in its numbers. Each individual contributes to the whole. Keep up your interest, maintain your membership, and encourage others to join with you in the high objectives and benefits derived from membership in AFCEA.

May I wish each and every one continuing success, good health, and a Happy New Year.

Sincerely,

Percy G. Black

**National President**

U. S. Air Force Photo

An Air Force cargo plane delivers vital Air Force supplies to an overseas base.

# AIR MATERIEL COMMAND IS GLOBAL LINK BETWEEN RESEARCH AND COMBAT UNITS

Supplying the Air Force with the right equipment, at the right place at the right time is the mission of Air Materiel Command. Its procurement, supply and maintenance operations fill the area between research and development on one side and combat units on the other. It is the largest business in the country.

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The vital logistic mission for the Air Force involves billions of dollars in procurement, thousands of airplanes, and more than a million different kinds of supply items. Organizationally, AMC includes fourteen air materiel areas, or major area depots, located in the United States, Europe, North Africa, and the Pacific. Geographically, air materiel operations extend throughout the free world.

Working with weapons systems contractors in private industry, AMC procures the equipment which has been developed and tested by the Air Research and Development Command, and distributes the equipment to combat units as needed. The never ending objective of the Air Materiel Command is to maintain an instant combat readiness, logistic-wise, in this era of super speeds and super weapons to support Air Force operations at any point on the globe. The philosophy of Air Materiel Command is that such readiness must be characterized by the closest interrelations of combat and logistic elements, by speed, flexibility, mobility and economy.

This is one of a series of ads on the technical activities of the Department of Defense.

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# GUIDED MISSILE

## The New Family of Weapon

### by Rear Admiral J. H. Sides, US

**Deputy to the Special Assistant to the Secretary of Defense for Guided Missiles**

When one considers that the guided missile industry is only a decade in age, he is forced to the conclusion that the progress has been truly astounding. At the end of World War II, when our missile developments really began taking shape, there existed only the most meager information on supersonic flight; the turbojet was an infant; no ramjet had ever developed a margin of thrust over drag in supersonic flight; large grain solid propellantry was a new field; radars, although they had had a terrific effect on the outcome of the war, were really relatively new; the electronic industry, when viewed in the light of the present day and in the light of the demands which missiles would make was also in its infancy; and no one had a very good idea of how to design and produce a satisfactory radome. One of the most serious deterrents to satisfactory progress in the early days was the almost total lack of precise knowledge concerning the operating environment in which each component would be required to operate. This lack persisted for more years than we like to contemplate, and attempts were even made to put certain projects into limited service use before the environments were well understood. Needless to say, these attempts now represent a rather dark chapter in the history of the progress of the guided missiles.

Before becoming Deputy to the Special Assistant to the Secretary of Defense for Guided Missiles, Rear Adm. J. H. Sides spent a four-year tour as Director of Guided Missiles, Office of the Chief of Naval Operations. After this assignment, he became the first commander of the newly formed Guided Missile Cruiser Division, comprised of the *Boston*, *Canberra* and *Northampton*.

#### *Data Recording*

The most important tool for obtaining the information which we need is, of course, telemetry. A great deal of ingenious engineering has led us to advances in telemetry and now permit us to gather and analyze the important information from each flight so that we can determine how well it has been designed, how well it has been assembled, and the like. In fact, there is little doubt that the guided missile program has been primarily responsible for the great progress that has been made in telemetry; and today telemetry is used not only in guided missiles but in high performance piloted aircraft as well, and even for recording physical reactions of pilots and animals when they are subjected to extreme environments. We are now being faced with the encroachment by certain new radar systems and television systems into the assigned telemetering frequency bands, which may require us to move into other parts of the spectrum. If it becomes necessary to do this, it will require an effort and budgetary support far greater than is well understood by those not directly involved and it will take several years to accomplish it.

In the early days of missile development there was a widespread tendency to concentrate on flight testing first, in an effort to gain time, with the thought that building reliability into a missile system was something which could wait until the production, or at least the pre-production, phase. I can think of no philosophy which has had a more serious effect on our progress.

There is no magic by which reliability can be obtained. There are no tricks, no cheap ways, no easy roads. The attainment of reliability is, in the final analysis, an engineering problem which requires the last word in thoroughly coordinated engineering effort to produce a proper design, followed by production and inspection techniques which will assure translation of the results of that effort into the end product. We have learned that in order to do a proper production job, and particularly in order to facilitate test and check out, it is necessary to arrange the components in such a manner that all those of one basic variety are placed within the same section of the missile.

### *An Engineering Job*

If we are to achieve the true reliability, there never comes a time when the design engineers can turn a job over to the production people and wash their hands of it. Reliability is an engineering job which must start at the very inception of a project and never be allowed to slacken. Any attempt to achieve it as an afterthought will result in wasted man-hours, wasted dollars, wasted range time, and many heartaches.

And now I should like to mention one aspect of reliability which is important to the user at the end of the line. It matters little to him that a missile checked out satisfactorily at the end of the assembly line, was accepted by the government inspector, and was paid for. What he is primarily concerned about is whether it will perform properly when he fires it in anger, long after the final acceptance test. He must have test and check-out equipment which will tell him quickly and accurately whether the missile is in shape to launch—and which will tell him just where to look for a troublesome component in case there is one.

With all our progress in the past decade, I'm afraid that it would only be fair to say that the guided missiles of today are, after all, only the model T's of this new family of weapons. In a way perhaps we should be concerned about the rapid rate of progress. It is somewhat discouraging to find that by the time a weapon system is fully developed and put into service use, it is almost obsolete in one sense, because of the rate of progress which has taken place in the interim. However, if one thinks this situation all the way through, he will realize that it is not our own progress which causes a weapon system to become obsolete, but rather the effectiveness of our weapon systems as compared to those of the enemy.

It was a mistake, several years ago, to look upon surface-to-surface missile systems as extensions of heavy artillery, to regard surface-to-air missiles as extensions of antiaircraft batteries, and so on. Such a philosophy was certain to confuse the issue as to responsibilities among the various Services. Guided missile systems are, in fact, new weapons systems which can and will accomplish tasks which are completely beyond the capabilities of the predecessor weapons which they will first complement and supplement, and which they will eventually, in certain cases, replace.

I hold no brief for the enthusiastic missileer who proclaims that the day is just around the corner when missiles will relegate the manned airplane to the dim distant past. Certain tasks will be taken over by missiles in the not too distant future. In other tasks, the timetable will be a much longer one. And in other tasks it may never come to pass.

I believe that surface-to-air missiles, as replacements for short range interceptors, will be the first category of guided missiles to actually take over a task, and that they will do it more effectively and more economically. But they must first demonstrate a degree of reliability and generate an acceptable confidence factor before those responsible for the defense of our Nation and of our fleets will be justified in going all the way for missiles.

In the surface-to-surface field, particularly at long ranges, the progress will inevitably follow a longer time scale. However, once the missile systems become truly operational, they will year by year assume a more important role and assume a greater and greater portion of the burdens of doing the job to be done.

In the air-to-air field guided missiles will soon be a "must", if effective air-to-air combat is to be realized. Just as modern jet airplanes have rendered anti-aircraft artillery almost obsolete, so have these same planes spelled the doom of the aircraft gun. If the long-range interceptor's armament consists of only guns and unguided rockets we shall require ground control superior to anything in sight today. And even assuming a perfect intercept there will be opportunity for only one short burst. With two six-hundred knot planes approaching each other at the rate of a mile every three seconds, even normal human reaction time will defeat us. Air-to-air missiles will greatly expand the envelope about a target from which an attack may be launched. This will take the slack out of the ground control intercept systems, and will nullify the seriousness of the human reaction time.

### *Long-Range Missiles*

In the air to surface field, it is perfectly obvious that relatively long range missiles which can be launched from a bomber and which will complete the terminal phase of the delivery of a powerful warhead at speeds and altitudes well beyond those which can be built into the bomber itself, would represent an outstanding addition to our capabilities. In this case, the bomber and its crew need not penetrate into the zone surrounding the target which will be most heavily defended both from the ground and with fighters. The high performance of the missile and its relatively small, clean airframe will make it an extremely difficult radar target for the enemy to detect and attack. This type of weapon system should greatly increase the effectiveness of bomber forces and should prolong by several years the period when manned bombers will be effective.

Up to this point I have confined myself to rather general remarks about guided missiles and their potentialities. I believe that it will be in order to mention some of the guided missiles weapon systems, which are now in actual operational use by our military services, as well as certain others in development.

In the surface to air field, the first land based system to become operational is the NIKE I system. This weapon system, developed and manned by the Army, possesses capabilities far beyond those of the anti-aircraft artillery battalions which they are replacing. The probability of kill against the type of attacking bombers is, in order of magnitude, greater than anything which we have had in the past. From information already published, the NIKE is a command system in which target and missile are continuously tracked by separate radars, the data from which are fed into computers which then transmit the appropriate commands to the missile so that it can successfully intercept the target.

### *First Operational Ship-Based System*

The first ship-based system to reach operational use is the TERRIER system. TERRIER batteries are now installed in the heavy cruisers BOSTON and CANBERRA, the former of which is about to join the Sixth Fleet in the Mediterranean. In the early 1960's, the Navy should have literally dozens of surface-to-air combat ships in commission mounting not only TERRIERS but TALOS and TARTAR. The TERRIER is a beam rider; the missiles are launched into the beam of the radar which is actually tracking the target; this causes the missile to take a pursued course to intercept at which point the fuse is detonated. Any number of missiles can be fired into the same beam and sent simultaneously on their way to intercept the same target.

During the many years while NIKE I and TERRIER were being perfected, great improvements were made in radars, propulsion plants and components of all kinds. These improvements inevitably pointed the way to improved missiles of higher performance and greater capabilities. As a result, the next round of missiles to emerge from the systems already in service are the NIKE B and the TALOS, respectively. Both of these will reach out into the short-range interceptor regime and both will have the capability of carrying either normal high explosive warheads or warheads with sufficient power to sweep entire close formations of airplanes from the sky. NIKE B will soon take its place alongside the NIKE I missiles in defense of the continental United States and the Navy Cruiser *Galveston* is now undergoing conversion as the first TALOS ship.

Another missile system in this field is the Navy TARTAN. The day when it will become operational is somewhat further removed as compared to the other missiles I have discussed.

As a still longer range development, the Air Force BOMARC weapon system should result in the fulfillment of the true unmanned interceptor concept.

In the air to air field, the Navy has two systems in operational use in the fleets. Both the SPARROW I and the SIDEWINDER may now be found on board the carriers of our fleets in both the Mediterranean and the Far East. Also, the Air Force FALCON missile is taking its place as armament on certain of the interceptors now operating under the air defense command for the continental defense of the United States.

In the surface to surface field, great public interest has been created by the perhaps too much publicized intercontinental and intermediate range ballistic missile programs. These programs are going extremely well and they are on schedule. The successful integration into our national arsenal will be important. The intercontinental effort is confined to the Air Force but the intermediate range efforts will result in both land based and ship based systems which can be employed by all three Services.

Also in this surface to surface category certain weapon systems are already operational. These include the Air Force MATADOR which is already deployed in Europe; the Army CORPORAL which is likewise already deployed overseas and the Navy REGULUS which is already operational from submarines, cruisers and carriers. Important improvements are under way in all these projects which will result in quantum improvements in range and accuracy in the second generations of these missiles and their successors. All of them are capable of carrying extremely powerful warheads.

In the air to surface field the Navy PETREL missile is already operational from certain planes of the patrol plane type. The Air Force RASCAL is also well along in development for use from heavy bombers.

### *Conclusions*

In conclusion, I should like to once more stress the importance of reliability as it affects the future of guided missiles. To me it has always been a sobering thought that what, in a piloted aircraft, might be considered a minor derangement often susceptible to adjustment and correction in flight by members of the crew, would in a guided missile be a catastrophe. This is the key reason why reliabilities which might be acceptable in most any other industry are unthinkable when we are talking guided missiles. Once we have convincingly demonstrated that we have the reliability and that we actually possess the capabilities for which the systems were designed, certain other weapon systems may be phased out with a minimum of risk and with a net saving in annual operating costs which may be measured in the billions of dollars.

I should like also to stress the point that guided missiles are not on the verge of supplanting manned aircraft for many years to come. They are, however, supplementing and complementing those systems initially and will gradually, on a rather lengthy time scale, actually replace other weapon systems for certain tasks.

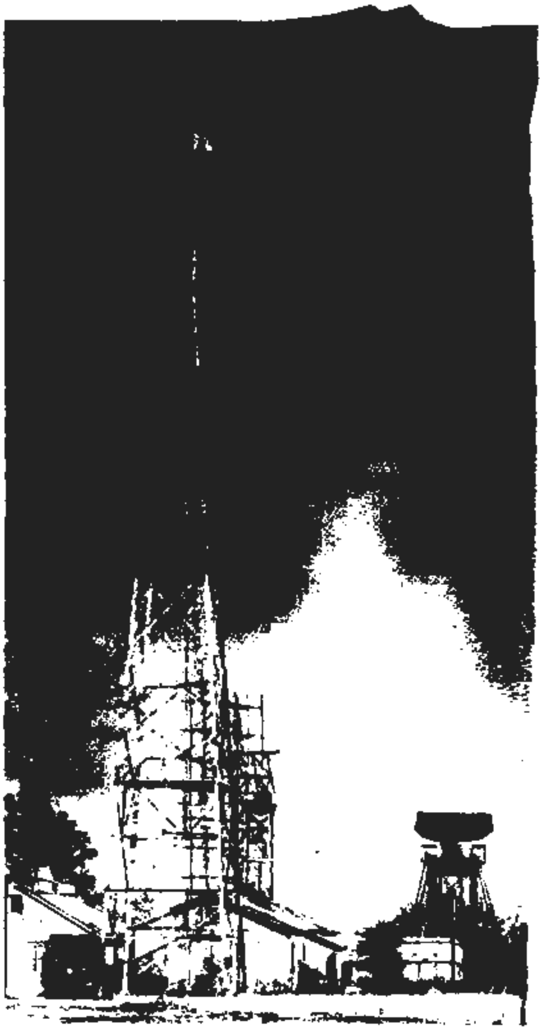
With this changing vista in armaments and weapon systems which has resulted in serious shortages of engineers and scientists, we must be extremely careful that we do not waste our talents, our efforts, and our resources by attempting to accomplish with guided missiles tasks which can be carried out more effectively by other means. We must be selective and we must ensure that we do first things first. We must not be misled by the mistaken illusion that the national treasury can pour forth limitless billions year after year for multiple projects which are designed to accomplish the same tasks on similar time scales, except in specific well considered instances.

* * *

# tropospheric scatter

## Meteorology's Gift to Radio Communications

**By J. D. Hixson, Staff Engineer**
**Office of the Chief Signal Officer, USA**



Antenna of Moon Radar Equipment

WITH THE MAGIC OF SCIENCE AND the wonders of nature, man's ingenuity has made available a new and useful vehicle of communication known as tropospheric scatter.

Scatter—the dominant word in radio communications today—is aptly termed. As the word implies, the radio signal is literally scattered by elements of the atmosphere in a region designated as the troposphere. The troposphere is that part of the atmosphere up to approximately five miles above the earth's surface. It is here that a phenomenon of nature produces a condition that causes the radio waves to refract or "scatter." Another form of scatter exists in the lower ionosphere, but that is another story and will be discussed here only to clarify the story of tropospheric scatter. For better understanding of the action that the radio waves experience, scattering may be likened to the scattering or dispersion of light from a car's headlights on a foggy night.

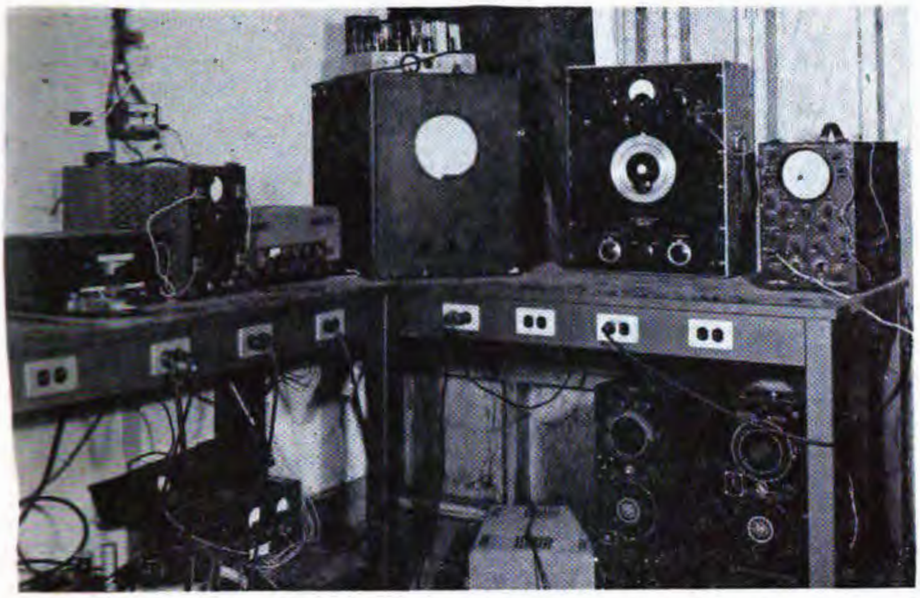
Scatter propagation is the combination of high and low level diffraction to produce signals beyond the horizon. The diffraction field is an area beyond the horizon where the signals are bent earthward purely by diffraction. Greater range is realized by high level diffraction, or scattering, within the troposphere.

### *A Standard Atmosphere*

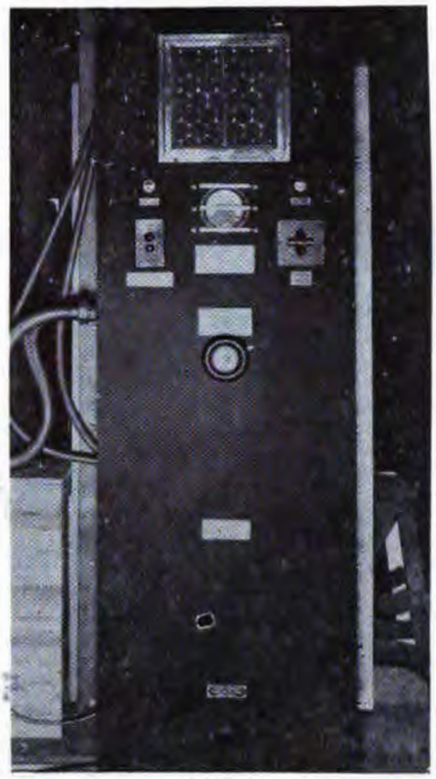
Optical illusions, such as the refraction of light rays, are due to atmospheric conditions and have been known for some time. Yet it was not until 1930 that Jourust showed the significance of atmospheric refraction in radio wave propagation. The effects of the meteorological elements of atmospheric temperature, pressure, etc., are measured and combined by formula to provide, in a common term, refractive index.

The atmosphere is not a stable body. If we assume a standard atmosphere where the refractive index decreases uniformly with height, the effect on a radio signal is nil. But if the condition of the atmosphere is super-standard the effect on a radio signal would be to bend the radio wave earthward. Consequently, the range of the signal is extended beyond the normal line of sight. And at the other extreme, meteorological conditions may exist in the atmosphere to produce a sub-standard condition where the effect on the radio signal is to bend the radio wave skyward and be lost to earth surface reception.

The standard atmosphere is not a normal condition; it is the ideal, and is used primarily as a reference. A transitional condition of the atmosphere is nearly always prevalent in some form at some altitude. Fortunately, the sub-standard condition is not frequently experienced, at least not at very low levels of the atmosphere. The ability of this meteorological phenomenon to influence the path of a radio signal and thereby to produce scatter is not dependent upon the fluctuation of the refractive index only, but also upon the wavelength of the radio signal. Prior to 1930, it was a popular belief that



Controls, synchronizing and indicating equipments for "Moon Radar Project"



Transmitter of radar set used for "Moon Radar Project"

radio signals above 30 megacycles penetrated the atmosphere and were lost for all practical purposes beyond the horizon.

The ionosphere is the predominant influencing factor in propagation below 30 megacycles. Reflection of a radio signal from the ionosphere shown as normal reflection consequently has great range capabilities. In the lower ionosphere the phenomenon of ionospheric scattering occurs. The relationship of tropospheric scatter to the other modes in effective distance and mechanics of propagation is also shown.

### *Development of Radar*

By 1934, industry and military establishments recognized great potentialities in the scatter phenomenon. Before World War II the use of radio frequency above 30 megacycles was not much more than a toy for amateur radio operators, and a topic for scientific discourse. With the advent of World War II, new equipment development in the higher frequency range with more power, and receiving equipments having greater sensitivity made possible the beginning of controlled experiments of this new mode of propagation.

The development of radar was probably the largest stepping stone in the advance of tropospheric scatter communications since radar accuracy and range are a function of the frequency and power. Advancement in these features was accelerated due to the war effort. Radar operators in the beginning were amazed to find echoes being received from apparently nothing. This, the so called "Angel." is a condition resulting from a meteorological phenomena, which causes the radio wave to be reflected, or back-scattered, to the receiver. The

*(Continued on page 25)*

Shown above is the assembly of antenna, mount and tower of the Diana Radar System for use in very long-range radio propagation


USAF
USAF

Power amplifier required for tropospheric scatter

Assembled above is terminal equipment, telephone AN/TCC-7 and radio terminal set AN/TRC-35

classic case is that of a reader operator in the South Pacific who observed echoes at a range of 1,500 miles while operating a 200 megacycle radar.

The Navy during this time was exploring the VHF (30 to 300 megacycles) and UHF (300 to 3,000 megacycles) radio bands for "ducting." Ducting is a phenomenon occurring in the atmosphere which produces an elevated boundary *or* boundaries for the radio wave to be conducted over distances greater than normal. This condition, predominant over coastlines and water, is produced by a complex form of non-standard atmosphere. The results of these experiments led to the first organized study in tropospheric scatter. By 1950, the now famous Booker-Gordon Theory was evolved. This theory satisfied the experimental results and provided quantitative values to the phenomenon of tropospheric scattering of radio waves, paving the way for scientifically engineered experiments.

With a working theory and the instrumentation to develop tropospheric scatter as a system, effort was redirected toward expanding a sister mode, ionospheric scatter. The ionosphere is a region of our atmosphere approximately 100 miles above the surface of the earth. It is then axiomatic that ionospheric scatter has greater range than tropospheric scatter. Further, the frequency of operation being different from that of tropospheric scatter, ionospheric scatter is realized up to approximately 100 megacycles whereas tropospheric scatter extends well into the gigacycles (thousands of megacycles). And, by nature, the phenomenon of tropospheric scatter requires a large amount of power and range from the ultra thru the super high frequencies to be effective. For these reasons progress was more rapid in ionospheric scatter than for its predecessor, tropospheric scatter. For the extreme ranges of the tropospheric scatter mode, a tremendous amount of power will be required. For this reason, it is optimistic to expect high reliability and multi-channel capacity circuits for ranges greater than 400 miles in the near future.

The Army has supported and is continuing to support research and development in both tropospheric and ionospheric scatter mode propagation. The advancement of these modes has left in their wake other new and promising modes of propagation.

To better understand the mechanism of the upper atmosphere and the part it plays in the propagation of electromagnetic waves, the Army Signal Corps set up an experimental high power radar to probe the atmosphere, utilizing a technique of reflecting a radio signal from the moon, to measure and study the atmospheric effects upon the transmitted radio signal.

### *Army Advances Research*

The Army has contracted with academic and commercial institutions, and has supported the work of the National Bureau of Standard's Central Radio Propagation Laboratory in scientific research, to advance the science of tropospheric scatter mode propagation. The Army is still engaged in extensive internal research and development within the Signal Corps Engineering Laboratories. The results of all this research have led to the development of tropospheric scatter communication equipments for the Army.

In tropospheric scatter, the future holds much for our way of life and for the world of communication. The extention of the useful radio frequency band will relieve an overly crowded UHF and VHF band and permit the utilization of stations employing greater bandwidth.

Television service areas will be extended without use of radio relay links, which in some instances might be difficult and costly to install. The Army has nurtured the research and development of tropospheric scatter as a mode of radio propagation. The investment has been rewarding and the future is bright. The ultimate evaluation, however, must await the development of instrumentation in the higher frequencies and greater power.

* * *

**"OPERATION SNOW WHITE"** describes all manufacturing in General Electric's separate large factory building at Owensboro, Ky., where 5-Star and other military tubes are built. Hospital cleanliness applies throughout. Premises are air-conditioned and pressurized to keep out dust or dirt that can cause inter-element shorts. All employees wear lint-free Nylon or Dacron garments.

**TUBE PINS** before and after cleaning. This ▶ is an unretouched photograph.

# General Electric "Sand-Blasts" military tube pins for better electrical contact, added reliability!

General Electric military tube pins are "sand-blasted" clean, further extending the Snow White program of impurity-free manufacture. Miniature tube stem-making and bulb-sealing require high temperatures that leave oxidation on the pins. The special pin-cleaning process developed by General Electric scours all oxidation from pin surfaces, assuring efficient socket contact.

Twin guns force streams of abrasive emulsion over the pins. The abrasive scrubs off all non-conductive material and the pins then are rinsed in clear water and dried by infra-red lamp. When a tube is plugged in, electrical contact is complete and lasting.

Abrasive cleaning of pins is only one step in General Electric's extensive Snow White program to produce high-reliability tubes for military applications. Tube parts are precision-made, and the tubes assembled and inspected, under immaculate conditions which ban any impurities that might cause early-life failures or unstable electrical performance. Snow White cleanliness is a principal reason why 5-Star and other General Electric military tubes have the dependability and long life so vital in critical sockets.

Ask for G-E high-reliability tubes—5-Star or other military types—in new electronic equipment! Replace with them in equipment now on hand! *Electronic Components Division, General Electric Co., Schenectady 5, New York.*

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# SIGNAL·GRAM

## — GOVERNMENT —

CONTRACT FOR FAIRCHILD ENGINE The Engine Division of Fairchild Engine & Airplane Corp. has announced receipt of orders and firm contract commitments amounting to approximately $7 million for the fabrication of major components of a new large jet engine now being made in quantity for the military service.

IMPROVED "TRAFFIC COP" An improved electronic "traffic cop" that prevents unwanted frequencies from interfering with the operation of radio equipment has been developed by Federal Telecommunications Laboratories, Nutley, New Jersey. This device, known as a magnetostriction filter, is expected to find many applications in radio and radio-telephony. It shows marked improvement over older models in size, operation and cost.

TURBO-PROP TRANSPORT AIRCRAFT The first turbo-prop transport aircraft to be used by the United States Air Force, the Lockheed C-130 Hercules, is designed to carry 20 tons of equipment or airlift 90 combat-ready troops, and make delivery by parachute or landing. It can also be set up to air evacuate 70 injured on stretchers along with medical attendants. The new prop-jet aircraft is designed to fly higher, faster, and more economically than any existing military transport and is scheduled to replace the present medium troop carrier aircraft, the C-119 Flying Boxcar.

NEW INJECTION SEATS TO INCREASE SAFETY MARGIN FOR NAVAL PILOTS The Department of the Navy recently announced that it has embarked on a program to install "ground level" ejection seats in all present and future applicable naval aircraft, increasing the margin of safety afforded pilots beyond anything ever before realized in the history of U. S. Naval aviation. A spectacular demonstration was made by the Martin-Baker Co. at a Farnsborough Air Show in England, in which a live subject was recovered from an aircraft traveling 125 miles per hour with wheels still on the ground during takeoff. This proved the feasibility of providing ground-level escape capability in the low altitude escape program then under investigation by the Navy.

HOLTZ NAMED ASSOCIATE GENERAL COUNSEL The Federal Communications Commission has announced the appointment of Edgar W. Holtz as Associate General Counsel. His former position was that of Assistant Chief of FCC's Office and Opinions and Review. Before joining the Commission in 1955, Mr. Holtz was Assistant City Solicitor of Cincinnati, and, in that same city, served as general counsel for WCET, the first educational TV station to be licensed.

NEW COMMUNICATIONS LINK William G. Thompson, assistant vice president of American Telephone and Telegraph Company, presided, as the U. S. Signal Corps and the Bell Telephone System opened to public service on December 11, 1956, a new and important communications link between the United States and the growing Territory of Alaska. The link consists of an underwater telephone cable system stretching some 1,270 miles from Port Angeles, Wash., to Skagway, Alaska. The inaugural call was made by Hatfield Chilson, Assistant Secretary of Interior and B. Frank Heintzleman, Governor of Alaska. At each location, Government, military and industry officials participated in the ceremonies.

## — INDUSTRY —

G-E AUTOMATIC PROGRAM CONTROL SYSTEM FOR TV Elmira, N. Y.'s UHF television station WSYE-TV is the nation's first to adopt the General Electric program control system developed to assure television viewers more accurate programming with a minimum of "blank screen time." The program-control system automatically schedules all switching necessary for programming slides, films, network, and audio. Thus, the normal routine of television station breaks, commercials, and succeeding programs is continued without pause or interruptions. A maximum of seven pieces of equipment can be controlled, such as two motion picture projectors, a slide projector, a station-identification projector, network and audio tape.

ATOMIC CENTER FOR RESEARCH A new corporation will be organized as a jointly-owned company by Sylvania Electric Products, Inc. and Corning Glass Works to expand research and production in the atomic energy field. The center will concentrate on the development and production of nuclear fuel elements and components, and is expected to be one of the outstanding facilities of its type in the world.

INFRARED MONOCHROMATOR The Servo Corporation of America, New Hyde Park, N. Y. has developed an airborne infrared radiation laboratory for infrared analysis of airborne targets, known as the Infrared Monochromator. The device detects, analyzes, and records information about missiles and jet aircraft by their exhaust gasses and skin temperature heat radiations.

RADIO-TRANSMITTER-RECEIVERS A radio, about the size of a cigar box, said to send and receive over a 30-mile range, has been developed by the Avco Manufacturing Corp. The transistorized unit is housed in a glass fibre case which will stand any kind of abuse. The company envisions demand for the set by the military, heavy construction concerns, radio stations, and newspapers among others.

NEW MEMORY DEVICE Development of a new type of memory device by Dr. Jan A. Rejchman, RCA scientist, may pave the way for smaller, more efficient electronic computers. The device, RCA claims, can store a million bits of information in space little larger than a shoe box. It lends itself to extremely simple molding production techniques and offers substantially greater simplicity of operation and maintenance.

FLIGHT CONTROL SYSTEM Lear, Inc. recently was given permission by the USAF to disclose that the flight control system for Lockheed's X-7 missile, a supersonic ramjet-powered test vehicle, has been supplied by Lear since inception of the project in 1949. After launching from a B-29, and after being accelerated to ramjet operating speed by rocket, this missile performs its prescribed test mission and is then decelerated and recovered by parachutes. After servicing, it is ready for another flight. Thus the missile's flight control system not only had to meet Lockheed and Air Force requirements for control at high altitudes and speeds, but also had to withstand the severe shocks of repeated recoveries without damage.

## — GENERAL —

ROCKET SPEEDS IN EXCESS OF LIGHT PREDICTED The Air Force is interested in testing the new atomic theory of a Navy scientist which, if valid, could lead to speeds of 186,324 miles per second, the speed of light, or more. Claims are strictly unofficial but basically the theory states that as the atom gets colder it becomes less active. Electrons in the cold atom structure tend to gravitate towards the atom nucleus at ever increasing speeds. If the atom can be made cold enough, the electrons will plunge into the nucleus of the atom causing a nuclear reaction which would release the entire energy of the nucleus. This theory defies two present theories now held as postulates: that 459.6 degrees below zero Fahrenheit is absolute zero, and that the speed of light is the highest speed obtainable.

RADIO ASTRONOMY OBSERVATORY The National Science Foundation has entered into a contract with Associated Universities, Inc., to conduct basic research activities in the field of radio astronomy. The contract provides for establishment of a radio astronomy observatory at Green Bank, Pocahontas County, West Virginia. Under terms of the contract, AUI will construct the facility and provide for the "management, operation and maintenance of the observatory with the primary purpose of making its facilities available for visiting scientists." The Foundation will obligate $4 million to finance the program. Included in the equipment will be a precision radio telescope with a diameter of approximately 140 feet.

INTERNATIONAL CONFERENCE ON SCIENTIFIC INFORMATION The National Science Foundation, the National Academy of Sciences—National Research Council, and the American Documentation Institute recently announced joint sponsorship of an International Conference on Scientific Information to provide for a thorough discussion of present developments and research pertaining to the organization and dissemination of scientific information with special emphasis on storage and retrospective search. The conference will be held in Washington, D. C. early in November, 1958. The objective is to attempt to overcome mounting difficulties in scientific communication resulting from the increasing tempo of research activity and the ensuing flood of scientific publications.

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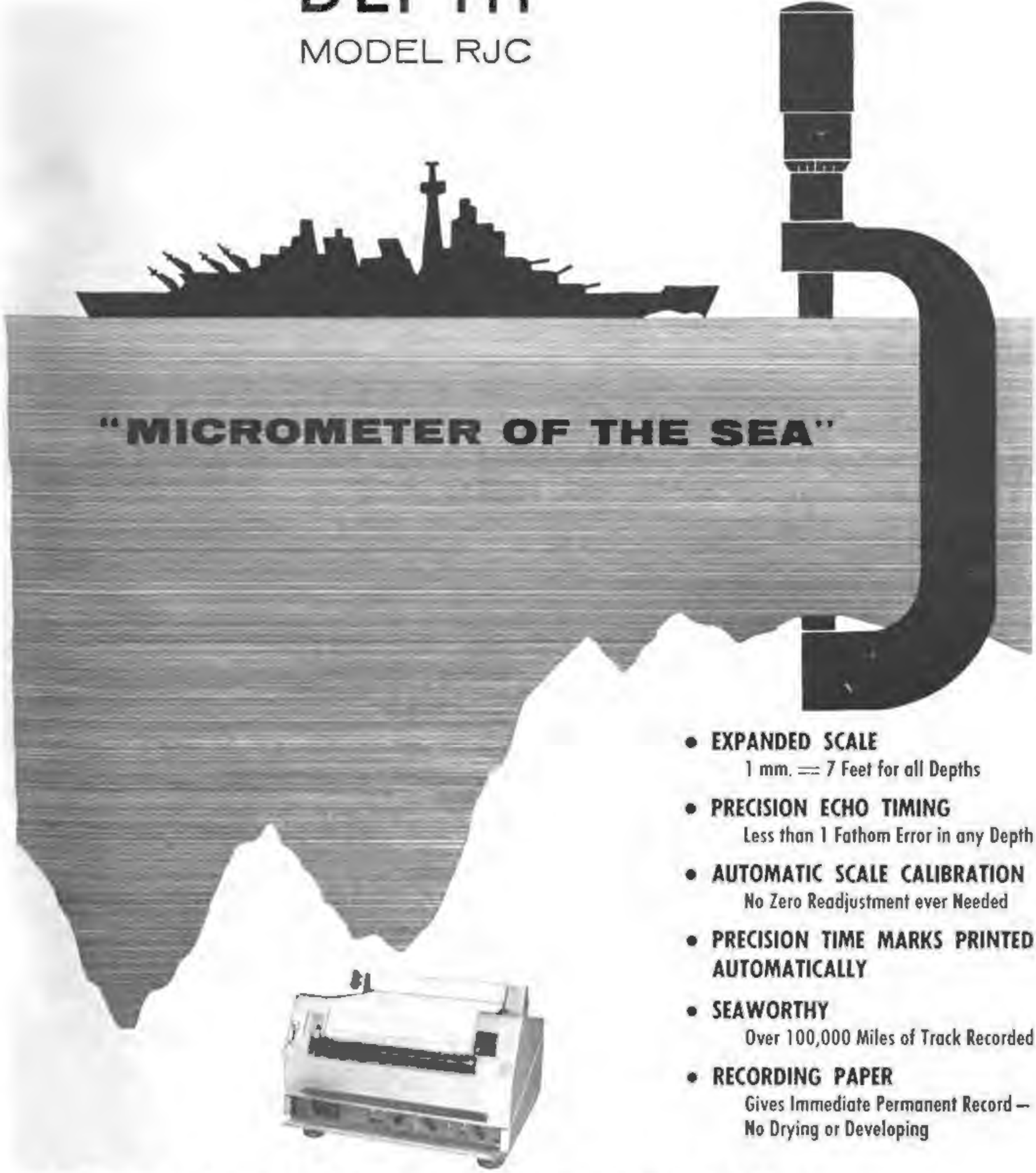
MODEL RJC



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# What Price FREQUENCIES?

## By Major General Alvin L. Pachynski, USAF

**DIRECTOR OF COMMUNICATIONS-ELECTRONICS**

**U. S. AIR FORCE**

WE HEAR A GREAT DEAL TODAY CONCERNING THE resources the Air Force needs to meet its obligations to national security. At the forefront is the public interest in Air Force weapons. But less publicized is the requirement for the material, other than air weapons, which permits the capabilities of such weapons to be fully exploited. Communications-electronics equipment constitutes a major element of such material. Last but not least, the Air Force as an entity is not complete without personnel—a vital segment of our resources.

The Air Force we have today and what we are able to provide for tomorrow, in terms of these resources, is dependent in large part on the size of the appropriations the Nation sees fit to make available. For it is money that largely determines our progress in research and development, the degree to which we can maintain an inventory of modern weapons, and the material required to support them. It is also money that determines our personnel ceilings and, to a significant degree, the quality of our manning.

### The Author

General Pachynski graduated from the United States Military Academy in 1927 and was first assigned to the Army Signal Corps. During World War II, he was Signal Officer for the Fifth Air Force in the Southwest Pacific Area, and Communications Officer for the Far East Forces. In June of 1956, he became Director of C-E at Air Force Headquarters. eral Pachynski is a National Vice ent of the AFCEA.

Increased appropriations, of course, generate additional problems. They increase the variety and complexity of new material brought into the inventory. In the communications-electronics area, greater complexity of our gear requires us to focus our attention on the problem of reliability. Today there is seldom a meeting of industry and military representatives where some aspect of reliability is not given emphasis in the discussions. Obviously a high degree of reliability of communications and electronics gear is essential if it is to fulfill its role within the scheme of Air Force operations.

Currently, in Air Force-Industry relations, growing emphasis is being placed on the subject of maintainability. The increasing variety and complexity of communications-electronics equipment and systems required to meet the demands of today's and tomorrow's operations is placing an increasing burden upon the manpower available to the Air Force to maintain it. The limitations in terms of technical skills available make it mandatory that as new communications-electronics gear is developed, it is so designed that it can be effectively maintained within our military organization with the skills available.

These and other problem areas within the Air Force can be licked—for the most part—given the money required. There is, however, one resource essential to our operations, not procurable through appropriations. In fact it is a resource that has no tangible value, yet is invaluable. The Air Force would be completely immobilized without it. I have chosen, therefore, as my topic a subject encompassing this resource, the Air Force needs involving it, and the roles of the Air Force and of industry in providing for its optimum utilization. The resource I am referring to is the radio frequency spectrum.

Pertinent to any consideration of current radio spectrum usage, I believe, is a chronological review of how we arrived at where we are.

Five years after Marconi bridged the Atlantic in 1901 with his epoch-making wireless signal, the first international radio conference was held at Berlin. This conference agreed on international use of two discrete frequencies—500 and 1,000 kilocycles—for ship-shore radiotelegraphy. I say "discrete" advisedly, for compared with today's allowable tolerance in use of the radio spectrum, the radio transmission typical of those days hardly could be referred to as occupying "discrete" portions of the spectrum.

The next conference in 1912 at London was the first to deal with a complete segment of the spectrum, providing for use of the band 150 to 1,000 kilocycles. The Washington Radio Conference of 1927 extended the recognized international usage of the spectrum down to ten kilocycles and upward to 23,000 Kc, which was further extended by the Madrid Radio Conference in 1932 and the Cairo Conference in 1938 to 30,000 kilocycles. Finally in 1947, the Atlantic City Radio Conference provided for internationally agreed allocated use of the spectrum to 10,500 megacycles. The allocations currently published by the Federal Communications Commission envisage present and potential national use of the electromagnetic spectrum to 30,000 megacycles and above.

### *Spectrum Space*

You will note that the agreements reached at the international level covered progressive extension in the use of the spectrum which paralleled, generally, progress in the state of the art. The greatest progress followed each of the two world wars. New techniques, particularly in vacuum tube development during World War I, were responsible for exploitation of the high frequency portion of the spectrum. It is true that almost until the end of the 1920's, only the amateurs recognized the propagation potentialities of high frequency communication. When the amateurs, however, confirmed the economical and technical usefulness of long-range, high frequency communication, there was a scramble to adopt this technique for international communications.

The rapid expansion of high frequency networks to meet national and international telecommunications needs during the period between the two world wars constituted no great problem. The supply, in terms of spectrum space, was more than adequate to meet the demand.

By the time of the Atlantic City Radio Conference of 1947, however, the situation had changed. For the first time, this conference had to cope with problems involving the accommodation in the high frequency portion of the radio spectrum, of not only established services with greatly expanded requirements, but also of new services such as aeronautical point-to-point and air-to-ground. World War II brought about a burgeoning electronics technology which demanded a place in the spectrum for many new techniques applied to civilian as well as military use, such as television and radar. World War II had already demonstrated that in the high frequency portion of the spectrum, at least, there appeared to be a finite limit to the number and density of services that could be accommodated. This experience was sufficient to put the nations of the world participating in the conference on the alert with regard to anticipating similar conditions in other portions of the spectrum not yet exploited. The competition not only between nations but also between interests representing different types of services to obtain rights in the spectrum was intense. The conference resulted in compromises which really failed to fully satisfy any of the participants. The provisions made for the U.S. Military Services at the time, and in subsequent regional and U.S. allocations, appeared to reasonably satisfy military requirements. But these allocations were based on a U.S. position which assumed a protracted period of genuine peace, with military forces primarily committed to progressively decreasing occupation functions following World War II.

### *The Cold War Impetus*

The cold war, beginning in 1948, changed all this. The United States found it necessary to reverse its field and to start rebuilding its forces to provide for a military posture more in keeping with the suddenly apparent menace. Korea gave added impetus to this trend. The Air Force found itself placed at the forefront of the effort to establish a proper U.S. military posture. Recognized was the fact that the Nation needed a strong strategic air force and an effective air defense if the national security was to be maintained in the face of the known threat.

The adequacy and effectiveness of an air force is measured in terms of providing not only superior weapons but, technically, the means required to fully exploit the capabilities of those weapons. Air Force communications and electronic equipments and systems must keep pace with these requirements. As the speed and range and fire power of our weapons increase, so do the complexity and scope of our communications and electronic equipments and systems.

### *SAGE: Case in Point*

A case in point is SAGE, the Semi-Automatic Ground Environment system required for an effective air defense of the United States. The operating concept of SAGE calls for a marked increase in the number of UHF frequencies required for the operation and control of weapons in this new electronic ground environment. As our advancing technology gives us new tools to fulfill the Nation's security requirements, it concurrently increases the problems of providing the required operating space in the frequency spectrum.

Concurrently with the build-up and modernization of U.S. Military forces, there has been a steadily accelerating and apparently insatiable demand and application to use in the civilian economy of new communications-electronics devices and systems also requiring space in the radio spectrum.

Until recently, the effort to absorb this output of our technology within the frequency spectrum has been confined chiefly to accommodation within the established table of frequency allocations. The increasing variety and density of existing and new services, such as broadcasting, international and domestic fixed, aeronautical, mobile, public safety, industrial, Government and amateur—to name a few—are such that no one service is entirely satisfied with the spectrum space allocated to it. As each becomes more firmly established in its allocated frequency band, the greater its proprietary interest in the band because of the economic investment made. Hence, decisions to transfer or readjust allocations between classes of service become increasingly more difficult as time passes.

### *Forward Scatter*

This brings us to another problem area. The Atlantic City Radio Convention of 1947 was the first to recognize the usefulness of the spectrum above 27,500 kilocycles. In providing for the services to be established therein, through allocations, the assumption was made that frequencies in the VHF and higher portions of the spectrum were useful to those services where the line-of-sight propagation characteristics of such frequencies were applicable. Obviously, this meant short-range, local operation as distinguished from the long-range characteristics of radio frequency propagation below about 30 megacycles. But continued research in propagation developed the existence of a phenomenon referred to as forward scatter, or over-the-horizon transmission, in which the higher frequencies apparently could be used for communication at much longer ranges than former theories visualized possible. The Air Force has since proved the soundness of these findings through extensive operation of both forward ionospheric and tropospheric scatter circuitry. This is a new technique which was unheard of in 1947. The carefully arranged Table of Allocations established at that time makes no provision for it. To what degree, for what purposes, and how is it to be accommodated in the spectrum?

### *Problems of Policy*

*The point of all this is that, in my opinion, the time is coming—if it is not already here—when the health of our communications-electronics community will be determined in large part, not by the amount and variety of devices and equipment that the Nation's economy can absorb, but by the availability of frequencies in the radio spectrum.*

The Air Force has a big stake in the frequency spectrum. Our appropriations for communications-electronics probably total two-thirds or more of the Department of Defense budget for this area. Contrary to the concept visualized by the average man-on-the-street, the closer we approach the pushbutton era of warfare, the more complicated will be the organization of men and material behind the pushbutton. But the real rub is in the fact that the bulk of the equipment we buy must be put into immediate operational use and not into mobilization storage as it was before in past wars. As our inventory of communications-electronics equipment increases, so does the demand for radio frequencies. Obviously, the demand is in competition with the increasing demands of a civilian economy that is growing by leaps and bounds. What can be done to solve this problem?

In my judgment, there is no lasting solution to the problem if, by a solution, we mean trying to satisfy everyone who visualizes a use for space in the radio spectrum. The first element leading to a solution lies, therefore, in the sphere of policy. It involves an examination at the national level of requirements of what is important and what is unimportant relative to the national interest. Such an examination can only be made by policy-making officials who have the responsibility for the Nation's political, economic, social, and cultural welfare and for the national security. It should take cognizance of current and anticipated technological capabilities. Since it must be implemented by the national technical frequency management organization, this policy should be clearly stated.

The subject of policy, however, in so far as the purpose of this article is concerned, is of secondary interest.

Any national policy formulated must be complemented by a combined and conscious effort on the part of the user and the producer of communications-electronics equipment to conserve radio frequency spectrum space. This effort must be aimed at satisfying (through technological achievements) the requirements validated by the national policy.

### *Frequency Conservation*

An element of this effort should be aimed at integrating as many related operational functions as possible into a single system. This will require more forward thinking and planning than has been accomplished in the past. We have reached the point now in our weapons systems where a separate black box for each operational function becomes very costly to our weapons' performances. In the past we have accepted the separate black boxes because of economic costs of equipment. Fully integrated electronics systems, however, are the order of the day for our new and modern aircraft.

In one sense it is fortunate, perhaps, that our technology is accelerating the obsolescence rate of much equipment in our inventory. But the integration of operational functions cannot be carried out over night. In military and civil aviation, it involves replacement of equipment not only in the aircraft, but in the supporting ground environment which represents a tremendous dollar investment. We are making progress. The impelling motive behind our present efforts to integrate functions has not, however, been the need for frequency conservation but more effective operations in a jet age. *Fortunately, the objective of frequency conservation is for the most part compatible with the technological effort currently being made to integrate functions. From the long-term standpoint, this should pay dividends.*

The present trend toward modular construction of equipment, particularly in aircraft, should likewise pay dividends in the effort to conserve frequencies.

As new techniques aimed specifically at reducing the space occupied in the spectrum are developed, particularly in the field of modulation, we should have a capability to incorporate such new techniques through exchange of component assemblies, rather than replacement of complete installations which represent a high dollar investment.

This brings me to some specifics in the area. The amount of space occupied in the radio spectrum by any class of service, be it military or civil, is governed largely by the operating characteristics of radio transmitters. As an example, we have in the Air Force inventory today UHF air-ground communications equipment theoretically capable of operating on any of 1750 channels spaced at 100 kilocycles. *But in practice, we can derive only a fraction of that many channels for reliable operation. The reason is that we must cluster—to meet our operational requirements—as many as twenty or twenty-five channels within one geographical locality.* The equipment we have does not technically lend itself to operating in adjacent 100 kilocycle channels in such close physical proximity. Factors such as transmitter stability, image rejection, spurious response, receiver selectivity, and radiated harmonics preclude such utilization of frequencies. Spacing of several hundred kilocycles or more is often required. To the uninformed, this might appear to be a prodigal use of the spectrum. It is not unique. It is typical of all equipment, whether used for military or civil purposes. Our UHF equipment is the best the state of the art could produce, but it serves to point up another area in which our technology can help in conserving spectrum space.

### Greater Initiative by Industry

Defense requirements laid on the communications and electronics industries can be credited, I believe, for promoting the development of many techniques looking to greater reliability and flexibility in operations. These include such technical criteria as transmitter stability, receiver selectivity, spurious and harmonic radiation, and new modulation techniques. Sometimes industry has been hard pressed to meet these criteria. On the civil side, the Federal Communications Commission has set the standards. FCC standards have frequently been established only after consultation with the agreement by industry. Thus industry has, in many instances, followed rather than led on the adoption of new tolerances applicable to use of the frequency spectrum. Admittedly, the tolerances have been set only after a reconciliation of both state of the art capabilities and the economics involved in marketing equipment. *But I do not believe that there has been any really impelling motive to advance the state of the art specifically for the purpose of conserving radio frequencies; and it is entirely possible that costs of producing the equipment required to preserve a market in the future may have to be given less weight.*

An important step forward to alleviating our growing frequency congestion appears to be for industry itself to assume greater initiative in this area.

### International Geophysical Year

As you know, some forty-five nations have joined in a common effort called the International Geophysical Year 1957-1958. This takes place at the cyclic peak of solar activity. It is possible that this concerted research effort will uncover new uses for the radio spectrum not presently visualized or permit certain classes of service now allocated frequencies in the congested portions to be accommodated in presently unused segments.

Like our experience with forward scatter, we cannot be entirely certain that what we know about propagation today will apply to an evaluation and determination of spectrum usage tomorrow.

### Modulation Techniques

Finally, I would like to dwell for a moment on modulation techniques and the application of information theory. The integration of functions involving the consolidation of several sources of information into one channel, utilizing a single frequency assignment, is not achieved without cost in terms of band width—or frequency spectrum usage. During World War II, teletype—as a means of communications—satisfied our needs. Since then the concept of our operations has progressively changed with improvements in weapons capabilities. We have requirements today not only for multi-band teletype, but for voice, facsimile, data transmission, photo, and even television. Like all users of the radio frequency spectrum, the Air Force is confronted with the problem of finding the space required to accommodate these wider band transmissions. Our technology, whether as a result of conscious application of information theory, or otherwise, has made progress in packing more information into a given bandwidth. Perhaps the most dramatic proof of this is in the new National Television System Committee color television standard. Color television, based on the obvious technique would require three times the bandspread of the 4.5 megacycle black and white television. The NTSC action, in spacing the color information in unused space between side bands of the black and white signal, permitted the established channel assignment to be used without change. Yet television broadcasting, as such, is still an expensive service when measured in terms of the six megacycle channel spacing it now requires. This is one of the areas where further application of information theory could pay great dividends from the standpoint of frequency conservation.

### No Immediate Solution

What I have said to you about radio frequencies has served merely to outline the problem and the possible steps leading to its solution. There are complexities involved which must be studied in great and time-consuming detail by competent people. No hasty solution is possible. Certainly no immediate solution can be achieved. The factors involved (not the least of which is the economic one) are such that there can be no immediate and wholesale reallocation of spectrum space. Rather, the solution lies in the establishment of long term objectives rooted in technological progress and which, among other things, must take equipment obsolescence into account. The successful achievement of those long term goals is dependent on a joint awareness by all of us of the problem that exists today. If we recognize today that it does exist and work jointly toward a solution, radio frequencies tomorrow may still be procurable at a reasonable cost.

# in Defense of INDUSTRY

by **WILLIAM E. HAINES**

Director of Industrial Defense
Business and Defense Services Administration
Department of Commerce

## An address given to the Lexington Chapter of the AFCEA

IT IS DIFFICULT, PERHAPS IMPOSSIBLE, for most of us to visualize the destructive power of a ton of TNT. Yet, only a few short years ago the world began to measure the power of explosives in thousands of tons of TNT—kilotons. Now, even the kiloton yardstick is too short, so we must resort to the megaton—the million-ton equivalent of a ton of TNT. To say that this latest measurement of death dealing power is almost beyond man's comprehension is but to explain the obvious.

Just as the power of modern weapons has increased with fantastic speed, so have the problems involved in even attempting to deal with their awesome consequences. Living as we do in an age of danger we must try, somehow, to prepare against a day which we fervently hope—and pray—will never come. We can hope that no man will ever pervert the atom's use to the destruction of civilization. Yet, we must not, we dare not, live by that hope alone.

We are compelled by circumstance to maintain what is often called a "posture of readiness." Now just what is a posture of readiness? Does it mean that we shall build the most powerful weapons, perfect the most efficient methods for effecting their delivery, and devise a network of defense to prevent or frustrate the strategic and tactical efforts of an aggressor? Clearly, these things are not enough.

### *Megaton Weapon Brings New Dimension*

The coming of the megaton weapon has brought with it a new dimension to mobilization planning: the sobering prospect of the massive destruction of our capability to produce. Until recent years we could not conceive that America's vast industrial complex might ever occupy a direct combatant status—might ever be vulnerable to attack. But today it is a stark, inescapable fact of life. Today the defense of American industry involves far more than the production of the hard goods of war.

It involves both a job for Government and a job for management. The Government must be responsible for those things which because of their very nature must be undertaken by the Government. It must see that procedures are developed for the efficient and prompt distribution of scarce and critical materials; that certain materials are adequately stockpiled; that reliable supply-requirements estimates are in being; that a sufficiently broad mobilization base is established and maintained; and it must be generally prepared to deal with the many wholly new and staggering problems which would beset the Nation in event of attack.

Further, there is an enormous job for management—a job far greater and infinitely more difficult than any which industry has ever had to face in any previous conflict. It is a job which can only be done by the owners and managers of the Nation's important production resource, if it is to be done at all. It is a job which will not wait until the "string is out."

If an aggressor should ever decide to launch an attack upon the continental United States, it is unthinkable that there would be a "phony war" period, such as there was in World War II, during which to mobilize. It is also unthinkable that we would not have to concede the first blow to the aggressor.

### Guidance and Leadership

We must not, therefore, look to the Government as the exclusive executor of the Nation's plans for mobilization readiness. The head of every industrial enterprise important to the national defense has an inescapable responsibility for doing those things which are the sole responsibility of management.

The Director of Defense Mobilization has delegated to the Secretary of Commerce responsibility for providing: "Guidance and leadership to industry in the development of plans and programs to insure continuity of essential production in the event of attack. . . ."

### No Absolute Defense

That is a king-size responsibility. Some say it is an impossible job. One can only guess what the consequences of a nuclear attack upon the United States would be like. Moreover, we are aware of the practical obstacles involved in many of the steps which might be taken, such as an optimum program of industrial dispersion and protective construction. We are told that there can be no absolute defense against mass delivery of nuclear weapons and that we must assume large scale damage to the Nation's production facilities. Further, that we must assume a period of post attack paralysis of indeterminable duration and untold severity.

What, then, can be done to "assure the continuity of essential production—" One view, the utterly fatalistic view, holds that the destruction would be so complete as to render any steps useless and futile.

Another view holds that certain things could be done which might assure at least some degree of continuity; that somewhere between the extremes of achieving the impossible or doing nothing lies a feasible middle course. It is based on the premise that the managers of every business enterprise have an obligation to their stockholders, their employees, their customers, and the Nation to take such steps as will facilitate—if not assure—the continuity of their operations. The continuity of management and technical know-how is an indispensable prerequisite to the continuity of production.

In preparing the asset side of the Balance Sheet of America we are prone to list only physical plant, production, and research facilities. That is understandable. Yet, we are apt to overlook that "intangible" asset: the managerial genius and technical know-how which has made our production possible. This is something which must be preserved at all costs. Whatever may happen to the Nation's physical facilities, there must be preserved a legacy of managerial and technical know-how.

### The Job for Management

Now just what is the job for Management? It is not easily defined, for it differs from company to company and industry to industry. Each company must decide for itself what is feasible and what is within the limits of its own capabilities. What makes sense for one company may be unsuited to another. Every company, however, should prepare an overall company plan for industrial defense which encompasses the activities and responsibilities of every department from the plant level to the top management echelon. While it is not possible to list all the steps which might be taken, the following occupy a high priority status: (1) Remote storage of all vital corporate records in non-target locations; (2) Preparation of management succession plans; (3) Designation of an alternate company headquarters or rendezvous point; (4) Designation of a top company official to coordinate all industrial defense planning at the highest company level; (5) Amendment of corporate by-laws, where necessary, to facilitate emergency action; (6) Protection of all vital production, research and operating facilities against sabotage and espionage; (7) Development of plans for the assessment of attack damage, and (8) Transfer of vital production from plants in target locations to plants in non-target locations.

### Balance and Perspective

These are but a few of the many steps which many far-sighted companies are now taking to facilitate the continuity of their management and operations. They are steps which can only be taken in advance of an attack—steps calculated to reduce the lead time required to even commence the restoration and rehabilitation of essential production.

Now this business of industrial defense planning is not a very pleasant business. Those of us who are working with it every day must constantly strive to maintain a sense of balance and perspective. We, of course, share the hopes of the Free World that somehow the road will be found to a lasting peace. Further, we try to avoid the naiveté of thinking that there is an ultimate passive defense to the fearful consequences of a nuclear attack. Yet we are convinced that industrial defense is an integral part of a national posture of readiness. It is an ingredient in the economics of the Atomic Age. We dare not ignore it. We must not fail to meet it.

### The Apathy Barrier

During the past two and one-half years, BDSA has held individual conferences with the top managements of some 475 companies whose products and facilities appear on the Critical Industrial Facilities List. The electronics and communications producers stand well up on this list. Similar meetings are being scheduled with other companies appearing on that list. Every effort is being made to stimulate each important producer of defense, or defense-supporting goods coming under the cognizance of this Department to take certain minimum steps, at least, which would facilitate the continuity, resumption, or rehabilitation of production.

We have learned from these conferences that a number of companies have already made great strides in the preparation of their company plans. Unfortunately, too many have done little or nothing. All seem to recognize the importance of the problem but the big question is how to penetrate the apathy barrier. Progress is being made, however, and we are happy to report that an increasing number of companies are "on their way." We see evidence of an accumulative interest on the part of both company managements and industry groups. The examples being set by many of the Nation's leading companies are doing much to stimulate others to follow suit.

In addition to the individual company conferences, BDSA is working closely with several trade and professional organizations. Some have designated committees to study the industry-wide implications of industrial defense, others tell us they plan to do so. It is our hope that every important trade association will (a) keep its member companies currently informed on developments in the field of industrial defense and (b) stimulate them to prepare company plans for the continuity of their operations. It is our job in BDSA to work closely with such groups in every possible way. We urgently need their assistance and hope that we might work with them.

Much has also been accomplished to date through the many industry committees which advise BDSA. These IAC's — Industry Advisory Committees—have been of great help in recommending approaches to the problem, stimulating interest, and developing sound continuity of production measures. We expect to make continued use of these advisory groups as an important facet of our Industrial Defense Program.

There are a number of industry-wide problems which are receiving the attention of BDSA such as attack damage assessment. Several of our industry divisions are currently studying this problem toward the end of developing a self-triggering procedure for the assessment of attack damage by technical industry survey teams. It is hoped that considerable progress can be made along these lines during the coming months.

In conclusion, a good start is being made. We respectfully solicit your help in encouraging industry to tackle the job.

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# Automatic TELETYPEWRITER SWITCHING AT FIFTH ARMY

by **LT. GEN. W. H. ARNOLD**
**Commanding General**
**Headquarters, Fifth Army**

IN THE FALL OF 1952, THE FIRST military automatic teletypewriter switching center was placed in operation at the Headquarters Fifth Army, Chicago, Illinois. This center, known as Teletypewriter Switching Center, AN/GGC-2 (XC-1), is the prototype and forerunner of the Teletypewriter Switching Center AN/FGC-30 now in operation in the Sixth Army Area, near Davis, California, and others currently scheduled for installation at selected headquarters.

During the summer of 1940, it became evident that existing and expanded radio channels would not handle the traffic generated by partial or full mobilization. To meet the mounting traffic volume and anticipated heavier loads, other communications equipment was investigated. At what is now Fifth Army, IBM radio-type equipment was used in the fall of 1940 as a supplement to the high-speed semi-automatic radio channels. Teletypewriter Exchange Service, and some point-to-point wire channels were used to supplement the manual CW channels.

In 1943 a semi-automatic torn tape teletypewriter relay center was installed in Chicago and was used during the remainder of the war. This equipment is still used to process much of the traffic at Fifth Army. In 1952 the semi-automatic system was supplemented by the automatic teletypewriter switching center which handles between 5,000 and 11,000 messages daily on twenty channels.

The automatic switching center is designed to relay automatically teletypewriter messages prepared in accordance with existing military procedures and formats, and to process single address, multiple address, and book messages.

### *Incoming Line Units*

Messages enter the switching center through teletypewriter-reperforators in the Incoming Line Units, and are reproduced on punched paper tape. This tape passes through a tape reader which transmits control information to the incoming line relays. These relays detect a new message entering the system and also check the number on this message, against a number previously set into a channel number comparator. This comparator counts the number of messages received on the circuit concerned, and stores the number of the next message to be received. If the number appearing on the message agrees with the number stored in the comparator, processing of the message continues. Should the number disagree, audible and visual alarms notify operators of the discrepancy.

After the message number has been checked, the tape reader leads are switched to the Director. Information representing the precedence and addressee of the message is transmitted electrically to storage and control relays in the Director. The addressee information is then spilled from the Director into the Translator, and converted to information representing the circuit over which the addressee is served. This information is returned to control relays within the Director. Acting on this information, the Director activates switches in the Cross Office Selector Unit, and in the Outgoing Line Selector Units.

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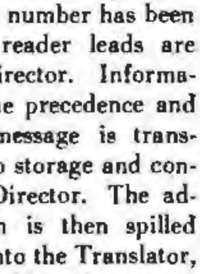
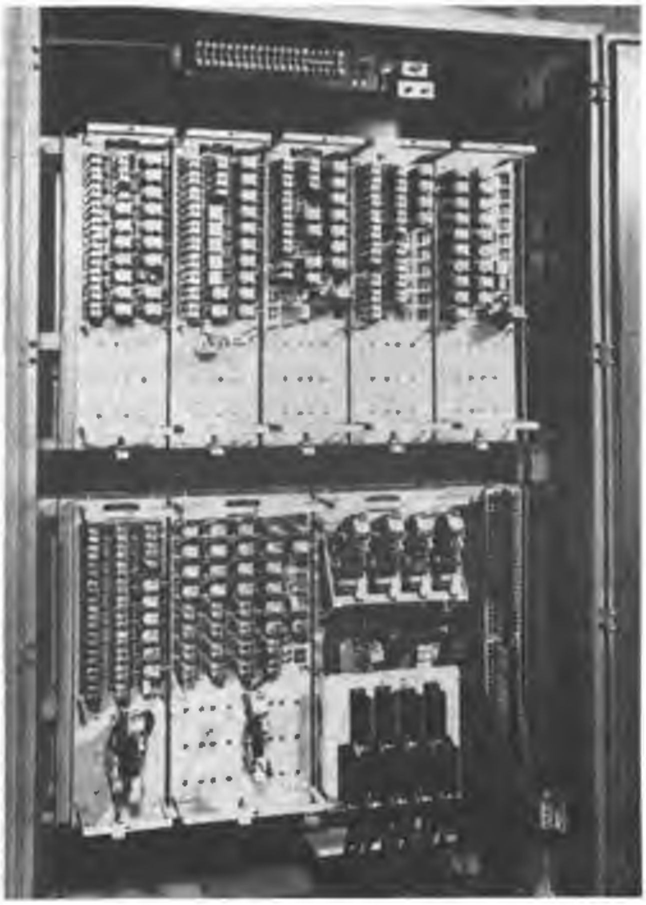
THE AUTHOR

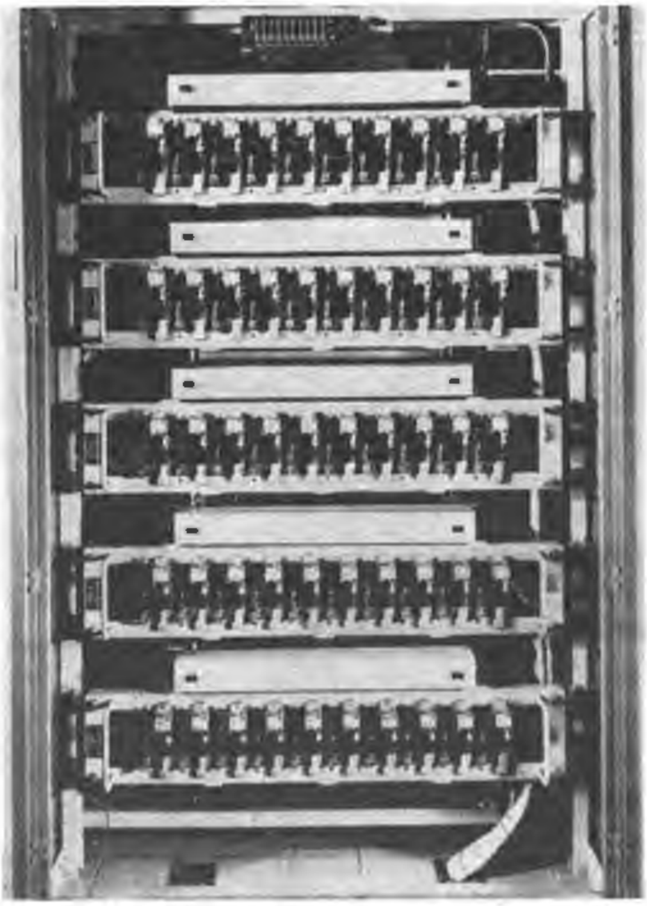
**Lieutenant General William Howard Arnold, USA, is Commanding General of the Fifth Army, Chicago, Illinois. He was appointed to this post in 1955.**



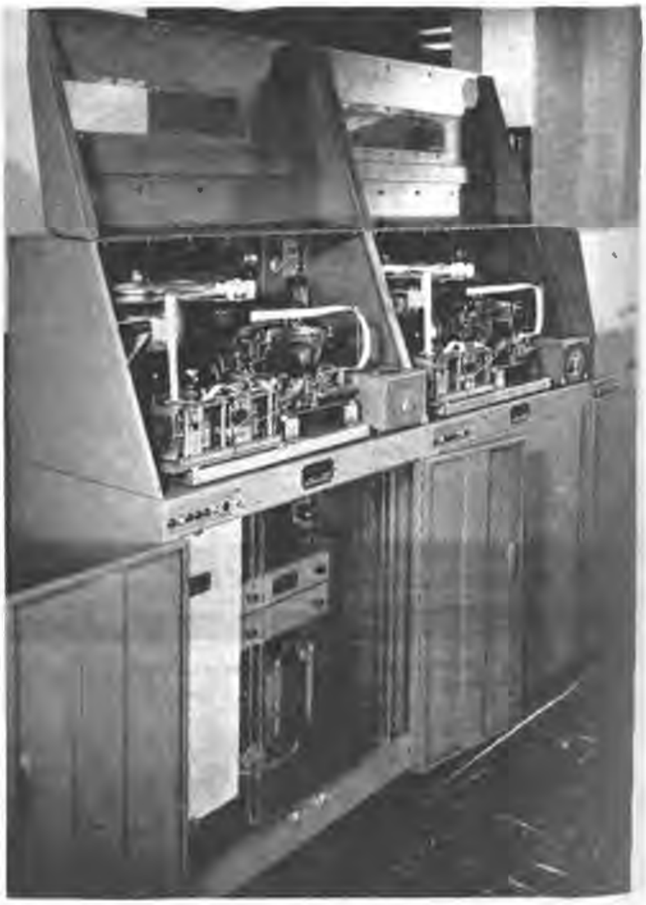


Director completes process of message in 8 seconds

Translator, front view, converts message to proper circuit



Cross office selector switches incoming message to outgoing line



Cross office storage units hold message for a clear line

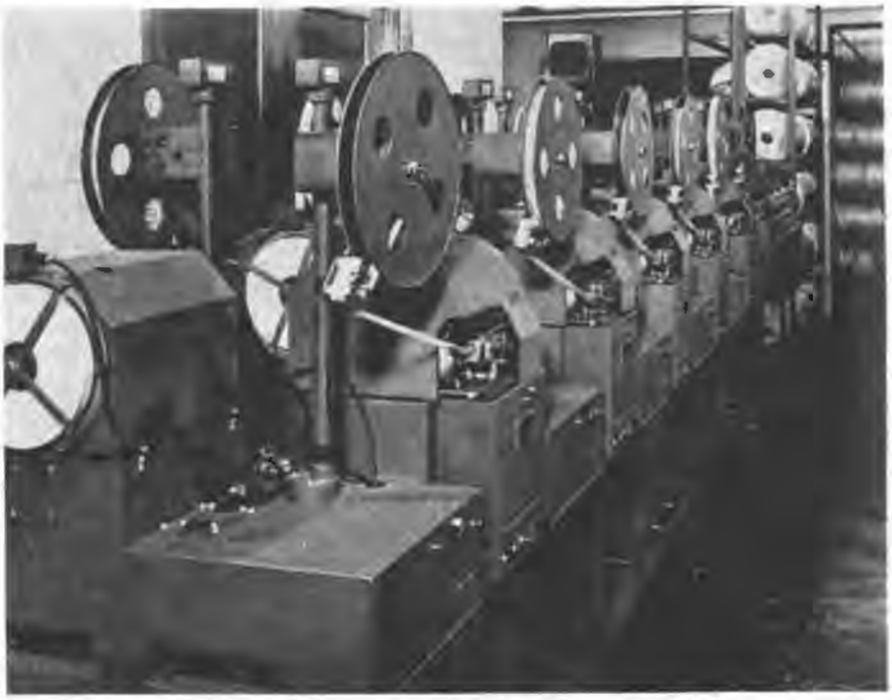
Switches within these units complete the connections from an Incoming Line Unit to a Cross Office Storage Unit, and from the Cross Office Unit to the outgoing line, through Monitor Reel Record Units.

Transmission of the message is from a transmitter-distributor in the Incoming Line Unit to a teletypewriter-reperforator in the Cross Office Storage Unit, where it is reproduced. The tape then passes through a tape reader in the Cross Office Storage Unit which, together with control relays, detects that a message is ready for transmission, and tests availability of the outgoing line. If the line is free, the message is transmitted to the outgoing circuit and is reproduced on the monitor for storage purposes. If the line is busy, the message is stored on punched tape in the Cross Office Unit until the line is available.

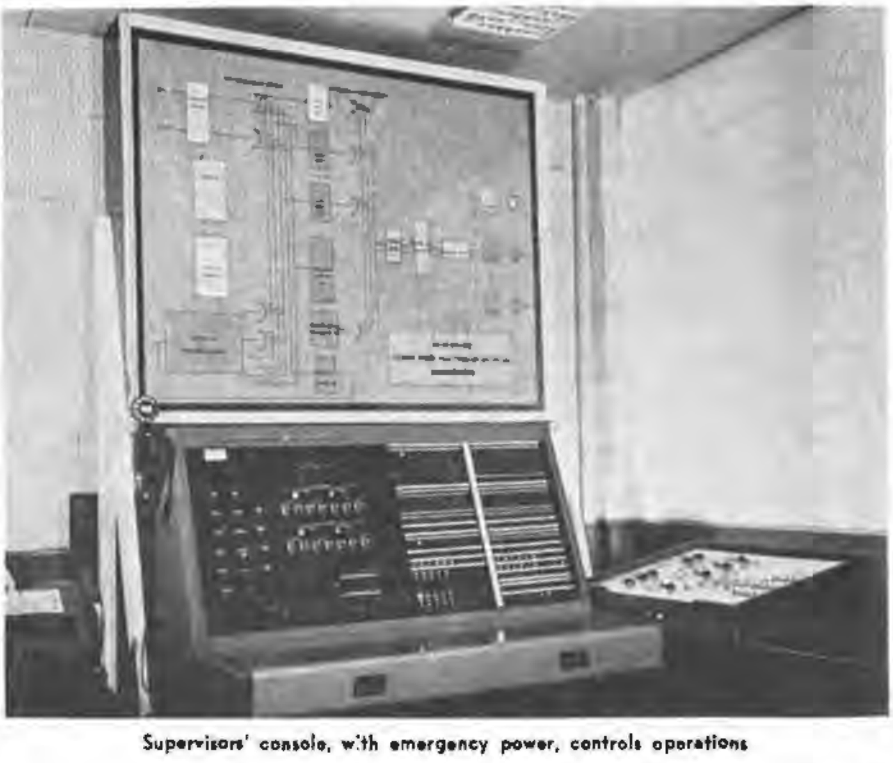
Messages are segregated and stored in precedence and address categories. During heavy traffic periods, messages for the same addressee and of the same precedence are usually stored in the same Cross Office Unit to await availability of the line. Should this particular unit be busy receiving a message at the same time another message of the same precedence for the same address is incoming, a second storage unit is used for storage of the new message. Messages are transmitted from storage in a sequence determined by precedence.

The procedure governing some types of messages requires immediate transmission and interruption of any transmission on the same line involving a message of lower precedence. This is accomplished automatically. The high precedence message enters the system in the same manner as lower precedence messages. However, when the Director receives information on the high precedence message, a new cross office connection path is established and the message is transmitted from the incoming line to an empty storage unit. As soon as information is detected in the new storage unit that the message is ready for transmission, any existing transmission of a lower precedence on the circuit involved is interrupted, the interrupted message is cancelled automatically, and the high precedence message is transmitted without delay. The interrupted message is retransmitted later as a new message. The above procedural requirement is a primary reason for common, pooled, storage equipment, others being economy of equipment and flexibility. Processing by the Director and Translator is normally completed in about 8 seconds per message. If the outgoing line is not busy or if a high precedence message is processed, the beginning of a message may be received at the receiving station before the message ending is transmitted from the originating station.

Book and multiple address messages are processed completely automatically. Incoming book and multiple address messages are received as a single tape and reproduced into as many individual messages as may be required. In this system, the maximum number of separate tapes reproduced would be twenty; these twenty tapes may carry a total of ninety-nine addressees. The capacity for reproduction, then, is governed by the number of outgoing lines available,



Monitor reel storage units through which message travels



Supervisors' console, with emergency power, controls operations

Overall view of the Switching Center

or by restrictions intentionally built into the system. On an average, four tapes are the usual reproduction requirements on book and multiple address messages. Frequently, messages with fifty-five addresses are received for processing. Messages of this type are processed in approximately eight minutes; manual processing of the same message requires sixty to ninety minutes depending on the textual length.

### *Intercept Positions*

Facilities are provided for intercepting incorrectly prepared messages, messages containing erroneous precedence or addressee information, or messages which for any reason can not be processed automatically. The intercept positions are shown in the right center of Figure 7. Messages received at these positions are corrected by operators within the center, if possible, or the distant station is requested to retransmit a corrected copy. Messages locally corrected are forwarded to the addressee station from a position on the Manual Forwarding Unit. Each forwarding position contains control switches and buttons which permit setting the transmitter-distributor at that position to any desired outgoing circuit, and to set into the position any desired degree of precedence, irrespective of the precedence appearing on the message. This feature permits operators within the switching center to override any existing transmission, except a transmission of the highest (FLASH) precedence.

Control of operations is centered at the Supervisors' Console. On the left of the control panel, switches are provided for control of normal and emergency power. On the right of the panel appear duplications of alarms appearing on each piece of equipment within the center. From observation of the alarm lights, the condition of the entire center, or any part of it, can be determined at a glance. An intercommunications system controlled from the console, permits supervisors to direct operations within the center, as well as to communicate with maintenance and other personnel.

### *Speed of Operation*

During four years of operation, over four million messages have been processed without a major outage of equipment or circuits. In fact, total outage to date is less than four hours. From this, it is considered that this equipment undoubtedly meets the reliability requirements for military communications. Handling a like amount of traffic on semi-automatic equipment requires 60% more personnel than is required for automatic operation. Maintenance personnel requirements increased about 15%. Initial training of operating and maintenance personnel was conducted by the manufacturer of the switching equipment; no training was required for maintenance of teletypewriter equipment since it is identical to that used in present semi-automatic communications centers. Speed of relaying and processing of messages has been increased considerably. Circuit utilization is closer to maximum than possible with semi-automatic equipment, consequently, the cost per message has been reduced substantially.

The transition from semi-automatic to automatic operation was not too difficult. With the cooperation of the manufacturer, who provided Fifth Army personnel access to a laboratory model of the equipment, training courses and instructions were drafted and presented. Training with the equipment itself was conducted during testing and debugging. Since this equipment is compatible with equipment used in other army teletypewriter stations, no major network changes were required. Minor modifications in procedures, affecting the starting and ending of messages, were made without difficulty.

The automatic switching center at Headquarters Fifth Army is firmly established as an integral part of the world wide Army Command and Administrative Network.

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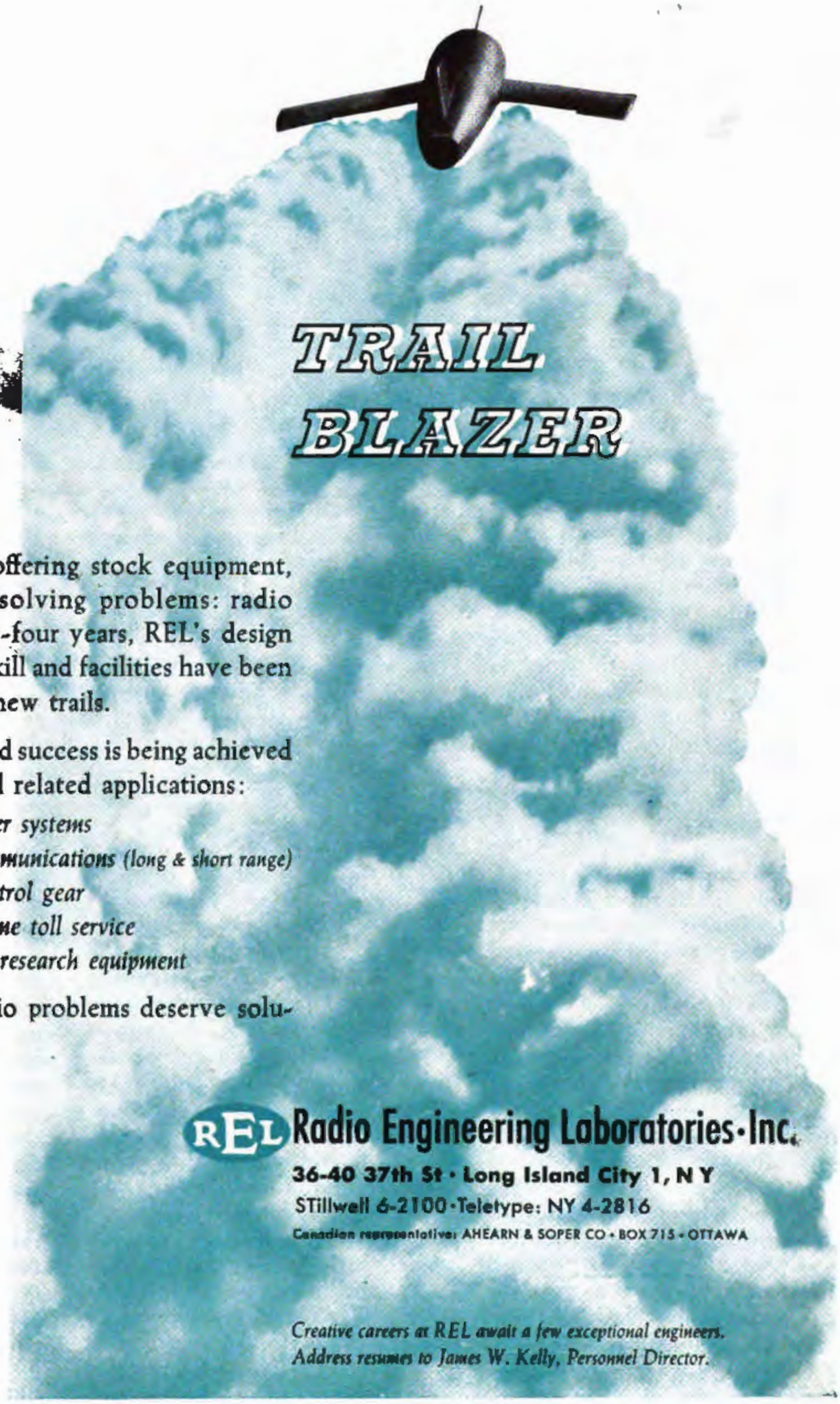

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*Creative careers at REL await a few exceptional engineers. Address resumes to James W. Kelly, Personnel Director.*

Laying and picking up cable on steep, uneven ground is one job for which the versatile Skagit Trac-Karrier was designed. Independent track action is shown in this view of the machine going down grade with the load pulled back over the tracks. The load is horizontal although the track at the left is lower and on much steeper pitch than that at the right. The oscillating, self-leveling tracks and walking beam construction of the undercarriage make this possible. Note the cable reel gearing at the right.

# the Skagit Trac-Karrier

**by Lt. Col. M. Preston Goodfellow (Ret.)**, President Overseas Reconstruction, Inc.

A PROBLEM WHICH FREQUENTLY plagues many people in the field of communications is the handling and stringing of cable on rough, steep terrain, swampy ground, and through water. The Army Transportation Corps also faced such a difficulty in its study of aerial tramways for handling materiel, particularly on beachheads.

How the Transportation Corps found an answer to this problem as part of the over-all aerial tramway project is an interesting story of product development.

The handling of cable would be simplified, it generally was agreed, by using a track-mounted, self-propelled reel carrier that could reel and unreel cable while stationary or moving in either direction. The unit would have to be capable of negotiating steep ground, under load or traveling light; also it must operate on rough, uneven terrain without danger of tipping, traverse soft, swampy ground and go through breast-deep water. The unit ought to be designed for multiple use in handling materiel as well as for cable reel work so it would have to be equipped with quickly interchangeable lift fork and cable reeling attachments. Since use on beachheads was likely, the forks should pick objects out of the sand. Of course, it must be compact in size and easy to move and operate.

Everyone was certain such a cable carrier would simplify the problem. The only difficulty was that no such machine existed.

Skagit Steel & Iron Works of Sedro-Woolley, Washington, undertook to engineer and build such a combination cable reeling device and lift tractor as part of its development contract for the aerial tramway project. Thus was born the Skagit PT-4 Trac-Karrier . . . a heavy duty, rough terrain, cable reeling, lift tractor.

### *Trac-Karrier on Operation*

Many of the engineering principles which went into the machine already had been proven by Skagit Steel in its normal production of heavy duty equipment: the main achievement was combining them into one compact unit of almost unlimited versatility without complicated assemblies and controls.

Basically, the Trac-Karrier consists of four main assemblies: The undercarriage; the lift carriage; interchangeable cable reeling device and lift forks; the power unit, drive and powerful, large-capacity winch drum.

The undercarriage, mounted on "Caterpillar" tracks, embodies exclusive Skagit design features. It has walking beam construction and oscillating tracks which permit the tracks to rise, fall and change their pitch independently of each other. This provides a self-leveling undercarriage which compensates for different ground levels and permits either track to over-ride an obstacle while the other is in a depression.

On land tests at the Skagit proving grounds in the foot hills of the rugged Cascade Mountains of the Pacific Northwest, the Trac-Karrier carried full loads and laid cable on ground with steep pitches, rocks, mounds and hollows. It maintained its balance with loads carried high and low while the tracks were on different levels.

During one test a heavy truck, used to transport boxes of steel for the test, bogged down when it backed off a road. The Trac-Karrier picked up the truck with load and set it back on the road. To prove his confidence in the machine, the operator elevated the truck and load to the full height of the lift forks, more than 8 feet, and carried it over the rough ground in an unscheduled demonstration.

The lift carriage is designed to raise and lower a load; to thrust it far forward or bring it back over the tracks, and to tilt it forward or back to keep it in a horizontal position regardless of the pitch of the ground.

The carriage is operated hydraulically and is mounted on the undercarriage with rollers. It has a horizontal movement of 55 inches and is powered by a fluid motor and speed

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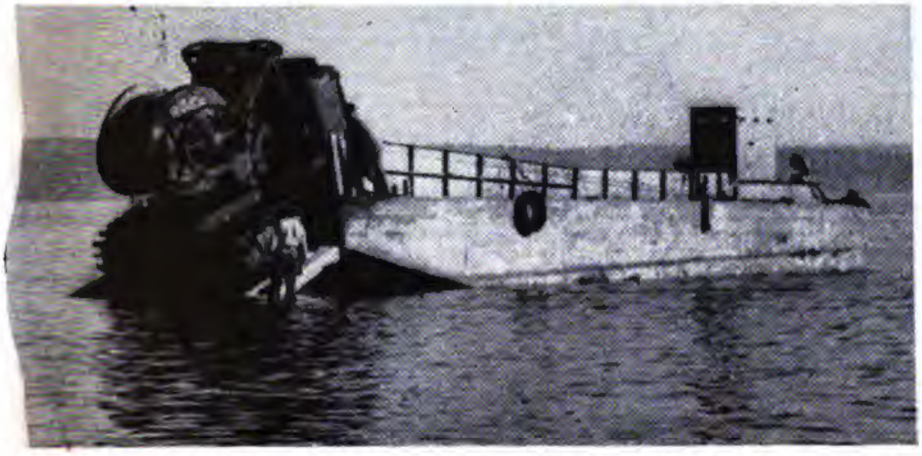
EDITOR'S NOTE: *The "Skagit Trac-Karrier" is a heavy duty load carrying tractor designed to operate in steep, uneven ground and in mud or water. Fully tested by the Army Transportation Corps, it is now in quantity production and should be useful in the field of communications.*

In going up hills, the load is thrust far forward to provide maximum traction. Lift carriage is vertical. Note fairleads for paying out cable when machine moves forward.



Trac-Karrier ran in four feet of salt water, laying and picking up cable to and from landing craft. Note the load pulled back over the tracks as it backs up ramp.

reducer drive which utilizes the main power unit. Raising and lowering is achieved with a combination roller chain and hydraulic cylinder mechanism.

The lift carriage tilting mechanism permits the load to be tilted from 15° forward to 30° back; this is accomplished with double-acting fluid cylinders.

In tests, the machine performed all functions easily on 48 per cent grades; it moved in a straight line over ground which required a tractor to follow a zig-zag course.

Because the motor and controls are mounted high, the unit was able to operate in more than 4 feet of salt water during amphibious operations. During one such deep water test, one track was allowed to drop off a ledge into soft mud; the Trac-Karrier maintained its level position. The reel of cable was raised above the water level, the winch line was anchored to shore, and the machine pulled itself out of the hole. The winch drum drive frictions are not affected by water and operate while submerged.

Also in the salt water tests, the machine laid cable to and from landing craft, being driven up the ramp onto the craft, forward and reverse, while the landing craft was both afloat and in shallow water. The ramp sometimes had an angle of 45° and the water depth against the engine was equivalent to 6 feet during some of these operations.

Pads which were easily installed on the grouser shoes were used to protect the deck of the landing craft. Since the undercarriage tracks have independent action and steering brakes, no difficulty was encountered in guiding the unit on the ramp where minimum clearance was available.

Movement of the lift carriage up and down, forward and back, and its tilting action are the same whether the cable reel or lift forks are attached.

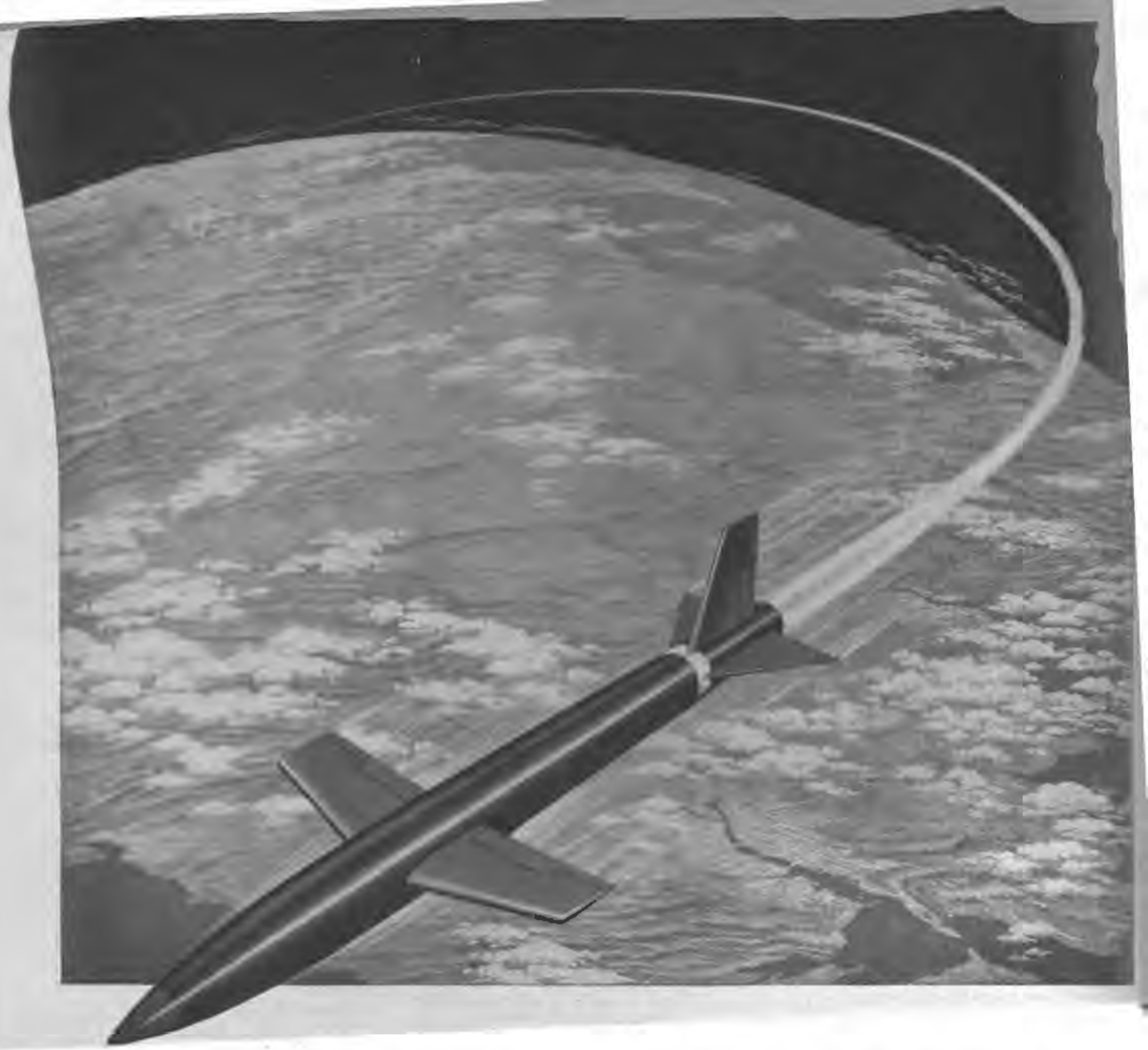
The reel carrying mechanism is of steel construction with heat-treated, cut steel gears and is equipped so that the reel may be attached and lifted direct from the ground. It has a reversing mechanism to rotate it in either direction. The reel is driven by a roller chain from a power take-off on the idler shaft; the friction drive and brake are designed to maintain tension. Fairleads are provided to lead the cable over the top of the machine when cable is being laid with the machine moving in a forward direction.

Although primarily designed as a cable reeling device and lift tractor, the Trac-Karrier has a draw bar pull of 22,000 pounds, depending on the soil and load conditions.

The standard model has five forward speeds and two in reverse ranging up to 6½ MPH. Optional width grouser shoes are available. The height of the lift carriage movement can be modified to meet special requirements, standard being 8 feet, 6 inches. Gasoline or diesel power is optional.

### *Controlling Devices*

The unit can be driven by an inexperienced operator after brief instruction; all controls are centrally located within easy reach. The track drive frictions are spring loaded and hydraulically actuated. Hydraulic operation also is provided for lifting and tilting the load and for the throttle. The horizontal movement of the carriage is controlled with a hydraulic motor through a worm gear speed reducer and roller chain. The turning brake on each track is equipped with a ratchet and also is used as an emergency holding brake. The engine clutch is foot-operated. A central gear shifter controls the transmission.



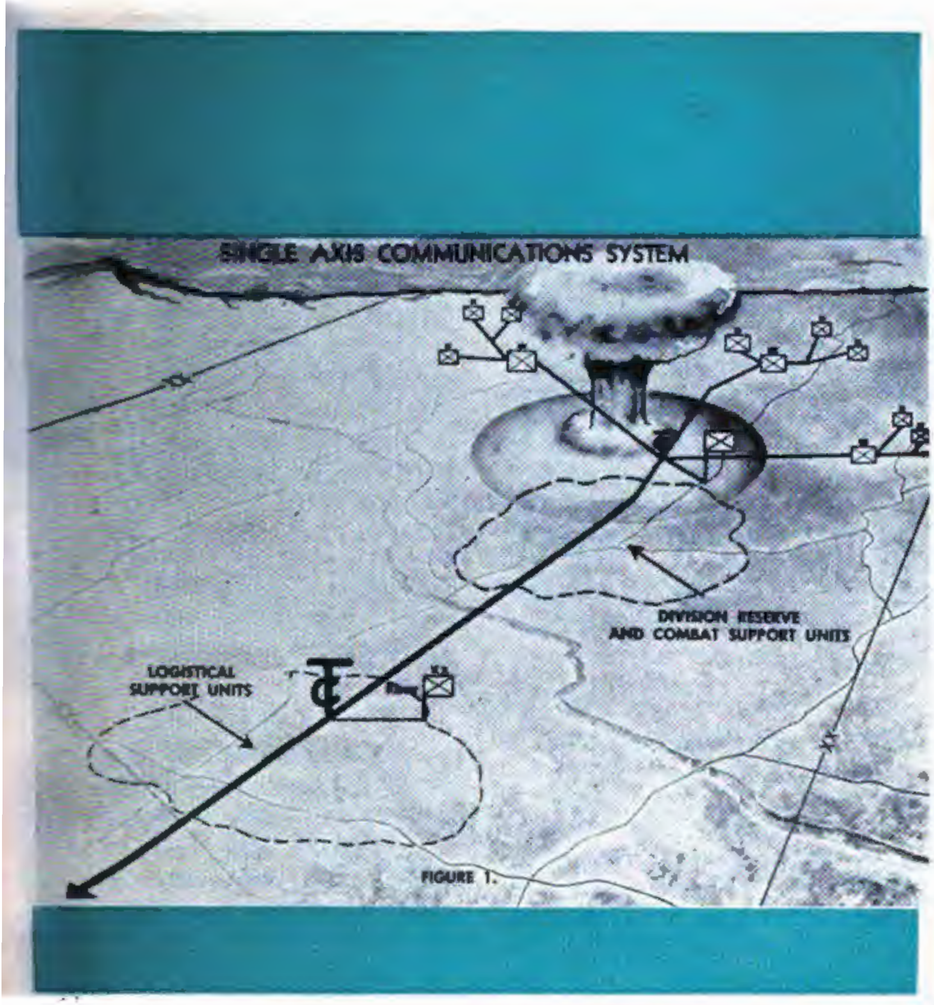


FIGURE 1.

# RAPPORT

**by Lt. Col. John Clapper, Jr., SC**

**Faculty, Command and General Staff College**

THE GRAY SHADOWS OF ANCIENT history hide the secret of who first said, "To win we must fight as a team." Perhaps it was some fur-clad family that long ago foraged the forest for food, armed only with spears and clubs. Whatever its origin, the statement stands out today as an axiom, "A leader and his aids must be in rapport."

Today, if military forces are to survive and win on the atomic battlefield, the demands for close teamwork, complete integration of surveillance, reporting, analyzing, directing, and supervising functions are vital. To talk of a weapons system is to speak in terms of a coordinated and controlled organization of interdependent elements which reaches its full stature because a means exists within the structure for regulating, guiding, and managing its utilization. But let us develop the picture from a simple beginning—"In Rapport."

As combat forces grow in size, the control problem becomes more complex. It reaches its zenith in atomic operations where dispersion between units makes a meeting impossible. Thinly defended areas between units, and greater distances to travel combine to limit the visits of the commander to his units. The old system of a series of command huddles all over the battlefield has given way to more dependence upon standing operating procedures, set plays, and the application of remote control. Yet, even as these techniques are emerging, there is a greater accent on quick reaction. Speed is of the essence in atomic combat situations, whether it be on the offense or the defense.

This matter of arranging procedures for passing information up and down the line, calling for and providing mutual support, and directing the maneuver of the group applies equally in principle all the way from the simple example of a handful of men, up to and including the complex operations of powerful formations equipped with the most awesome weapons of modern war.

### *Command and Control*

Since modern man has changed but little over the centuries, physiologically speaking, the improvement and development of the battle team has centered about new weapons, improved materiel, and better communications—more effective ways to shoot, move, and communicate.

As much as vanity may resist the admission, bravery and steadfastness are age-old virtues. Regardless of new weapons, battlefield gadgetry, and high morale, tomorrow's armies will be no bolder nor determined in the face of adversity than were the Roman Legions of old, or the valiant Allied defenders of freedom in World War II. They stood fast in the face of their fears and doubts because leadership got through to them, and welded them into highly effective battle groups. Tomorrow, then, we must have the command and control which spells the difference between a team and a mob, in a much more complex battle situation.

Once needs are known and stated, progress is under way. The fundamental sequence of filling the require-

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GRID COMMUNICATIONS SYSTEM

FIGURE 2

ments should fit generally into this pattern:

1. The development of new concepts of future war in accord with national objectives.
2. The determination of the requirements in organization and equipment.
3. The determination of the weapons necessary.
4. The generation of tactics and doctrine required to exploit fully the potential capability of new weapons and materiel.
5. The evolution of the requisite means to effectively command and control the agencies involved in using the new capabilities.

### *Resistance to Change*

Throughout the history of warfare there has been an inherent resistance to change. Despite the constant hue and cry for more means to reach the final victory with greater certainty, individual bias and inability to visualize clearly the over-all picture has led to many delays and failures to exploit new fields. Looking at the precepts of progress stated above, we can recognize that the greatest military champions were those who not only had the advantage of superior battle hardware, but also developed the technique to get the most out of what they had.

The great challenge then is to place sufficient stress and emphasis on all phases of development to acquire the maximum return from our inventory of assets. Although this article is concerned primarily with the last phase, the evolution of the requisite means to effectively command and control the agencies involved in using new military capabilities, the other elements should not be regarded as having been slighted. Naturally the last phase is dependent upon the preceding ones, and may well be developed concurrently with them.

Today, the Army boasts greater firepower and increased mobility and flexibility. Only with top quality communications can we reap their full promise. The development of new tactics, organization, and doctrine to exploit greater potentialities is being conducted zealously. Both combat and logistical operations in the fluid battles of tomorrow call for providing the control elements with a wealth of up-to-the-minute information about conditions over a large battle area. Once gathered, information must be filtered and forwarded to those who must evaluate it and revise their estimates of the situation in line with their findings. Decisions must be rapid and accurate to a degree not formerly required. And throughout the process, the system must be capable of furnishing excellent and uninterrupted communications, no matter what actions the enemy takes or what weapons he uses.

The temptation is to treat the requirements for a staff or operations control group as one entity, and to regard the requirements for a communications-electronics system which serves the control group and ties it into the subordinate action agencies as a separate and distinct package. The fault in such a view lies in a lack of appreciation for the close interrelationship between the parts. Compare the human cerebrospinal/automatic system and military response/autonomic control mechanisms. The point to be drawn is that human sensory preceptors, nerve ganglia, central conscious and peripheral unconscious response control centers, and motor impulse or reaction media are all bound into a compact unity. Psychologists advise that nerves and nerve centers directly condition behavior and consciousness. It is worthwhile to note in passing that man is physically superior to other vertebrates because he has a more highly developed central nervous system.

### *Nerve Center*

The military central nervous system for the battle area of the future must control battle groups of all arms, moving over greater zones of influence, and must provide for rapid and adequate logistical support. Units will assemble and disperse with rapid changes in density, yet always retaining the essence of one mass. The ability, through great mobility, to concentrate and strike, and then to recoil and later exploit the devastation caused by attacks of sudden ferocity places a premium on battle area surveillance, interpretation at the operation control center, and the transmission of the reaction impulse. Human eyes and ears will be supplemented by radars, seismic and acoustic detectors, and remote airborne and ground positioned photosensitive reporting devices which are linked into integrators at response centers.

In the ultimate system, information from lower echelon data collecting and mixing centers will be reported periodically to higher echelon control centers by means of unattended electronic devices which also will respond with the latest data upon interrogation impulses from eleven echelons. The data thus transmitted will be sorted, integrated, and assessed electromechanically to the limit of human ingenuity. Prearranged response patterns, warnings, and summaries can be presented visually, stored automatically, or typed for future study by controllers. As the quantity of incoming data increases, it will be imperative that clerical operations be performed by machines.

Atomic battle concepts clearly establish the need for effective communications at all levels in the field army. Command posts, even at corps and army levels, must be highly mobile. Division CP's will move as often as once a day. Corps CP's will move as often as every two or three days, and Army CP's will displace at intervals of a week or less.

Frequent displacement makes it mandatory that all signal equipment be as mobile as the headquarters it supports. Switchboards, radio relay stations, and other facilities must be mounted in small trucks no larger than the types used by the staff sections of the headquarters. Radio communication must be continuous, even during displacement, with local direction of incoming and outgoing calls to operating staff officers by means of radio switching centers. Power units must be mounted on vehicles and fed from central fuel tanks. Antennas for even relatively elaborate radio relay stations should be so designed that they can be put up and into operation in minutes. No setting up should be required inside a truck or van. Its equipment should be ready for use instantly. Local wire lines in the CP should be fanned out as fast as men can run, with an overall result that displacement of a CP ceases to be much of a problem.

### *Grid System*

Instead of wire lines between echelons, highly directional radio relay networks will be normal. The grid system must have the capacity and reliability to provide full switchboard-to-switchboard service on a common-user basis and also such private or sole user channels as are necessary. All transmissions must be coded automatically or scrambled with no time delay.

The destructive capability of atomic weapons and the requirement for fast, reliable, and uninterrupted communications for the control of battle groups of all arms operating over wide areas as well as for rapid, adequate logistical support, outmode the familiar single axis communications system shown in Figure 1. The blast depicted, or one severing the main axis from division main to division rear, would cause completely unacceptable disruption of the tactical, administrative, and logistical operations and control.

Figure 2 clearly shows the superior resilience and flexibility of the grid communications system. It is apparent that even complete destruction of the switching center at the hub of the system would not cause more than momentary interruption of vital communications. In fact, an enemy would find it costly and difficult, if not impossible, to disrupt communications completely—particularly if primary reliance is on radio communications. Unaffected switching centers merely would tie in with each other and nearby units and business would carry on as usual.

### *Radio Relay System*

At lower echelons the use of tactical radio gear must be expanded. Small multichannel radio relay sets can be developed which provide eight voice and two teletype channels, identical to wire service. The artillery, infantry, and armor will all have the same basic vehicular radio set, with hundreds of channels for suitable allocation. Fully integrated battle teams thus will be possible, with no frequency problem or inability to reach to units of another arm.

Just as the combat operation of the future will be molded into an entity of weapons and control systems, so also must the administrative and logistical capability be streamlined. Without fully adequate logistical support commanders in the atomic era cannot execute their tactical plans. To keep pace, smaller and more responsive service organizations, better operating procedures, faster transportation, and improved communication techniques are necessary.

The more quickly and surely we can deliver supplies to the battle area, to the right place at the right time, the less requirement there is for combat and combat support units to carry large reserve stocks. Items used frequently in quantity will be called for and must be delivered rapidly as needed. The better the service from rear to front, the smaller the forward stocks on hand will need to be. Bulky supplies will be held in the rear until required and shipped quickly to the consumer on order. The desired effect is the development of a smaller but more responsive supply and maintenance chain to help increase tactical mobility. In the absence of superior logistical control communication facilities, the whole idea is little more than a dream.

### *Flow of Data*

If such a system is to work effectively, "green light" supply procedures must be used. Theater policy will set forth authorizations and allocations. Control will be more centralized on critical items, less on plentiful stocks. Operations will be decentralized. Hoarding by using units will be denied by limiting transportation capability to that which will carry authorized levels only. The cumbersome multiple-item requisition of the present will be replaced in the future by single line item requisitions transmitted over wire or radio circuits from regimental and higher headquarters.

Stock and supply control will be built around electronic computers and integrators. Simple, uniform methods will be standardized, accelerating the flow of data and reducing order and delivery lead time. Aided by electronic data transmission techniques, the development of a highly responsive logistical system, long the dream of field commanders, may very well be one of the first major breakthroughs to the Army of the future.

It is imperative that machines free staff officers from the burden of manually performing every repetitive process not involving a high degree of judgment. Operation control centers must be uncluttered and quiet, yet highly responsive to the decision-making process. Delays in transmission can and will be eliminated once procedures are developed by officers specially trained to work out the complex relationships of all parts of the system. The command and control of administrative activities involves a myriad of telephone calls and message transmissions. Thus a network of high quality communication circuits will be necessary to insure continuous management over operations in rear areas. Multi-

channel facilities will be necessary to pass this heavy traffic over long distances by means of an area or "grid" system.

The form and nature of future tactical and logistical operations will be influenced greatly by increased use of Army aircraft. Army air operations will be conducted in all weather, at all hours, usually at low altitudes over electronically defined air routes. Communication and traffic control will cause the orderly movement of large numbers of planes. fully coordinated with tactical air support and anti-aircraft defense.

### *Unique Frequencies*

The basic principles of flight control operations are not new. The United States Air Force and the Civil Aeronautics Authority are rich sources of guidance. However, certain unique requirements of the Army have no outside counterpart which can be exploited. Army airfields will be created hastily and heliports will mushroom wherever the tactical situation dictates. Communication, air navigation, en route flight assistance, and landing aids for the field army will be "here today, there tomorrow." Only by the most carefully integrated system of command, control, and communications-electronics will the Army's own control over its flight operations meet expectations.

The fundamental test of understanding comes from uncovering basic principles and applying them properly. As a truth is recognized as being generally applicable, the details behind it lose much of their mystery. The more intricate problems of military signaling are being studied and solved by forward thinking officers who plan to use communications not as technicians but as commanders.

In the final analysis the commander who figuratively sub-divides his control system into its parts to understand how and why it works is well on his way to gaining the know-how to exploit the full capabilities of his command. Perhaps this is why so much attention is placed upon the need for superior communications by top military leaders who emphasize the absolute necessity for the closest union between the commander and his control system.

[illegible]

# PHOTOPROGRESS

by FRANK SMITH
Photo News Editor, SIGNAL

**Hycon Lightweight Aerial Reconnaissance Camera**

Something new in lightweight aerial reconnaissance cameras has been developed by Hycon Mfg. Co., Pasadena, Calif. Designed for use in missile and high speed drone aircraft, the camera can also be used for more conventional aerial reconnaissance tasks.

Known as the KA-20, the camera uses 9 x 9-inch film and 6-inch metrogon lens to provide a maximum area of coverage. It weighs only 17 lbs., one-fifth the weight of comparable aerial cameras. Built-in image motion compensation, which adjusts for the airplane's forward speed by moving the film at the time the exposure is made, assures sharp photography. Because of its size, light weight, and 9" x 9" format, the camera has application in all types of aerial platforms, both manned and unmanned, where weight is a critical problem. Missile and rocket use is completely possible with the new KA-20, since it has repeatedly withstood launching and landing loads of 40 G's according to officials of the company.

The first KA-20 was made specifically for installation in the Radioplane RP-17 drone and was developed under the direction of the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. It has been field tested by the U.S. Army Electronics Proving Ground.

**Mirror Type X-Ray Camera**

A new type X-ray camera which results in a 70 to 75% reduction in X-ray exposure to the patient has been announced by the General Electric Co., Milwaukee, Wisc. The camera portion of the unit is produced by the Fairchild Camera and Instrument Corp., Jamaica, N. Y. Heart of the new camera is a special mirror, which applies the same principle that is employed by astronomers to photograph light from the distant stars. The reduction in X-ray exposure is made possible by the mirror's optical speed which is between 4 and 5 times greater than that of refractive lens type cameras hitherto used. The large-diameter mirror system, similar to those used in giant telescopes, is reported to produce sharper and clearer images than have hitherto been possible. This system permits an extremely wide working aperture of f/0.7 (GRA f/0.65). Resolution of the X-ray image is 4 times that of refractive-type lens camera previously employed.

Developed by Fairchild in cooperation with the N. V. Optische Industrie, (Odelca) of the Netherlands, the new camera features the Bouwers concentric mirror optical system, which greatly surpasses the light-gathering capacity of the conventional lens.

The camera uses miniature 4" x 4" or 70mm film which provides considerable economy over the use of larger film sizes. The camera can be adapted to serial film work permitting the taking of from 1 to 6 frames per second.

**Kalfax Photographic System**

A wholly new and revolutionary photographic process called Kalfax which requires no chemicals, fumes, vapors or the like has been developed by T. J. Moran's Sons, 909 South Broad St., New Orleans 25, La.

The Kalfax Process uses physical development rather than conventional chemical development processes. The developing agent is heat applied at a moderate temperature, and is clean and simple and consists of only two steps—expose with light and develop by heat.

The sensitivity of the present Kalfax emulsion is in the ultra-violet band of the light spectrum and thus the material can be handled in daylight or ordinary room light. This characteristic of Kalfax enables operations to be carried on with greater flexibility and permits the application of principles of photography to a new and unusual series of applications.

Kalfax emulsion is essentially grainless and the resolution of the material is superior to most of the conventional silver-halide emulsions.

Image permanence is substantially greater than that of conventional photographic materials and the Kalfax film displays insignificant loss of image when subjected to temperatures as high as 200F. Humidity tests have been made by completely immersing the developed material in water for long periods with no image deterioration.

Kalfax photographic papers may be of any color, thus achieving a number of colors without charge in either exposure or development techniques. The process is ionizing radiation proof and the materials may be used in "hot" areas without adverse effects.

The sensitized materials may be coated on anything and the copying material will reproduce continuous tone pictures usable in commercial photography for proofreading. Various units of equipment have been developed to use Kalfax paper and film as follows:

a. Kalfax Enlarger. Projection prints from 35mm or 16mm microfilm frames up to 14 x enlargement in 30-40 seconds.

b. Kalfax Film Printer. This unit exposes and develops in one operation 35 or 16mm film in strip or roll at a speed of 5 to 24 feet per minute.

c. Kalfax Photocopy Machine. Same size contact prints up to 11 x 17 in less than one minute.

### New Lamp Developments

A new photoflash lamp development which is sure to be welcomed by photographers everywhere is the Amplex baseless photoflash lamp which is a product of the Philips Laboratories, Eindhoven, Netherlands. Designated as the "My-T-Myte" PF1 (clear), the new baseless flash lamp fits any bayonet-base flashgun through the use of a simple inexpensive adapter. The baseless lamp, which is described as revolutionary by the distributor, is a medium-peaking lamp with a peak duration of 18-20 milliseconds and is suitable for use with all presently available fixed focus and synchronizing cameras.

Output of 7,500 lumens makes the baseless the most powerful, small lamp available in America. A blue baseless bulb, PF1B, is also available for the Daylight Type Color films. The adapter, which can be purchased for 20 cents, is provided with an ejector lever which can be operated with a simple flick of the finger. The Amplex Corp., 111 Water St., Brooklyn 1, N. Y., has been appointed exclusive distributors of the lamp in the United States. List price of the PF1 (clear) is 9 cents each. The PF1B (blue) is 11 cents each.

Another lamp development which is sure to interest all projectionists is the new Westinghouse 1,200 watt projection lamp which is claimed to give 30% greater screen brightness. Designated as the 1,200-watt T-12, the lamp is designed to work with existing projection equipment and is interchangeable with present 1,000-watt lamps.

Nearly two inches shorter than other 1200-watt lamps. the new light source has the same filament size as 1000-watt lamps. Engineers of Westinghouse state that the lamp has one of the most compact filaments ever made.

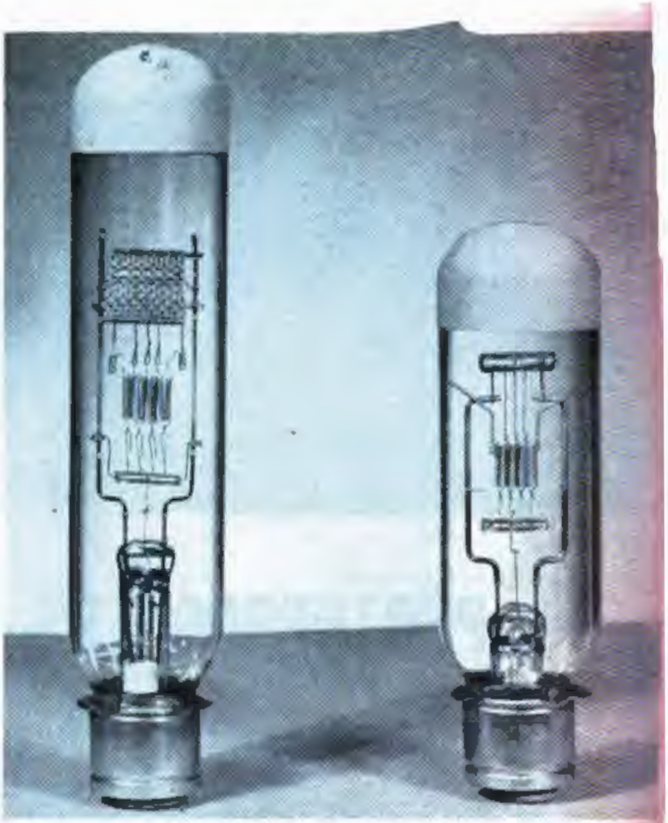
One of the important advantages of the new lamp is that it permits the use of the new wider screens. The extremely compact filament used in the new lamp was made possible by the development of new techniques of drawing tungsten wire and an exclusive floating bridge filament construction. This design allows the placing of the coils close together without danger of shorting when the filament expands upon heating.

### Photographic Pamphlets

One of the most interesting and at the same time handiest of booklets to come off the presses recently is the new 1956-57 *Optical Industry Directory*, priced at $5.00 and published by the Optical Publishing Co., Box 542, Huntington, L. I., N. Y.

The directory consists of 309 pages of information designed for ready reference. This new edition gives up-to-date information on some 3,000 domestic and foreign suppliers of optical components, instruments, raw materials, and services.

As a new feature it lists the pertinent data regarding thousands of commercially available corrected lenses for photography, instrumentation, and other special uses. Outstanding leaders in theory, development, manufacture and use of optics and optical instruments have indicated their specialities in the personnel section.



Brighter motion pictures may be obtained with existing projection equipment as a result of a new 1200-watt projection lamp developed by engineers of Westinghouse which is interchangeable with present 1000-watt lamps.

The expanded index of enumerated items (349) is a true glossary of modern optics. The directory is an indispensable tool for the purchasing agent, engineer, research worker, and manufacturer regardless of his particular field of optical specialization.

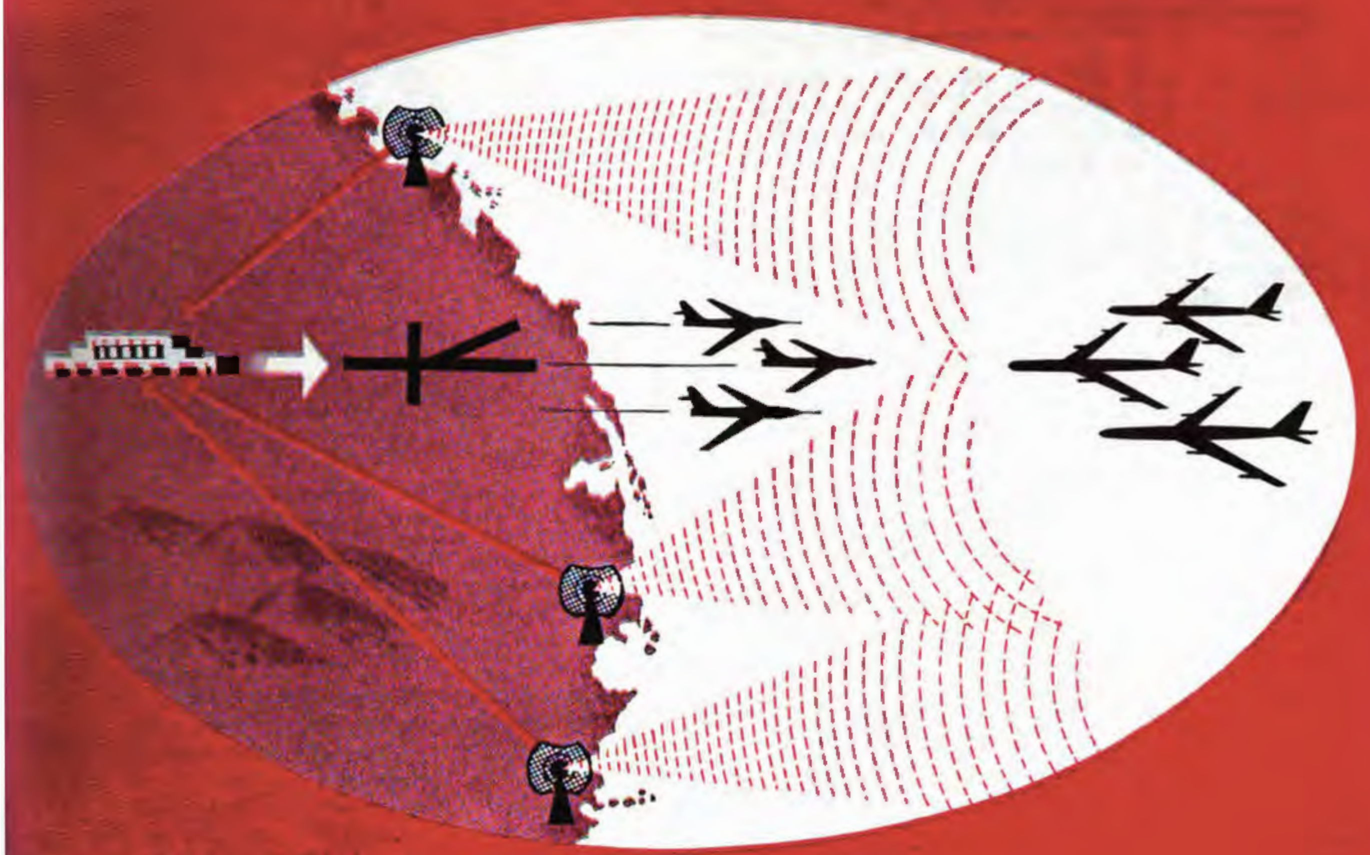
One of the neatest publications to come to the attention of your writer is the new 88 page handbook of Ansco covering color photography with the new high-speed Anscochrome color transparency and motion picture films. The new handbook is entitled *How to make better Color Pictures With High-Speed Anscochrome Film* and gives full and detailed directions to help even the least experienced photographer make superior-quality color transparencies on high-speed Anscochrome film.

Containing 53 four-color illustrations, the new book is priced at a modest 75 cents.

The booklet is comprehensive in coverage and gives considerable useful information on such subjects as correct exposure, using exposure meters and guides, diagrams and charts of indoor lighting arrangements, nature of light and how colors are formed, latest official Ansco filter recommendations, processing instructions, and a host of others. The book may be obtained in most camera stores or direct from Department of Publications, Ansco, Binghamton, N. Y.

One of the minor problems confronting the user of Kodak films has been to keep up with the many new and improved films of this brand hitting the market in recent months.

This problem has been very neatly solved with the publication of the 7th edition of the Kodak Data Book entitled *Kodak Films For Black and White Photography.*



# SAGE

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Briefly, SAGE does this: employs radar and electronic digital computers to detect and identify approaching enemy aircraft; determines appropriate defensive measures such as antiaircraft weapons, missiles, or intercepting planes; guides missiles and interceptors to the target and then returns planes to their home base.

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**Electronic Tube Division, Plainfield, N. J.**
**The Todd Company, Inc., Rochester, N. Y.**

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**Looking to future expansion, Burroughs invites inquiries from qualified engineers.**

All the new films are included therein together with complete technical information. The book contains 68 pages, is priced at 50 cents and explains photographic processes, and gives detailed information on black-and-white sheet and roll films used by commercial, professional, and amateur photographers.

Among the 15 films for which exposure, processing and sensitometric information is provided are Kodak Tri-X, Panatomic X, Verichrome Pan, and Royal Ortho, recent developments of the Eastman Kodak Co.

A new section of the book discusses graininess, sharpness and revolving power of films in light of recent Kodak discoveries in the field of acutance—the scientific measurements of sharpness of films.

### Some Recent Photographic Patents

Perhaps this account would not be quite complete without mentioning three recent U.S. patents that may possess wide implications in the photographic field.

The first of these patents covers a radically new and different system of photo recordation which is neither conventional photography nor electrophotography as it is known and practiced today.

Such a process, known as the electrodynamic, has been invented by J. E. Jacobs and Rudolf Frerichs, and a U.S. Patent #2,764,693 was issued thereon under the date of September 25, 1956. The title of the patent is "Process and Apparatus for Image Production and Recordation" and briefly, the principle of operation is as follows:

The method, which uses a photosensitive screen of finely divided semi-conducting crystals of current amplifying material, produces images in terms of electrical currents, flowing in each and every portion of an image producing area, whereby the image may be recorded by applying the currents directly to a current sensitive sheet to mark the same, thereby reducing the recording procedure to one of utmost speed, precision, and simplicity by avoiding the chemical procedures inherent in conventional silver-halide photography and the mechanical dust pattern transfer procedure of xerography.

The photosensitive layer may consist of cadmium or mercury sulphide or cadmium selenide, or other semiconducting material having the inherent capacity of operating as an electrical current amplifier when irradiated with light rays from the ultraviolet to X-rays.

The patent comprises 13 claims and has been assigned to the General Electric Company.

### Improvements in Electroluminescent Lamps

Another patent U.S. #2,755,400 issued July 17, 1956 to C. B. Stiles and assigned to Sylvania Electric Products, Inc., Salem, Mass. mainly covers improvements in the basic electroluminescent lamp.

The inventor states that he has found that the light output greatly increases as the temperature is raised above 100 F. In some cases, the output is increased six times or more above that obtainable at room temperature. The reason for this increase is that formerly the voltages used were not sufficient to raise the temperature of the lamp more than a few degrees above ambient. Several means may be used to increase the temperature of the lamp, among them being, heating the lamp by external means, such as by a separate heater resistance, increasing the resistance of the lamp electrodes by increasing the resistance of the transparent conductive layer, increasing the voltage across the lamp and increasing the frequency of the voltage.

However, the inventor states that it generally will be found to be more efficient to let the lamp heat itself by raising the voltage or frequency or both and by enclosing the unit in an inverted outer glass envelope.. As an illustration, a graph appended to the patent shows that at 150 F. and 250 volts, the brightness in foot lamberts is approximately 0.8. At 150 F. and 550 volts the brightness is approximately 2.8. As the brightness values of the electroluminescent lamp are pushed higher and higher, the lamp becomes increasingly more valuable as a possible photographic illumination source since this factor, more than any other, has prohibited its use.

The Amplex Baseless PFI Photoflash Bulb slips into its permanent adapter base which fits any bayonet-base flashgun. Lever at right of adapter ejects the used bulb. American Flashgun manufacturers are now working on designs that will take the Baseless Bulb directly without an adapter, and a number of European guns for the Baseless Bulb are now on sale in America.

### Electronic Exposure Control Device for Variable Contrast Photo Papers

U.S. Patent #2,764,060 issued to Robert J. Roark, September 25, 1956, assigned to E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware, covers an electronic exposure control device for variable contrast photographic papers. As is generally known, one of the problems encountered in printing variable contrast photographic papers is the subjective opinion of the operator required in selecting the proper filter, paper, and the exposure required.

According to the inventor, the subject electronic device eliminates the above making all operations in effect automatic, or semi-automatic, and requiring a minimum of human intervention. The device essentially comprises an electro-optical scanning system having a photoelectric detector which generates a pulsating E.M.F. in response to the light transmitted by the negative when a representative area of the negative is scanned by a Nipkow disk or like device. This E.M.F. is transmitted to two parallel connected electronic circuits, one of which indicates (or controls) the duration of the total light exposure as a function of the density of the negative, while the other indicates (or controls) the light quality as a function of the contrast of the negative.

The inventor claims that the device is compact in arrangement, and can be adapted for attachment to a wide variety of designs of conventional photographic printing equipment. Furthermore, the apparatus is claimed to be low in first cost and maintenance, and the automatic or semi-automatic feature provides for an increased production rate.

# Association Affairs

## 1957 Convention News

The National Convention Chairman, Admiral Joseph R. Redman, has made the following announcement regarding Committee Chairmen for the AFCEA Convention to be held at the Park-Sheraton Hotel May 20, 21, and 22, 1957.

Chairman in charge of organizing the program and securing the technical papers is Francis H. Engel, RCA. Entertainment and banquet arrangements will be made under the leadership of John L. Gilbarte, Admiral Corp. Mrs. Engels will organize the committee handling the program of ladies activities.

The Tours and Transportation Committee will be headed by George Sheets, Stromberg-Carlson, and Roland C. Davies, *Telecommunications Reports*, will direct the public relations.

William C. Copp, of William C. Copp & Associates, will handle the exhibits again this year. Frank Martins will be treasurer and Burnett R. Olmsted will take care of the administration and budget.

### *Exhibits*

In the short space of three weeks a total of 90 exhibit spaces out of the 160 available have been contracted. Since spaces are going rapidly, organizations which anticipate securing space should not delay in mailing their request.

### *Technical Papers*

The response to the request for technical papers to be presented during the convention has been most gratifying. A total of 45 papers on various subjects have been received to date. From this number, the Chairman for Technical Papers and his Committee will choose a total of 12 for presentation.

### *Attendance*

From all indications, this year's convention will be the biggest in the history of our Association. Approximately 3500 representatives from the military and from business are expected. This will exceed the attendance at our Boston Convention by 2000. Special plans are being made for the ladies to tour points of interest in the Washington area.

## General Blake Moves to New Post

Maj. Gen. Gordon A. Blake took over a new assignment on January 1 as Commander of the United States Air Force Security Service at Kelly Air Force Base, Texas.

General Blake takes a wealth of electronics experience to this assignment having served as Director of Communications-Electronics, USAF, for over two years, from January. 1953 to June, 1956. In June, 1956, he became Assistant Deputy Chief of Staff, Operations of the Air Force.

A leader in AFCEA, General Blake served as the National Director of chapters from June, 1954 to June, 1955. From 1953 to 1956, he was a national vice-president and served as a member of the National Board of Directors and of the Executive Committee.

## Overseas Interest in SIGNAL

During the past two months, it was gratifying to note that our overseas chapters have evinced an interest in the change of format and the type of material contained in SIGNAL. This is a forward step and one which pleases the National Headquarters no end. In this connection, SIGNAL would be pleased, not only to receive worthy comments, but also to receive interesting articles for publication in the field of communications, electronics and photography by members of our overseas chapters from time to time.

## Past Issues of SIGNAL

National Headquarters has received quite a few requests for past issues of SIGNAL which we advertised for sale at $1 per copy in a previous issue of SIGNAL. Since we will dispose of our supply of past issues on March 1, we would like to suggest that those chapters or individual members, who have not yet placed orders for copies desired, do so before the deadline date. National Headquarters will be glad to make available without cost copies of our last 4 issues for use at banquets or Association meetings to pass out to visiting guests. If any chapters desire to take advantage of this opportunity, please communicate with the Washington office before March 1, 1957.

# AFCEA Group Members

## Communications—Electronics—Photography

***Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.***

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# Chapter News

### *Baltimore*

The chapter's October meeting, held at the Bendix Radio Division, was highlighted by a tour through the corporation's new engineering building. A buffet dinner preceded the tour.

E. K. Foster, manager of the plant, acted as host to the group of 160 members and guests, and introduced the guides who took groups of members through the new building.

The 100,000 square-foot structure, which includes spacious work areas and offices, has an auditorium, a complete printing plant, engineering library, and loading dock.

The Air Research and Development Command entertained the chapter at a dinner-meeting November 13. A film, "The Time of War," was shown.

The theme of the film was the need for scientific and technical progress in aviation. It explained that "The War of War" requires that we get ahead and keep ahead as far as possible and that research and development are playing an important part in this fight. The film also pointed out the ideas, missions, and organization of ARDC and how it works along with industry.

The host of the evening was Col. C. R. Tosti, Assistant Executive Officer to Lt. Gen. Thomas S. Power, ARDC.

### *Boston*

The chapter's November meeting was held at the Western Union plant where members and guests were taken on a tour by Robert Dirkes, assistant vice president of the company.

Mr. Dirkes explained his company's latest facsimile equipment to the group and later discussed switching center devices developed by Western Union for its customers.

### *Chicago*

The chapter's tenth anniversary was celebrated at an October dinner-meeting in the new Headquarters of the Chicago Air Procurement District, USAF. Col. LeRoy C. Lewis, Chief of Chicago Air Procurement District and a member of the chapter's Board of Directors, was host.

The program, divided into two parts, was opened by Maj. Gen. W. O. Senter's speech, "Facing the Engineer Personnel Shortage." General Senter is the Commander of the Oklahoma City Air Materiel Area.

The remainder of the program was devoted to the outlining of Col. Lewis' Command, including the explanation of contract administration and procurement assistance to potential suppliers. To aid the members' knowledge of the subject, a detailed index of Commodities and Air Materiel Command Purchasing Offices was distributed.

Brig. Gen. William D. Hamlin, Commanding General, TASSA and Brig. Gen. Hiram D. Ives, Illinois Military District were the distinguished speakers at the chapter's November meeting.

General Hamlin spoke on "Procurement Trends and Comparison of the Chicago Regional Office to Overall Signal Corps Procurement."

The topic of General Ives' speech was the "Reserve Officers Act of 1955 and Its Effect on Industry."

The dinner meeting was held at the 5th Army Headquarters and the host was Col. Marlin S. Moody of the Signal Corps.

### *Kansas City*

John Knoell, operations supervisor, Airways Operations Div., Civil Aeronautics Authority, Kansas City, was the guest speaker at the chapter's October meeting.

Speaking on the activities and plans of the Civil Aeronautics Administration, Mr. Knoell thoroughly discussed air traffic control in the past, present, and future. Upon the conclusion of his talk, he conducted a general question and answer period.

### *Korea*

Approximately 100 Signal Corps officers from all over Korea recently gathered together at the Chosen Hotel, Seoul, Korea to attend the last meeting held under the leadership of Col. William Gaeckle, chapter president.

Coincident with this meeting was the periodic visit of Gen. Harold Hayes, Signal Officer, Army Forces, Far East, who attended the dinner and spoke briefly to the group.

Colonel Gaeckle, who left Korea on December 1, relinquished his gavel and chairmanship to Col. Walter E. Lotz, Signal Officer, 8th Army. Colonel Lotz will act as chapter president pending submission of a new slate of officers for 1957 by the nominating committee.

Shown at the Baltimore Chapter meeting held at the Bendix Radio Division, Bendix Aviation Corp., are, left to right, William E. Cleaver, Bendix Radio General Sales Manager; Chapter President George C. Ruehl; E. K. Foster, Vice President and General Manager, Bendix Radio; and Mrs. Foster. The program included a tour of the new Engineering Building of Bendix.

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Robert Dirkes, Western Union assistant vice-president, explains his company's latest facsimile equipment to Col. Murray D. Harris, Northeastern University PMS&T, at a recent meeting of the Boston Chapter. Looking on are, left to right Maj. Wilbur DePauw, Boston Army Base; Elmer Cutts, WU area superintendent; V. L. Hughes, WU Eastern Division manager, private wire sales; David R. Hull, Raytheon vice-president; Chapter President Fred E. Moran; and George G. Creal, WU general manager.

The gathering was honored by the presence of Brig. Gen. Briand I. Johnson, Commanding General, Eighth Army Support Command; Brig. Gen. Charles R. Bixel, Acting Chief of Staff AFFE/8A (Korea); Dr. E. T. Cho, retired Chief Signal Officer, Republic of Korea Army; Col. Robert W. Duke, G-4, Eighth Army; Col. Mabry G. Miller, G-4, Eighth Army Support Command, and Col. John Grant, Signal Officer, First U.S. Army Corps.

The speaker for the evening was Grant Whiteman, deputy director of the Office of Economic Coordination for Korea, who described the role of the Office of Economic Coordination with particular reference to the program for Korean self support. A veteran of many years of experience in the Far East, Mr. Whiteman emphasized the need for stimulating Korean economy and described the several programs that have been initiated to accomplish this task.

### Lexington

In a speech at the October-November meeting, Maj. Gen. W. Preston Corderman, Deputy Chief Signal Officer, praised the organization as "an indispensable reservoir of know-how and experience."

Speaking to the group at a dinner-meeting at the Lexington Signal Depot, the General stressed the importance of co-operation between the Armed Forces and civilian enterprise.

General Corderman, speaking of the reorganization of the local group, praised Jack Davis, Bill Jordon, Harry Huether and Byron Cracraft as men who "remained stalwart members of the Association during the few lean years and were on hand to spark the rebirth of the Lexington Chapter."

Commenting on the defense program, the General stated that the "ever present danger of a shooting war makes it imperative that the civilians on duty at armed forces installations, scientists in the universities and laboratories, and the people in industry and commerce work in unison on the defense effort."

He stated that the notion "that war can be quick and relatively painless" is a fallacy. "Push-button warfare is not here," the General declared, "there is no super-weapon guaranteed to achieve victory.

"In this connection," he said, "the Army recognizes the need for versatility and has made a major reappraisal of the way the army of the future may fight."

The future army will fight on an atomic battlefield "vastly increased in depth," with widely dispersed units. Consequently, the victory will come to the side possessing superior mobility to exploit the effect of weapons with greatly decreased fire power. Units of the future will be "semi-independent and self-contained," he stated.

"With the increased emphasis on control of widely dispersed units, the importance of communications has increased greatly," he added.

Approximately 150 members, their guests, and conferees, who were at the depot for a conference, attended the meeting.

Maj. K. J. Holmes, chapter president, introduced to the group, Mr. Edward J. Brown, Jr., and Mr. Raymond Soard, Jr., who recently were elected first and second vice presidents of the chapter.

### London

For its October meeting, the chapter visited the Research Station of the General Post Office at Dollis Hill.

The group was taken by guides to see the experimental facilities of the station. Brief explanations were given about some of the projects being carried on there. The British part of the experimental work on the transatlantic cable which was developed at Dollis Hill was also explained to the members.

After dinner, the program of the research station was further outlined by the Controller of Research, G. J. S. Little, C.B.E., G.M. He and his colleagues answered questions and discussed special projects with members who had specific interests. Brig. L. H. Harris, C.B.E., a chapter member, also answered particular questions.

### *Louisiana*

Brig. Gen. Paul L. Neal, communications consultant, Government Relations Dept., Western Union Telegraph Co., was the guest speaker at the chapter's December meeting.

General Neal, who spoke at three chapter meetings in the Southwest, encompassed in his speech an evaluation of record communications from the days of Morse to the present time. He also gave a crystal ball look at the future of record communications.

For a further report of the General's speech, see news of the South Texas Chapter and page 67.

### *New York*

Dr. John P. Hagen, project director of Vanguard for the Naval Research Laboratory was the guest speaker at the October 31 meeting.

Colonel Percy G. Black, AFCEA national president, gave a brief report on the continued growth of the Association. He stated in this report that the Association's membership is well over 9,000 and that it is still growing.

Dr. Hagen addressed the meeting on "The Earth Satellite Program." Using colored slides, he described the background for this scientific program to be held during the International Geophysical Year.

He explained that the satellites to be used to gather scientific data about the upper regions surrounding the earth will be launched by means of three-stage rockets. Dr. Hagen described these satellites as approximately 20 inches in diameter and as weighing about 11 pounds.

Dr. Hagen stressed that radio communications will play a most important part in the Earth Satellite Program because they will be depended upon to transmit data from the satellites to the various scientific laboratories established to record and analyze the information.

The speaker of the evening at the chapter's November 28 meeting was Maj. Gen. J. D. O'Connell, Chief Signal Officer of the Army, who spoke on "The Army in the Missile Age."

General O'Connell's talk was interspersed with film clips, illustrating the many new weapons and missiles and many of the electronic devices for "Command Control" used by our modern army.

To complement this equipment, he stated that the Army needs intelligent, competent service personnel. To illustrate his point, he introduced Sergeant First Class William Ames of the New Equipment Devices Section of SCEL at Fort Monmouth. The General said that Sergeant Ames, a Bronze Star combat infantryman of World War II, was typical of the modern career soldier-technician the Signal Corps has been developing.

### *North Texas*

Brig. Gen. Paul L. Neal, consultant, Government Relations Department, Western Union Telegraph Co., spoke before chapter members December 7.

General Neal, who gave a series of addresses to the Southwest AFCEA chapter, showed the group a collection of slides illustrating his talk. The slides included pictures of the latest Western Union equipment as the receiving and transmitting positions at United Air Lines, a typical torn tape console and the Ticket Fax, main office equipment. For further notes on his speech, see South Texas news.

### *Northwest Florida*

Floyd H. Gleason, Collins Radio Co. engineer, presented the Collins Integrated Flight Display to chapter members at a dinner-meeting, November 15.

Maj. Gen. James D. O'Connell, Chief Signal Officer, who was guest speaker at the New York Chapter's November meeting, is shown with Chapter President S. F. Patten and Col. Arthur A. McCrery, CO, Army Pictorial Center.

Lexington Chapter's October meeting was addressed by Maj. Gen. W. P. Corderman, Deputy Chief Signal Officer. Pictured with General Corderman are five members of the original Kentucky Chapter who were active in its reorganization as the Lexington Chapter. Left to right, Byron E. Cracraft, Bill Jordan, Hubert Jones, J. H. Davis and Harry J. Huether.

**Mr. Gleason opened his presentation with a brief historical sketch of navigational aids and traced the advances in** design, which have been necessary because of the ever increasing speed of flight, to the present day integrated flight instruments.

He then pointed out that the reduction in the number of flight instruments is of primary importance especially for pilots of high performance aircraft.

### *Orange*

James E. Gardner, executive vice president, Wilcox Electric Co., was the principal speaker at the chapter's November meeting.

Speaking on the technical advances of communications and electronics, Mr. Gardner discussed engineering, development, design, and manufacture of the modern "black box." He stated that while tremendous strides have been made in the capabilities and dependability of electronic devices, they, like all things, are not perfect.

**In his speech, Mr. Gardner stated that the AFCEA was the best platform to provide a meeting ground for the** suppliers and the users, and that through the AFCEA, a more positive check on the source of supply of communication and electronic engineers and technicians could best be kept.

### *Pittsburgh*

"Two Modern Miracles," an illustrated demonstration of two of the greatest scientific achievements of our time, Direct Distance Dialing and the guided missile, Nike, was presented to chapter members on October 18 at the Bell Telephone Building.

R. G. Fithian, sales manager of Bell Telephone Co. of Pa. in Pittsburgh, presented the lecture-demonstration which showed how essentially the same equipment and techniques, which automatically pinpoint the one telephone you want to reach out of the 56 million telephones now in service, will, should war come to us, assist in finding and **destroying enemy bombers before they unleash their devastation on our larger cities.**

A comprehensive tour through the Westinghouse Research Laboratories was arranged with the help of John C. R. Kelly, Jr., manager of the Technology Department, for the chapter's November meeting.

The trip enabled chapter members to see into the electronic future through the eyes of Westinghouse.

### *Rocky Mountain*

The following slate of officers for 1956-1957 was chosen at the chapter's last meeting: president—Bryon E. Thady, Mountain States Telephone Co.; vice presidents—Marion F. Sanders, Hq., Air Defense Command; Lt. Col. Sam Jacks, USA, and Capt. Arthur A. Fox, USAF; secretary—Capt. F. D. Tappin, USAF; treasurer—Capt. B. L. Shelton, USAF; directors—Lt. Col. C. A. Baril, USAF; Maj. D. W. Camp, USAF; Maj. J. W. Claney, USAF;

Six admirals were among the New York Chapter members who greeted Dr. John P. Hagen, project director of Vanguard for the Naval Research Laboratory, and Percy G. Black, National AFCEA President, at the October meeting. Left to right are: Rear Adm. Roy W. M. Graham; Rear Adm. Leslie A. Kniskan who was host to the chapter as commander of the New York Naval Shipyard; Rear Adm. Stanley F. Patten, chapter president; Dr. Hagen; Col. Black; Vice Adm. Walter S. Anderson and Rear Adm. Ellery W. Stone. Also present but not in the photograph was Rear Adm. William C. Organ.

Maj. R. J. Steamer, USAF; D. A. Doty, Philco Corp; J. L. Faber, Mountain States Telephone Co.; M. M. Mintz, D and M Electronics Corp.; Warren Moser, Philco Corp.; J. M. Shepherd, Mountain States Telephone Co.; G. M. Ward, Jr., Radio Corporation of America.

### *Rome-Utica*

The atomic age and its impact upon "Communications in Underseas Warfare" was the topic of the lecture delivered by Frank C. Lynch, operations research manager of the General Dynamics Corp., Electric Boat Division, at the chapter's October meeting.

Mr. Lynch, a retired Navy captain in the submarine service, vividly traced the history of the submarine from its earliest conception by Leonardo Da Vinci to its present atomic day appearance as represented by the *Nautilus*, the first atomic-powered submarine, produced by the General Dynamics Corp. shipyards at Croton, Conn.

A movie covering the construction of the *Nautilus* and its launching, which was produced by the corporation, was shown after the lecture.

Some 75 persons heard a talk and saw a film dealing with communications cable at the chapter's November meeting.

E. Mark Wolf, assistant chief engineer at Rome Cable Corp., was speaker. He showed a film entitled, "Cables—Pathway of Power," and briefly reviewed the history of the communication cable, its development and manufacturing.

He pointed out that it is surprising to most people that until early in 1956 when the transatlantic telephone cable was put into operation, all transatlantic telephone communication was via radio.

"Prior to this year, a cable capable of fulfilling this requirement was not available," he explained.

### *Seattle*

W. T. Harrold of Radar Engineers, Inc., discussed and demonstrated a Cable Fault Finder Set developed and manufactured by his company at the chapter's November 14th meeting.

The Cable Fault Finder, a small, compact unit with a range of 200 feet, is designed specifically for detection of faults in electrical and communication cables on shipboard and aircraft. Operating on the radar principle, with irregularities in cables being indicated on a calibrated scope screen, it can detect openings and shorts, and can be used to check impedances.

### *Scott-St. Louis*

Robert I. Colin, assistant to the vice president and technical director, Federal Telecommunications Labs, Nutley, N. J., was the guest speaker at the chapter's November 2 meeting.

The subject of Mr. Colin's speech was "TACAN Radio Bearing and Distance System for Aerial Navigation."

**An expert in the field of radio naviga**tion, Mr. Colin has had first hand familiarity with the development of TACAN.

## *Southern Connecticut*

The first meeting of the new season for the chapter was held on November 7th in Bridgeport, Connecticut.

The highlight of the evening was a talk by Mr. Robert A. Curran, vice president and chief engineer for Insulated Circuits, Inc., on the general subject, "New Advances and Techniques in Printed Circuits."

Mr. Curran described some of the new advances and some of the new possibilities available to those interested in using printed boards. Advantages which include cost reduction, miniaturization, and the possibility of mass production on short notice were all cited. As one example of simplification, Mr. Curran mentioned a case wherein an order for the design and production of one new printed board replaced what had previously been accomplished by the issuance of twenty-seven individual purchase orders. Although still in the developmental stages, the possibility of automatic assembly is envisioned for the near future.

Head table at Scott-St. Louis Chapter's November meeting. Left to right: Allan L. Eisenmayer, chapter secretary; Robert I. Colin, Assistant to the Vice President and Technical Director, Federal Telecommunications Laboratories, who addressed the chapter on TACAN; Chapter President Walter W. VanSkiver; Louis E. Dechant, chapter director; and Richard W. Hilgard and Louis E. Dechant, Jr., guests.

## *South Texas*

At the chapter's December 5th meeting, members and guests heard Brig. Gen. Paul L. Neal's speech on "Record Communications" at the Fort Sam Houston Officers Club.

In his timely lecture, General Neal, who is consultant, Government Relations Dept., Western Union Telegraph Co., discussed the past, present, and future of Record Communications.

In speaking of its history, General Neal said, "The evolution of telegraphy has been typically American in that **it never followed a middle-ot-the-road** path. Morse's first receiving machine was a recorder printer which printed the dots and dashes of the Morse Code. Operators soon learned to interpret the sounds made by the recorder and converted them directly to writing and thus created the profession of 'telegraph operator.' The recorders were junked and for many years the key and sounder ruled the roost. The evolution of the keyboard teleprinter, utilizing the five unit Baudot Code, has swung the pendulum back to recording methods as standard practice."

General Neal also thoroughly discussed the future. He noted that "Facsimile transmission from the sender to the addressee would be an almost ideal method of handling record traffic. Banks are now using it for signature and balance verification between main offices and branch banks. Personal messages could be in your own handwriting and business traffic could include sketches, tabular forms of any sort, and authentic signatures."

Officers for 1956-1957 season were elected at this meeting. They are as follows: president—Col. Albert J. Snider, 1822 AACS Group Commander; vice presidents—Lt. Col. Carl O. Duncan, Deputy Chief Signal Officer, 4th Army; Branch T. Masterson, Hearst Advertising Service, and Ralph N. Ness, Graybar Electric Co.; secretary—S. J. Keane, Southwest Research Institute; treasurer — Capt. Blaine B. Shockey, U.S. Air Force Security Service; directors—Maj. Gen. Harold H. Bassett, U.S. Air Force Security Service; Maj. Gen. Harry Reichelderfer, Deputy Commander, 4th Army; Col. George Richon, Signal Officer, 4th Army; Charles Albach, Western Union Telegraph Co.; Henry S. Dunn, Base Communications Office, Kelly AFB; **Ben Givens, Southwestern Bell Tele**phone Co., and S. H. Simpson, Jr., Southwest Research Institute.

## *Tinker-Oklahoma*

At the October meeting, the principal speaker was Dr. Ronald B. Shuman who gave an address on "Automation What It Will Do To You."

Dr. Schuman, who is a research professor of management, University of Oklahoma, stressed that automation is not a new or coming thing, but that it has gone hand-in-hand with the dynamic technological advance associated with the industrial revolution. He presented a broad picture of the effects of automation on our economy, labor, management, and the United States citizen in general.

At the close of the meeting, the members and guests were able to see a display of some of the late communications, photo, and electronic gear demonstrated. The display was furnished by the Southwestern Bell Telephone Co. and the Dorsett Labs., Norman, Oklahoma.

Otis Howard, manager of operations, Oklahoma Gas and Electric Co., was the principal speaker in November.

An outstanding authority on the peaceful uses of atomic energy in generating electric power by the process of nuclear fusion and fission, Mr. Howard spoke on "Atomic Energy in Power Generation." He discussed the plans concerning the construction of a nuclear power generator in the Southwest.

## *Washington, D. C.*

Members of the Washington Chapter met on December 6th at the Willard Hotel in Washington, D. C. Guest speaker was Rear Admiral J. H. Sides, USN, whose speech can be found on Page 19 of this issue.

Anything that can be postulated is possible, says science—including *timelessness.*

The latest table-talk among the rocket and missile men has to do with the physics (and metaphysics) of photon propulsion: thrust for a space vehicle derived by shooting incredibly concentrated beams of light (photons) from its tail. Result—speeds approaching that of light! Round trips to distant galaxies could thus be accomplished in a single generation of the crew. Meanwhile, however, the Earth would have passed through a billion years—possibly into cosmic oblivion!

The space-time ratio is increasingly a factor in the calculations of a brand new field of science known as astronautics...Work in this field at Martin is already at the threshold of tomorrow.

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# ITEMS OF INTEREST

## From Government, Industry and the Services

### New Intercept System

A new ground control intercept system to provide the United States with improved air defense capability has been developed by the Heavy Military Electronic Equipment (HMEE) Department of the General Electric Company.

Nomenclature for the system is the AN/GPA-37 Radar Course Directing Group. The equipment operates on the principle of "electronic automation." This factor is increasingly important to Air Force intercept systems where human error, or excessive time in computation, or transmission of control signals to our interceptors could be disastrous.

The AN/GPA-37 system would receive signals from large ground radars within the Air Defense Command and, by properly utilizing these signals, solve the intercept problem to direct our interceptors to the proper position to destroy the potential bombers. It would then compute and automatically transmit the necessary commands to cause the interceptor to follow the optimum computed path. In the interceptor itself, these signals are automatically incorporated into the fire control system rather than being sent as a verbal command to the pilot as has been done up to this time.

### First Test of Dualex System

The demonstration of the marine Dualex alerting and selective signaling equipment has recently been held on the Great Lakes. The two week project was undertaken through the study on marine radio alerting and call selectors which Congress has ordered.

Dualex, the first system of marine automatized radio record communications, consists of a two-tone tape printer and a digital selective calling system. It was praised as having been totally effective and giving no false alarms during the period of observations of the tests on the 500 KC distress frequency up to distances of more than 200 statute miles. The unattended printer has an automatic transmission capacity of up to 120 words per minute.

It was noted that the cargo ship, *John C. Munson*, used the Dualex system for communications of the vessel as well as the testing on the distress frequency during the entire two weeks.

Displayed above is the operation of the new ground intercept system. Developed by G-E, it receives signals from radars within the Air Defense Command, computes them and directs our interceptors to the proper position to destroy potential bombers. These signals are automatically incorporated into the fire control system rather than being sent as a *verbal* command as has been previously done.

### Greater Accuracy of Measurement With Constants of Nature

The National Bureau of Standards recently presented a research paper on the advantages of expressing measurements of length and time in terms of constants of nature.

At the present time, the U. S. standard of length is a platinum bar one meter long kept at NBS. This bar has proved accurate to within about three parts in 100 million but it is believed that even greater accuracy is possible with wave lengths of light. They have a comparable precision of about one in a billion and it would be relatively simple to establish the unit of length any place in the world. The paper suggests that the red light from a cadmium atom would be an excellent yardstick and the precise measurement of length would be so many spectral lines per meter.

The calculation of time, based on the earth's rotation on its axis, has shown some slight variation over the years. To obtain a constant of nature as a base for calculating exact time the scientists turned to the cesium atom. Atomic vibrations are extremely stable and time could be expressed with a high degree of accuracy in terms of frequency per second.

### Contract for Long-Range Radars

The largest single purchase of electronic equipment in its history has recently been made by the Civil Aeronautics Administration, who has contracted with Raytheon Manufacturing Company for 23 long-range radars.

These radars, which will be designed and built by Raytheon at a cost of $9,000,000, will form part of an expanding coast-to-coast traffic network. CAA plans to install them at 23 of their 28 locations across the country. Information from military radars will be used at the remaining 5 locations.

In addition to this, approximately $21,000,000 was obligated for new air navigation and traffic control facilities during the fiscal year beginning July 1, 1956.

### "Milking Machine"

An investment of $900 for an automatic defect-finding machine has saved the U.S. Signal Corps about a quarter of a million dollars. The Lewyt Manufacturing Corporation has developed and built the machine in an effort to reduce costs.

The "Milking Machine," so called because of its many electric cables that reach down from the equipment's "belly" for test work, saves up to 57 percent of labor required for the testing of intricate Signal Corps transmitters and receivers. It insures a

E. H. RIETZKE, President CREI
Capitol Radio Engineering Institute

*• One of a series of institutional messages*

The President of CREI asks:

"You can lead a man to knowledge . . . but how do you make him think?

# CREI Technical Courses Now Mold Desirable Job Attitudes as Well

Since October 1, 1956, CREI has included in all its technical courses a section on Leadership training administered by the Holmes Institute Division of CREI. The names of these courses are: "Moving Ahead On the Job" . . . "The Techniques of Handling People."

From the point of view of student acceptance, this has been probably the most successful addition ever made to CREI's accredited technical institute curricula in our 29 years of training technical personnel for industry and the military service. More than 5,000 students already have been enrolled under this new plan.

From yet another point of view — management's search for attitudes of cooperation and leadership — this addition has been most successful. These men are not only becoming better technical men —*they are also becoming better employees!*

**Mr. Electronics Executive: Mr. Military Officer: Wouldn't you like to have your technical personnel do this kind of thinking?**

*(An actual statement taken from the examination paper of a CREI student—a man with 12 years of professional experience in electronics)**

"When I first started this course, I thought to myself: Why everyone knows these things. After the first chapter or so, I decided that maybe there was really something here that I could use. So I stepped back and took a look at myself. What I saw I didn't like too well. I then went back and started reading again from the beginning. As I went, I checked all of the guide points and the 'do's and don'ts.' It surprised me to find out that upon being truthful with myself, I came out about 50-50. I have made a list of things I have to watch out for and the traits I want to improve or get rid of completely. This list I intend to follow and do my best to improve.

"I wish to say at this time that this is the first time in a good number of years that I have found a course in leadership which was written for people like me who really do need the help; most courses are just a bunch of ideas; this course anyone can understand. I think I have learned much and hope I can put into practice what I have learned."

**Name on file*

We believe the words of this student best describe to you our new training program. In teaching *Leadership*, and getting men to THINK, CREI is supplying that *extra plus* that makes a man more than a good technical man. CREI graduates will have the ability and concept to think above and be interested beyond a particular job assignment. For detailed information about this, or any other phase of CREI's Home Study or Residence program, and how it can help with your technical manpower or training problems, please write directly to: E. H. Rietzke, President.

**FOR YOUR SUPERVISORY TRAINING:**
*The Leadership section described above is also available separately, in complete form, for your own training of supervisory personnel. Details will be sent on request.*

## CAPITOL RADIO ENGINEERING INSTITUTE

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uniform yardstick for testing, which eliminates human error. Using an approved transmitter or receiver as a standard unit, the machine compares circuit with circuit, with defects clearly indicated to the tester.

More than 50,000 man hours, representing about a quarter of a million dollars, have been saved for the Signal Corps by using the machine. The equipment has tested more than 30,000 transmitters and receivers, ordered in multi-million dollar contracts.

## New Radar for USS Gyatt Terrier

The Terrier Missile System installed aboard the *USS Gyatt*, the Navy's first guided missile destroyer, combines for the first time a gun fire control system with radar guidance equipment.

A slim needle-nosed supersonic weapon, the "Terrier" is designed to intercept aircraft under all weather conditions night and day. While similar to the radar guidance equipment previously designed and built by Reeves Instrument Corp. for the "Terrier" systems installed aboard cruisers, it is more compact, has greater range and precision, is capable of self-monitoring and requires fewer men for its operation..

When the approach of an unidentified plane is indicated on the radarscope, certain signals are generated which identify the plane as friend or foe. If the approaching aircraft is identified as an enemy plane, the radar continues tracking the target, and relays necessary information to the missile launching computer for the firing of the missile being used to shoot down enemy planes. A closely interrelated data system between the radar, the launcher, and the missile itself then shoots the missile into the radar beam and the missile is guided by the radar to intercept and destroy its target.

## New Picture Making Technique

A new photo sensitive plastic which could be used militarily for printing photographs in areas affected by atomic radiation has been developed by the Army Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey.

Ordinary photographic papers tend to fog under nuclear radiation but the new plastic is almost unaffected by gamma rays and therefore has a particular military value for use in "hot" areas. Pictures made by using the plastic process are clear, durable, waterproof and are stronger than today's paper prints.

New "Terrier" Radar for Gyatt.

The process, discovered by the Ferro Chemical Company of Bedford, Ohio, offers other important military advantages: No water is needed and only a limited amount of equipment is required in the new system; neither chemicals nor a darkroom are required; a sunlamp takes the place of an exposure light and an oven replaces the trays of hypo and developing solution; and total developing time is five minutes.

To produce a plastic print, an aluminum plate coated with a special vinyl is placed under a negative, as in conventional printing. It is then exposed to strong ultraviolet light for five seconds. The light rays from the mercury-arc lamp burn an invisible image into the plastic. Baking at 320 to 350 degrees Fahrenheit brings out the picture. In five minutes, the plastic can be stripped from the metal as a finished print.

Developing paper used by photographic laboratories today must be handled in the dark or in dim amber light. However, Signal Corps scientists at Fort Monmouth develop their plastic pictures in a "darkroom" with the lights on. Since the vinyl is sensitive only to ultraviolet, it can be exposed safely to the electric lights of an ordinary room.

## New Signal Corps Microfilms

Microfilm "windows" in tabulating cards, used for transmitting engineering drawings, are expected to save nearly a half million dollars annually in the Army Signal Corps procurement program. The special machines used in this process are built by Recordak Corporation.

Over 300,000 engineering drawings have been microfilmed at Fort Monnouth, N. J. Positive film prints, nade from the original microfilm egatives, are being mounted in the abulating aperture cards. They will e distibuted to various Signal Corps nstallations for reference in repair nd overhaul of signal equipment and or procurement purposes.

**Shown above is the new microfilming process used by the Army Signal Corps to transmit engineering drawing. Positive film prints are mounted in the tabulating aperture cards.**

They will be used to make reduced size paper prints to use in issuing bids to industry. The new system replaces the old costly method of making full-size paper reproductions of drawings.

## U. S. to Spend Record Sum for Defense Next Year

The American citizen's defense bill for military spending next year will be the biggest yet under the Eisenhower Administration reports the December issue of *Fortune* Magazine.

Even before the recent upheavals in Eastern Europe and the Middle East, the Administration was resigned to an outlay of about $38 billion during fiscal 1958, an increase of $2 billion over current fiscal 1957 expenditures. Now, confronted with a newly threatening world situation, coupled with deep-seated dissatisfaction with their allotments by all three military services, and a Service-minded Democratic-controlled Congress, President Eisenhower may find it necessary to spend even more than that. The services' own "flash" estimate of their next year's needs is 48.6 billion.

Two factors in particular account for the rise in the cost of national defense. First, direct cost charged to personnel is running at the rate of nearly $10.5 billion a year, or 30 percent of all Pentagon expenditures.

During 1958-60 it is expected to rise by another 35 per cent. The other factor is the extremely high cost of new weapons. In the current budget "major procurement and production" takes about $10.6 billion, with 70 per cent going just for aircraft and guided missiles.

Here are some of the particular items that will contribute to the new spending record forecast by *Fortune:*

The Air Force will spend upwards of $7 billion in the next four years on its Intercontinental Balli tics Missiles program. Costs of underground sites for launching the missiles range as high as $600,000 apiece. Sites will number in the scores.

The Army claims that to enlist one American, clothe, house and feed him, put an effective weapon in his hand and move him about the world now costs between $12,000 to $13,000 a year, and will soon rise to $16,000. Twenty years ago the cost was only $2,700.

The Navy is seeking to add nuclear propulsion to the next carriers in the *Forrestal* category. This change would raise their cost $100 million or so above the present price tag of $190 million.

The Navy and Marine Corps got nearly $10 billion for fiscal 1957, and were down for the same figure next year. Now the Navy maintains it ought to have $13 billion.

## Ballistic-Launching Ship Commissioned

The U.S. Navy's experimental ship, *Compass Island,* forerunner of a fleet of nuclear-powered, ballistic missile-launching vessels, was commissioned recently.

A converted Mariner-class cargo vessel, the *Compass Island* is being equipped with "the most fantastic array of navigation instruments ever assembled in a ship," the Navy said. Its mission is to speed evaluation of new inertial aids for precise mid-ocean navigation and to expedite launching of the Fleet Ballistic Missile.

The ship's inertial navigational system (SINS) is the key to its all-weather, all-latitude, day and night capability. This system, which also includes celestial trackers, is a new development of the Navy's Special Projects Office of the Bureau of Ordnance and Sperry Gyroscope Company. The system determines ship position (latitude and longitude), true North, and the ship's speed over ground.

The ship uses an electronic star tracker. There is a dome on the navigation tower which resembles a small observatory. On this is set a telescope which requires no observer —where the human eye would normally play its part is a photo-electric cell, so sensitive that stars become visible in daylight.

Sperry Gyrofin ship stabilizers are also utilized on this ship. This stabilization is of extreme importance to the launching of missiles. While sister ships may be rolling 15 degrees, *Compass Island* will roll about a degree and a half. This is accomplished by underwater fins, one on each side of the vessel, approximately midway between bow and stern. The action of the fins is automatically controlled from the bridge by instruments which measure roll rate, roll angle and roll

**Pictured on the right is a Sperry Gyrofin ship stabilizer which is being utilized on the Navy's experimental nuclear-powered, ballistic missile launching vessel, the Compass Island. The Gyrofin is very important to the launching of missiles. While sister ships may roll 15 degrees, Compass Island will roll only a degree and a half. This fin is placed midway between bow and stern on each side of the vessel and its action is controlled automatically from the bridge.**

acceleration. Gyrofin continuously computes the proper stabilizing moment and by its unique lift control feature assures accurate application of the stabilizing moment to the ship. These compact sensors then transmit, through magnetic amplifiers, the required anti-roll signals to hydraulic actuators which directly operate each fin shaft. The fins may be retracted into recesses in the hull when not in use.

### "PAGEMASTER"

Members of the staff of Strong Memorial Hospital, New York, are being paged quietly and individually through a new "Pagemaster" selective paging system, manufactured by Stromberg-Carlson, a division of General Dynamics Corporation.

With this system, the individual doctor or other staff member carries in his pocket a small radio receiver, about the size of a pack of cigarettes. This receiver is tuned to respond only to a certain coded signal. When that signal is received, the device emits a clear buzzing sound, which informs the person carrying that particular receiver that he is being paged. He then steps to the nearest telephone, identifies himself to the operator, and receives the message.

The paging signals are broadcast from a small radio transmitter, with its control panel, or "encoder," located at the hospitals' telephone switchboard within easy reach of one of the operators. Four diffierent numbers can be set into the encoder simultaneously, and the transmitter continues to broadcast each of them in turn until the number is switched off.

## Personnel

### General Reichelderfer Retires

Major General Harry Reichelderfer, Fourth Army Deputy commander, whose distinguished military career of almost 40 years was highlighted by service as a Signal Corps officer, retired November 30th at Headquarters Fourth Army.

His outstanding service in the Signal Corps has included the post of Sixth Army Signal Officer in World War II during the operations of the Sixth Army from New Guinea to Japan. After the war, he served for a brief period in the Office of the Chief Signal Officer, Washington, D. C., and then was assigned as Army Field Forces Signal Officer, Fort Monroe, Va. He later left there to assume command of the Signal Corps Training Center, Camp Gordon, Ga., which he reactivated.

In 1949, Brig. Gen. Reichelderfer became Commander of the Signal Corps Engineering Laboratories, after which he became Commander of the Signal Corps Center at Fort Monmouth, N. J.

In 1953, he assumed command and established the Southwestern Signal Corps Training Center at Camp San Luis Obispo, Calif., and the following year he was given the command of the Army Security Agency, Washington, D. C. This appointment preceded his last assignment.

## Dr. Crenshaw Made Chief Scientist

It was recently announced that Dr. Craig M. Crenshaw has been appointed Chief Scientist for Signal Corps Research and Development. His former position was that of Director of the Physical Sciences Division, Evans Signal Laboratory, Fort Monmouth, N. J.

Dr. Crenshaw was a Graduate Assistant at New York University where he received his Doctor of Philosophy degree in nuclear physics. The data he collected there was adapted as world standard for low energy end of nuclear Range-Energy relation. He is also the author and co-author of numerous scientific and technical articles.

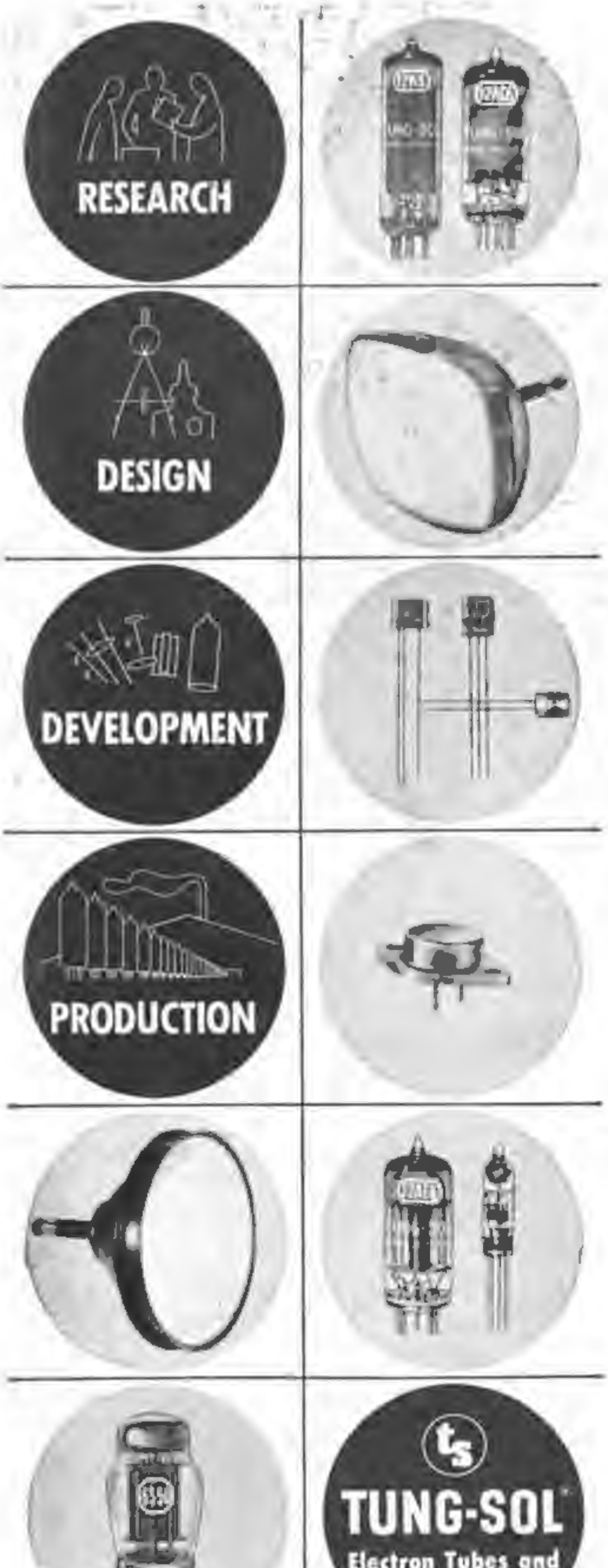
In 1942, he accepted the position of physicist with the Signal Corps Engineering Laboratories at Fort Monmouth. He directed Experimental Groups there for field operations of Operations Crossroads, Sandstone and Greenhouse.

## Hudgins New Executive Officer At Training Device Center

Commander William D. Hudgins has been named Executive Officer at the U.S. Naval Training Device Center, Sands Point. He will also serve as Administrative Director of many of the Center's key departments among which are Administrative Services, Industrial Relations, Public Works, Supply and Contracts.

Commander Hudgins has enjoyed a varied naval career and has filled several important billets in the past. During World War II he served as Radio Material Officer at the Naval Operating Base, Trinidad, British West Indies, where he was responsible for construction of major communications stations.

His former post was that of Commanding Officer of the Bureau of Ships, Industrial Manager Organization in San Juan, Puerto Rico. Here he directed and allocated ship repair and shore electronics construction work.



# PERSONNEL CLEARING HOUSE

## *AFCEA Members Available to Industry*

**The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ........, SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.**

District Sales Manager or Field Representative for electronics or associated firm. Excellent contacts with industry and Government agencies in 11 Western states. Fully cognizant of Western industrial expansion. Familiar with all Western Government projects and R&D operations. Capable of setting up Western office, advertising program, marketing, distribution program. Box 120.

Sales Engineer: Advertising—Sales Promotion Manager. Recent sales experience plus 10 years' experience in advertising and sales promotion of electronic products. Radio amateur for over 20 years. Age 37. Engineering education of 3 years and B.S. in Marketing degree. Prefer West or East coasts. Box 121.

Communications Specialist—Communications System Manager with leased long-line interphone experience plus 10 years military and civilian air traffic control. Broad background in electronics, air operations, and flight movement. AB and LLB degrees. Will consider any location. Box 122.

## *Government and Military Positions Available*

**Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.**

Ordnance Engineer ($7,000/year). Assistant Inspector of Naval Material, Germantown, Pa., has opening in development and production of ordnance equipment. Requirements: Bachelor's degree in engineering (or four years' equivalent experience) and 2½ years' engineering experience, one in ordnance engineering. Master's degree can be substituted for one year's experience; Doctor's degree in ordnance engineering can be substituted for all experience. For further information, write: Supervising Inspector of Naval Material, 17 Brief Ave., Upper Darby, Penna.

Electronic Engineers, Electronic Scientists, Mechanical Engineers, starting salaries $5,335-$6,390. Engineering Draftsmen, $3,415-$4,080. Vacancies now exist at the U. S. Navy Electronics Laboratory, a major West Coast scientific organization engaged in research and development of electronic equipment and systems. For further information address: U. S. Navy Electronics Laboratory, Civilian Personnel Division, San Diego 52, California.

Electronic Engineers: One Electronic Engineer (telephone) and one Electronic Engineer (radio), starting salary $6,390. Requirements are: degree in electrical engineering and 2½ years professional experience, one year of which must have been in the specialized field, or 6½ years professional electronic engineering experience. Applications should be forwarded to: Hqs., 5001 SU Station Complement, 5th Army, 1660 E. Hyde Park Blvd., Chicago 15, Illinois.

The Special Devices Center, an activity of the Office of Naval Research, located at Sands Point, Port Washington, Long Island, has several vacancies for electronic engineers at $6390 a year, and one vacancy for a general engineer at $6390 a year which requires specialized experience in audio-visual recording. Inquiries should be directed to the Industrial Relations Officer. Telephones: Flushing 7-8300 and Port Washington 7-3800.

Radio Operator Technicians. Veterans $3400-$4200 to start. Overseas opportunities. Amateur or commercial licenses helpful. Full pay during advance training. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, private training, work experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Teletype Operators and Cryptographic Technicians. Veterans $3200-$3700 to start. Overseas opportunities. Full pay during training period. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

# project VANGUARD poses a problem . . .

$$V = \int_0^t a\,dt$$

provide a
CONTINUOUS SOLUTION
to this time integral . . .

## . . . and **REEVES** comes up with the solution

Placing the earth's satellite in its pre-determined orbit requires precision to the nth degree. The second-stage of the three-stage rocket which will carry the satellite up to its orbit must be separated shortly before its trajectory bends back towards the earth.

Separation of the second stage is controlled by a coasting time computer designed and built for the Martin Company of Baltimore by Air Associates, Incorporated.

The Reeves Instrument Corporation has designed and is building for Air Associates the "speedometer" needed for computing the second-stage coasting time as a function of the burn-out speed. Essentially an integrating accelerometer, it provides a continuous record of velocity as the rocket speed builds up and feeds this information into the control unit's computer.

The control unit, after the computed coasting time has elapsed, triggers the system. Stage two is separated and stage three gives the satellite the final acceleration required for insuring that the satellite circles around the earth.

Because of its vast experience in design of precision gyros and accelerometers, Reeves has been assigned the task of developing an important instrument for use in one of man's great ventures, Project VANGUARD.

17RV56A

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# NEW PRODUCTS from Industry

### *EIMAC Announces Giant, Super Power Electron Tube*

A giant, super power klystron, the largest electron tube ever developed, has been anounced in San Bruno, California, by Eitel-McCullough, Inc.

The new tube is capable of generating 100,000 watts of average radio frequency power and more than 1,000,000 watts of peak pulse power. It will be used in radar and linear accelerator operations. The new tube will increase the effectiveness of certain radar applications and offer new advantages to the processing of food, chemicals, plastics and petroleum.

### *Portable ABG*

An Alpha, Beta, Gamma detector has just been developed by Universal Atomics Corp., 143 E. 49th St., New York, N. Y. The all-purpose laboratory radiation detection monitor tracks down radiation dosage, leakage, accidental spillage, and contamination.

The unit can be pre-set to sound a loud warning and flash a light at a predetermined level of radio-activity, and it maintains constant vigil 24 hours a day. It reads up to 50,000 cpm and weighs six pounds. It comes with 25 feet of cable, and additional cable is available.

The instrument is encased in a lightweight, watertight aluminum suitcase (420B) or may be obtained in a sloping-front console (420A).

### *Quartz Crystals Critique*

An automatic multi-testing device for speeding up the production testing of quartz crystals used in radio and television communications is being built for the U.S. Signal Corps by Reeves Instrument Corp., a subsidiary of Dynamics Corp. of America, 25 W. 43rd St., New York 36, N. Y.

While designed primarily for testing the types of crystals used in military communications, and especially those expected to operate under extremes of heat and cold, the multitester could also be used to speed up production and insure greater uniformity in the quartz crystal units manufactured for commercial and industrial broadcasting.

**The world's largest electron tube—a ten-foot five-inch Klystron—is measured by W. W. Eitel, president of Eitel-McCullough, Inc., manufacturers of Eimac electron tubes. The new giant super power tube will be used in radar and linear accelerator applications.**

The automatic tester will encompass the whole test cycle for 100 or more crystals an hour. Under present methods of manual testing, skilled operators require fifteen to twenty minutes to check the variations in the activity and frequency vibrations of each crystal. The Reeves' tester will have five test sockets operating simultaneously and completely automatically.

A single console houses the instrument and contains both heating and cooling elements to check the accuracies of the operating frequency ranges under all kinds of climatic conditions.

### *Conelrad Radio Monitor*

The first Conelrad receiver which requires both carrier break and 1000 cps tone to activate an alarm is announced by Motorola Inc., Chicago, Illinois. The unit is designed to eliminate nuisance alarms caused by carrier break alone. It monitors standard broadcast stations for the Conelrad Radio Alert. F.C.C. regulations require land-mobile radio stations to make provisions for receiving this alert after Jan. 2, 1957.

A front panel switch permits the speaker to be muted for silent monitoring until an alert signal is received. Reception of the alert signal activates the front speaker, a front panel alert indicator lamp, and a pair of contacts for an external alarm device. The alarm remains activated until manually reset, assuring operator cognizance that an alert signal has been received.

Abnormal conditions are indicated separately from the Conelrad "alert" alarm by a "fail-safe" indicator lamp which lights when the received carrier is abnormally weak, entirely absent, or "on" but inoperative.

The unit plugs into any standard 117 VAC outlet. Size is approximately 21 x 9 x 12 inches and it weighs 29 pounds.

### *Frequency Computed in One Setting*

The "Calculaide Frequency Computer," devised by American Hydromath Corp., 25-20 - 43rd Ave., Long Island City, New York, correlates in one setting the physical dimensions of the coil and the capacity of the condenser with the natural frequency and wave length of the circuit.

Inductance values can be determined for widely varying physical dimensions of coils, from high-power transmitting coils to the smallest single-layer receiver coils. The computer's range covers frequencies from 400 kilocycles to 3,000 megacycles and wave lengths from .1 to 600 meters. It handles condensers of capacity between 1 and 1,000 microfarads. It computes inductance values from .05 to 1500 micro-henrys.

The computer, made of Vinylite plastic, is pocket sized.

### *Fuel Gauge Tester for Aircraft*

Telectro Industries Corp., 35 - 17th St., Long Island City 1, New York, announces the availability of the USAF Type MD-1 aircraft fuel gauge tester designed specifically to test and calibrate aircraft capacitance type fuel gauges.

The MD-1 tester qualifies under A.F. Spec. MIL-T-8579 and meets all requirements of this Spec.

The tester is a direct reading variable capacitor with a range of 10 to 6,200 uuf. The mina dial and vernier dial have a positive locking de-

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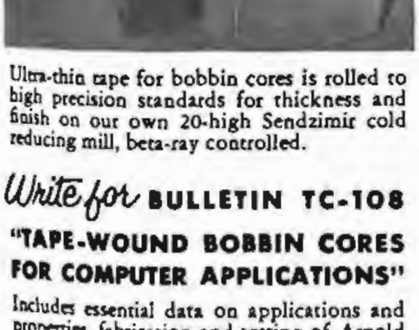

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Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps depending on the ultimate use of the core. Magnetic materials usually employed are Deltamax, Permalloy and Supermalloy, in standard thicknesses of .001", .0005", and .00025". Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation. • Let Arnold supply your requirements for Bobbin Cores—or other tape-wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry. wsw 6399

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vice and a mechanical arrangement that eliminates back-lash.

The tester is lightweight, portable, and sealed against moisture. No external power source is required.

### Plugboards to Test Aircraft

Dit-Mco, Inc., 911 Broadway, Kansas City, Missouri, announces Model 850 with plugboard multiplier to test aircraft. It is used in conjunction with the Dit-Mco Model 200 Circuit Analyzer.

The complicated circuitry of today's aircraft, missiles, and computers is undergoing constant design changes. For instance, constant design modifications and improvements in modern heavy bombers cause each ship to be slightly different from its predecessor. Previously this meant that the adapter cables of testing equipment had to be constantly modified to keep pace with the changes in the units being tested.

The Dit-Mco Model 850 enables testers to keep up with production modification without having to modify or rebuild the adapter cables. This is made possible by the plugboard programming. Comparable to a telephone switchboard, the desired circuitry connections are built up on the plugboard with phone-jack type patchcords. Therefore, the terminations of an aircraft's electrical system can be connected, with simple cables, to the terminals of the analyzer without reference to circuitry. The desired circuitry is then set up on the plugboard. The plugboard innovation offers new efficiencies and economies in testing.

Pictured here is Model 850 of Dit-Mco, Inc., an efficient plugboard multiplier developed to test aircraft circuitry. It is used with the Dit-Mco Model 200 Circuit Analyzer. The terminations of an aircraft's electrical system can be connected with simple cables to the analyzer's plugboard pictured at right, and the desired circuitry is set up on the plugboard. This enables testers to keep up with changes in aircraft circuit design without having to rebuild the tester's adapter cables.

### Improved Circuit Breaker

Several significant improvements in its miniature magnetic circuit have been announced by Airpax Products Co. of Baltimore, Maryland. This breaker is specially built for use in protecting electronic equipment.

Improvements over earlier units include extending the vibration resistance. The breaker is more tolerant of fluctuations in load current due to normal variations in line voltage. This miniature breaker can replace switches on electronic equipment and provide circuit protection as well.

### Ferrite Yoke Cores

A new ferrite "full-round" deflection yoke core for use in television picture tube assemblies has just been announced by the Allen-Bradley Co., Milwaukee, Wis.

The yoke core is pressed as a ring of perfectly uniform section and circularity. It is then "cracked" into two halves for later assembly over deflection coils and fitting to the tube. The mated halves are held together mechanically in shipment to avoid possible damage in transit.

Such perfectly circular yokes eliminate the grinding, fitting, and setting necessary with quarter-round sections. Inner and outer surfaces are always perfectly concentric and parallel. The result is better convergence, greater color purity, and reduced assembly time.

### New Television Tube

Type 6BY4, a new ceramic electronic tube, which will be employed in ultra-high frequency television receivers, features several refractory metals used by General Electric engineers. These metals, tungsten, molybdenum, tantalum, satisfy the stringent requirements placed on tube components during operation.

Sample quantities of tubes were produced in 1956. As in all triode tubes, there is a heater, a cathode, a grid, and an anode, but in this tube they are of microscopic size.

In its manufacture, the assembly is heated to 1,000°C., evacuated and sealed to form a compact unit.

This high temperature sealing prevents any gas release during normal tube types to operate at 400°C. to 600°C., far beyond the present temperature limits.

### For Radiation Accumulation

Lightweight dosimeter pens, that can be charged in a few seconds, measure accurately and safely all radiation accumulation. They are a safeguard in industry, civilian defense, and other areas, wherever radioactive material is found.

The pens are produced by Universal Atomics Corp., 143 E. 49th St., New York, N. Y. Each one weighs 1/3rd ounce. The metal case in which each is enclosed clips onto a pocket.

### Tiny Neon Lamp

A new subminiature neon lamp has been announced by the Circon Component Co., Santa Barbara, California.

The lamp is interchangeable in many assemblies with existing miniature aircraft lamps. It is considerably smaller than the previous flanged

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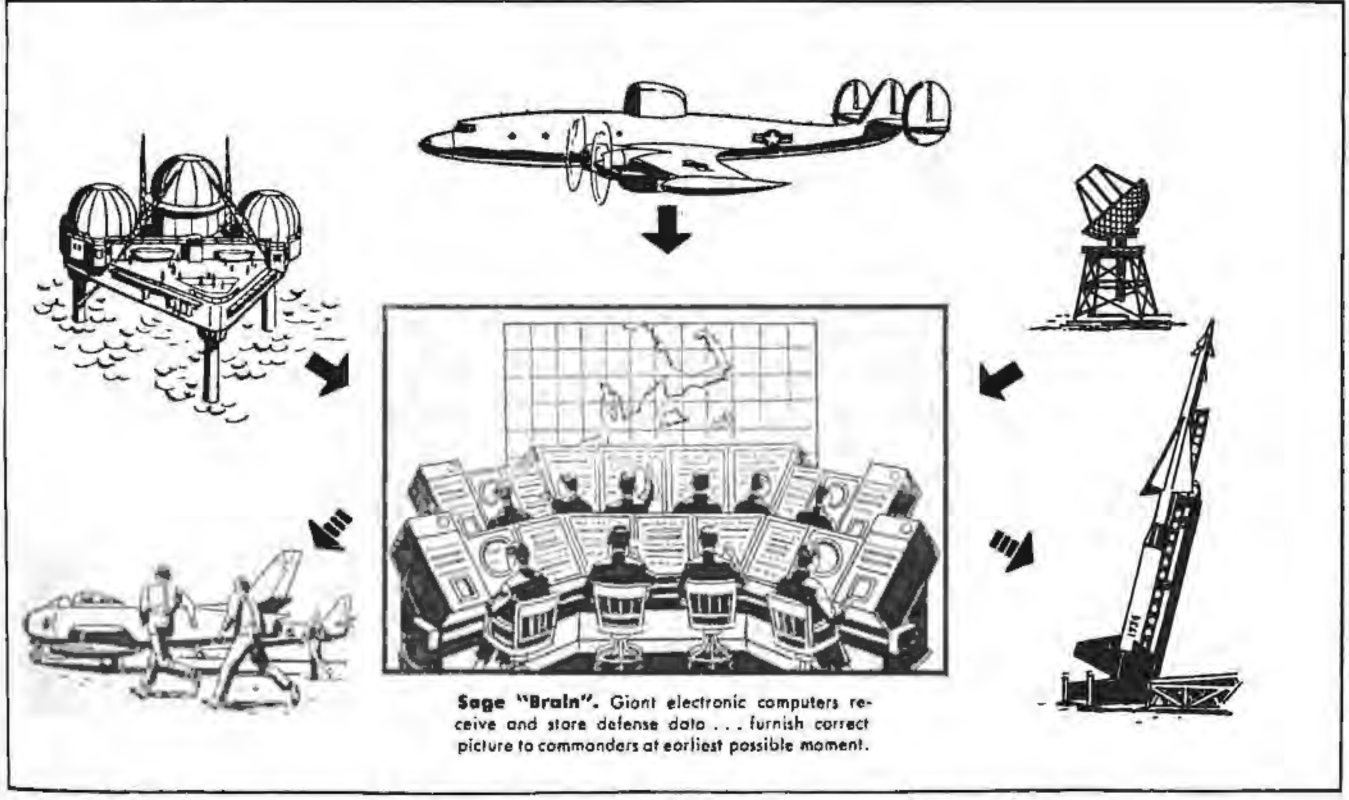

**Sage "Brain".** Giant electronic computers receive and store defense data . . . furnish correct picture to commanders at earliest possible moment.

New digital computer techniques and their application to radar data processing and weapons control have opened a new and expanding field of automation. The extensive classroom and laboratory training which precedes job assignment at Western Electric affords an excellent opportunity to enter this new and challenging electronics field as a part of the Bell System team.

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base neon lamps. It is useful in many indicator and computer applications.

The average life is over 25,000 hours. The lamp consumes only 0.04 watts, and gives off practically no heat.

## Memomotion

Time-lapsed motion picture photography was used once by Walt Disney to make flowers appear to grow in seconds, compressing hours of natural time into a matter of minutes.

An extension of this technique can be used by industry, by traffic studies, for visual records of instruments and processes, or for many other applications.

"Memomotion" can be incorporated into almost all good motion picture cameras. The camera records every event that occurs before it, and adjusts to record the scene at predetermined intervals. An hour's operation can be viewed in as little as four minutes when film is shot at one frame per second and projected at the normal speed of 16 frames per second.

The equipment has been developed by E. I. DuPont De Nemours & Co., Wilmington, Delaware.

## Cavity Oscillator for Aircraft

The new S-band cavity oscillator of Amerac, Inc., 116 Topsfield Rd., Wenham, Massachusetts, is especially suitable for aircraft, guided missile, and beacon applications.

It is a miniaturized, grid-separated, double coaxial line cavity oscillator. The light weight unit can operate with high efficiency under severe shock and vibration conditions.

Plate tuning is accomplished by a screw driver adjustment. A screw on the cathode section supplies sufficient tuning to accommodate differences between tubes. The overall length is 7"; the unit weighs 25 ounces.

## New Copper-Plated Communications Wire

A new type communications wire of high strength steel with a heavy copper coating has been produced by National-Standard Co., Niles, Michigan.

The biggest volume application of the new product is expected to be in telephone, telegraph, and railroad signal lines. The wire will meet multiple requirements of high tensile strength, electrical conductivity, and resistance to fatigue and corrosion. Heavier coatings were developed specifically to meet needs of the communications industry.

The new wire costs less than solid copper wire. Its reinforcing strength is such that one-third of the poles required for suporting solid copper wires can be eliminated. This presents a great saving to the industry.

Produced in all standard sizes, the wire has a wide range of strength and hardness. Initial production is concentrated on existing commercial specifications.

## Hyge Shock Simulator

A new device is now being manufactured by Consolidated Electrodynamics Corp's Rochester Division under license to Convair, a division of General Dynamics Corp.

This new product, the HYGE shock tester, makes it possible to simulate unlimited shock conditions with great accuracy. It was designed in order to test all components that must withstand high-level accelerations which are rapidly applied for sustained durations.

The arrangement of HYGE permits assembly into different forms for adaptation to specific problems. Giant units are designed to test objects as large as battleship components while smaller testers can he used on products as tiny and delicate as transistors.

Costs of operating are low and the HYGE is simple to install and operate.

## New VG Relay

The Electronics Division of Elgin National Watch Company, Elgin, Illinois, has developed for missile and aircraft applications a new VG relay series which is characterized by exceptional vibration and shock resistance.

The tiny relay has a vibration rating at 15 g's from 55 to 2,000 cps. Shock is rated at 100 g's.

In the subminiature class, the new VG relay measures slightly less than ¾ cubic inches and weighs 1.3 ounces.

# New Literature

## Contractors Guide Revised

The most recent, revised edition of "Contractors Guide" has been published by the Department of the Army. It is a reference for Army Research and Development (R&D) to aid potential contractors.

The guide tells how to draft a proposal, who to contact to submit the proposal, and how actual contracts are arranged.

Any organization may contact R&D, even though no specific project is proposed, as a possible candidate for future work that may be of service to the Army.

## BT Resistors Bulletin

Specifications and characteristics of Type BT Composition Resistors are covered in this 12-page bulletin. Detailed charts and graphs illustrate the data on construction, solderability, heat dissipation, resistance values, tolerances. Copies are available from International Resistance Co., 401 North Broad St., Philadelphia, Pa. Ask for Catalog Data Bulletin B-1A.

## Compressive Electronics Study

A publication, Electronics Test Equipment Descriptive Data Sheets, an outgrowth of an evaluation program of the U.S. Air Force, has been released to the public.

The five volume set is a comprehensive compilation of data on over 1300 electronic test equipments. Topics include voltage and current measuring equipment, signal generating equipment, active and passive networks, power and energy measuring equipment, waveform measuring and/or analyzing equipment.

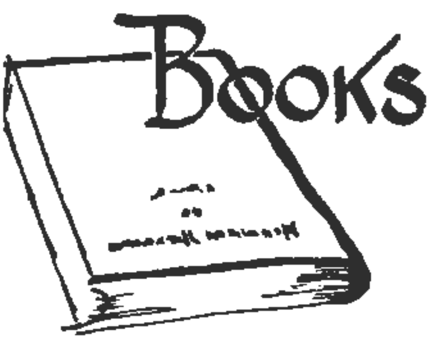
The volumes are bound in expandable, hard cover binders so that periodic "Additions & Revisions" can be added. The set is available from Carl L. Frederick & Associates, 4630 Montgomery Ave., Bethesda, Md. The price is $170.00.

## DATA Magazine

A new publication called DATA reports and predicts significant developments in the Armed Forces and Government agencies.

It covers government innovations in everything from atomic energy to transportation, yet it is concise and quick reading. Articles are pruned severely to save reader time, but important details—although skeletonized—are retained. Complete source material for a listed article is available to the subscriber at no additional charge.

Subscription rate for the magazine and associated follow-up service is $12.00 annually. Interested readers may address, DATA, Box 6026, Arlington 6, Virginia, to place subscriptions or request a sample no-obligation copy of DATA.



# BOOKS

***MAN OF HIGH FIDELITY: EDWIN HOWARD ARMSTRONG, by Lawrence Lessing. J. B. Lippincott Co., New York, N. Y. 320 pages, $5.00.***

Edwin Howard Armstrong, inventor of FM radio, was perhaps the last of the great individualistic inventors who refused to be swallowed up by the great industries. Armstrong's extreme independence colored the otherwise successful life of the inventor to the point of eccentricity, and led to his tragic, premature ending.

The scientist spent most of his latter years engaged in bitter court battles defending his patent rights on his inventions of earlier years. The biography incorporates the scientific and technical aspects of its subject with the personality of the man. Consequently, it is a dynamic, vigorous account of a twentieth century man of science.

Armstrong's three basic contributions to radio are the feedback current, the basis of modern radio and radar reception, and wide-band frequency modulation or FM radio.

This book deserves a place on the list of books for reading pleasure.

***RADIO TELEMETRY, Second Edition, by Myron H. Nichols and Lawrence L. Rauch. John Wiley & Sons, Inc., New York, N. Y. 461 pages, $12.00.***

In three subdivisions this book discusses basic theory as well as a cross-section of current practices in radio telemetry. The first section deals with methods, including time division systems, instruments for radio telemetry, and the problems of noise and error.

The second part, foundations, is devoted to modulation and multiplexing, and frequency analysis.

The final part treats techniques. Frequency-division and time-division radio telemetering systems are presented, and a brief section on remote control is included.

As an expansion of the first edition, which was a limited offset printing for the Air Force, this volume has been brought up to date with the inclusion of chapters describing telemetry systems in current use or development. Also added are an Index and Glossary.

***MEN IN ARMS, A History of Warfare and Its Interrelationships with Western Society, by Richard A. Preston, Sydney F. Wise, and Herman O. Werner. Frederick A. Praeger, Inc., New York, N. Y. 376 pages, $6.50.***

The impact of warfare has had a strong influence on society. In the political, social, and technological realms war has rendered changes, from the Greek era to the present. This book discusses the effects war has had on the total structure of western civilization.

In order to better understand warfare's present threat to civilization, the study of history is taken up in relation to the totality of human development.

The authors attribute modern technological developments and inventions to the demands generated by military needs.

This book will appeal not only to the reader with a special interest in military history and science but also to the serious general reader.

***CIRCUIT THEORY AND DESIGN, by John L. Stewart. John Wiley & Sons, Inc., New York, N. Y. 480 pages, $9.50.***

Both undergraduate and graduate students will find helpful this book on network and circuit theory, presented with an easilv grasped pictorial representation. Pole-zero methods are stressed as a means for understanding and controlling linear frequency-dependent systems and for designing a variety of circuits.

Included are many topics related to circuit design: function design, normalization, and the use of ideal transformers. Each chanter concludes with a number of problems relating to practical design system.

***THE QUARTERMASTER CORPS: OPERATIONS IN THE WAR AGAINST JAPAN, vol. 4, by Alvin P. Stauffer. Government Printing Office, Washington, D. C. $4.00.***

The fourth and concluding volume of a series dealing with the problems and achievements of the Army Quartermaster Corps in World War II has just been written by the Chief of the Historical Branch of the Office of the Quartermaster General. Dr. Stauffer has to his credit several publications devoted to the activities of the Quartermaster Corps in World War II.

This volume describes the supply lines that spread from depots in the United States to widely scattered island bases, the difficulties imposed by lack of common storage and distribution facilities, and how supplies were brought to troops dispersed over tiny atolls and jungles.

The untiring efforts of the Corps to keep the troops provided with the supplies they needed are discussed with a serious awareness of how vital these duties were to the success of combat forces in the field.

For those who enjoy reading military history here is an intensive study of the Quartermaster Corps in operations against Japan.

***HANDBOOK OF BASIC CIRCUITS, by Matthew Mandl. Macmillan Co., New York, N. Y. 363 pages, $7.50.***

Designed for quick reference, this handbook presents in alphabetical order over 130 basic circuits: AM, FM, and TV. In a few pages each, the circuits are described with schematic diagrams. Their physical location in electronic equipment is given as well as an account of their characteristics, purposes, and functions. A given circuit is presented singly, but references are provided to other circuits that perform similar or related functions. Mathematics and formulas have been kept to a minimum to simplify the text.

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# Taking the Guesswork out of Plastics

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Electrical properties of resins are more and more being studied as a means of obtaining additional insight into the physical compositions of these materials. Available to today's chemicals and dielectrics manufacturer for this work are the precision measuring instruments needed . . . the G-R Capacitance Measuring Assembly and accessory Dielectric Sample Holder. This measuring apparatus permits the convenient and accurate determination of both the dielectric constant and dissipation factor of materials under investigation. The direct relationship of these electrical properties with chemical and physical characteristics of many substances provides the link that makes this Assembly the invaluable equipment it is for investigations of basic problems.

At the Interchemical Corporation, the Capacitance Measuring Assembly finds wide use both in development stages and in manufacturing for product control of the plastics coatings, films and other products manufactured by this Concern. Here, typical work performed by the G-R measuring assembly includes:

- Detection of impurities such as ionic materials, water, etc. in plastics.
- Investigation of the effects of interfacial polarization and of dipole polarization in polymers.
- The "following" of chemical reactions as they proceed in films, sheets and coatings.
- Determination of material mix needed to meet a particular electrical specification.
- Production control pertaining to a great variety of solid plastics and elastomeric substances, where electrical specifications must be closely held to meet customer requirements.
- Accurate preparation of dielectric constant vs. frequency and power factor vs. frequency curves. The instrument's wide frequency range is very helpful here.

**Type 1610-A Capacitance Measuring Assembly**
Complete With All Interconnection Provisions, For Two or Three-Terminal Measurements, **$2050**
Without Guard Circuit,
For Two-Terminal Measurements, **$1755**

. . . makes possible direct-reading measurements of capacitance over very wide ranges: from as low as 0.1 $\mu\mu f$ to 1150 $\mu\mu f$ at frequencies from 30c to 100 kc; measurements to 1 $\mu f$ are possible at 1 kc . . . direct reading in dissipation factor from 0.00002 to 0.56. Basic direct-reading accuracy is $\pm 0.2\%$ for capacitance and $\pm 0.0005$ for dissipation factor; in substitution measurements, capacitance accuracy is $\pm 0.1\%$ and $\pm 0.00005$ for dissipation factor.

**Type 1690-A Dielectric Sample Holder, $435**
. . . an accessory unit, readily attached to the Capacitance Bridge unknown terminals, which permits precise determinations of dielectric constant and dissipation factor of solid dielectric-materials . . . 2-inch diameter electrodes are ground to optical flatness and are micrometer driven for highest accuracy . . . this instrument is rugged, completely shielded and useful to 100 Mc and higher.

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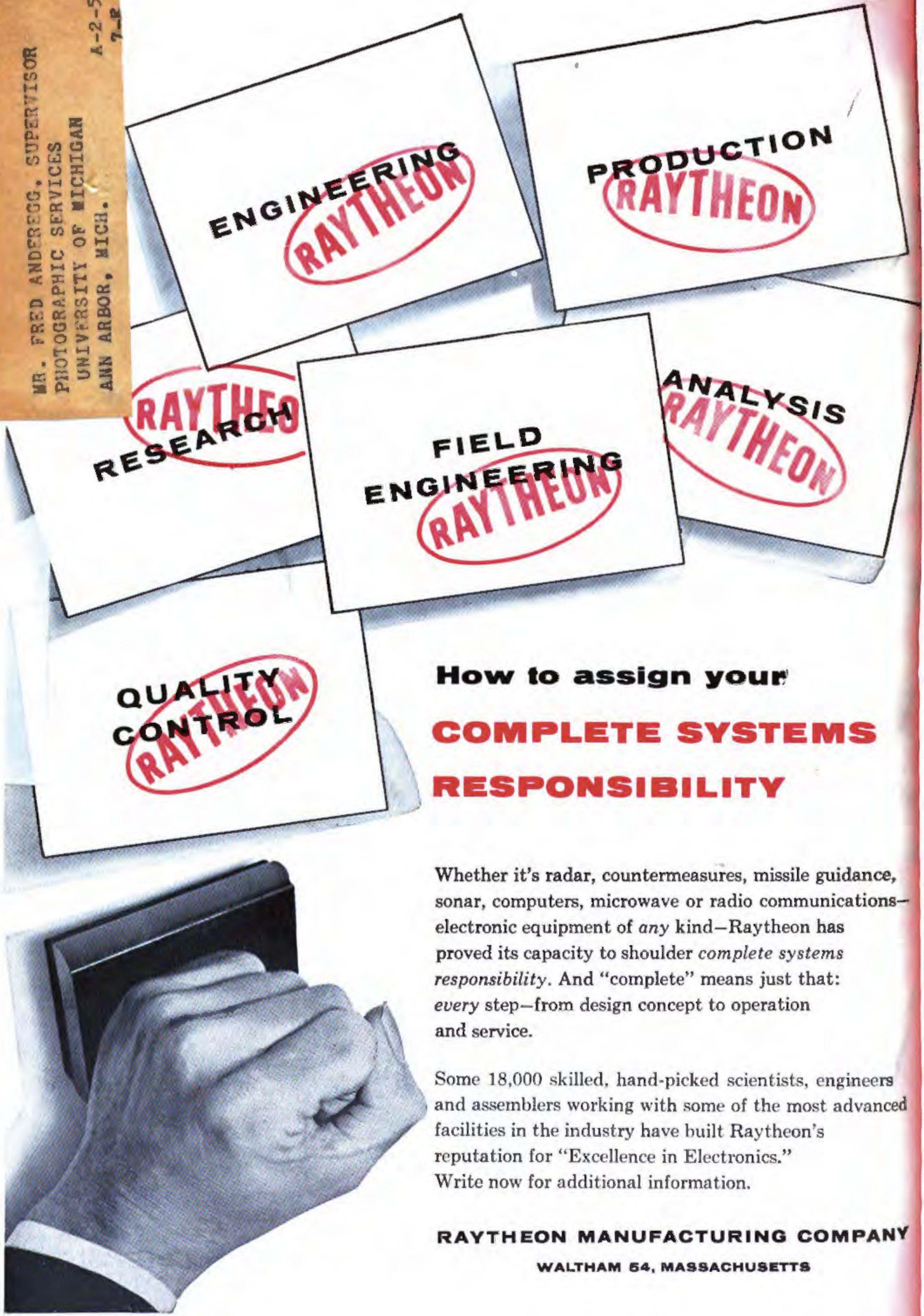
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Communications—Electronics—Photography

# SIGNAL

## AFCEA

## SALUTES

## *George Washington*

FEBRUARY 22ND

"To be prepared for war is one of the most effectual means of preserving peace."

## *Abraham Lincoln*

FEBRUARY 12TH

". . . That government of the people, by the people, for the people, shall not perish from the earth."

**February 1957**


What does it do between
HERE and...
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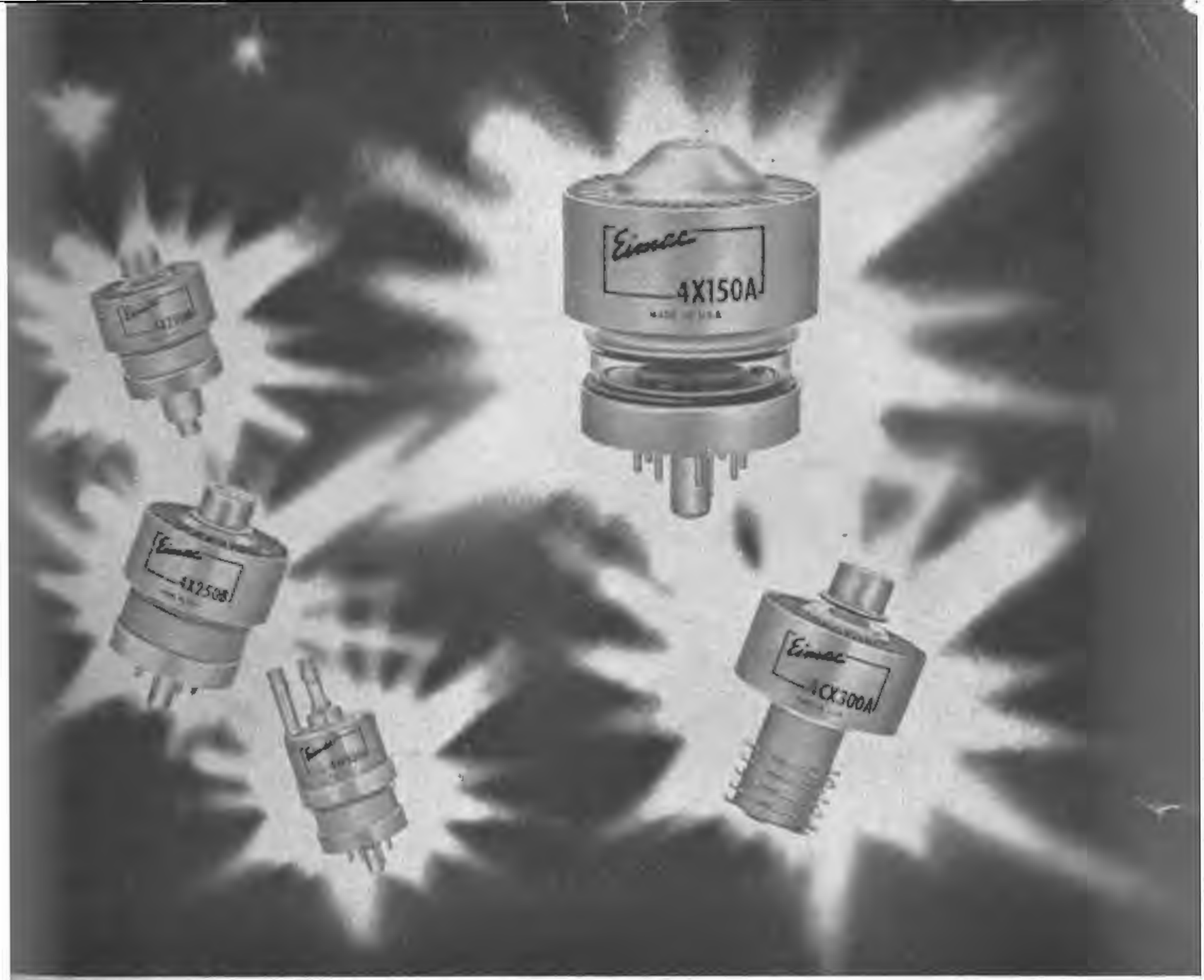

# Evolution at Eimac

Back in 1946 Eimac developed and produced the 4X150A—a new concept in power tetrodes. Its immediate acceptance by the industry then, has led to even more popularity now.

But today at Eimac the glass 4X150A is virtually obsolete.

Since 1946 Eimac has constantly improved the 4X150A to the point where it has evolved into a family of superior quality 250w and 300w tubes for operation to 500Mc. Small, compact structure has been retained. In fact, the 4X250 series is interchangeable with 4X150 tubes. Ceramic envelopes make possible greater mechanical strength, better production techniques, and higher temperature processing.

Because "good enough" has never been accepted at Eimac, however, this family of air cooled or water cooled, co-axial or conventional socketed tubes (2.5v, 6v, and 26.5v) is again accelerating the pace in quality, design, and performance, exactly as the 4X150A did a decade ago.

**EITEL-McCULLOUGH, INC.**
SAN BRUNO · CALIFORNIA
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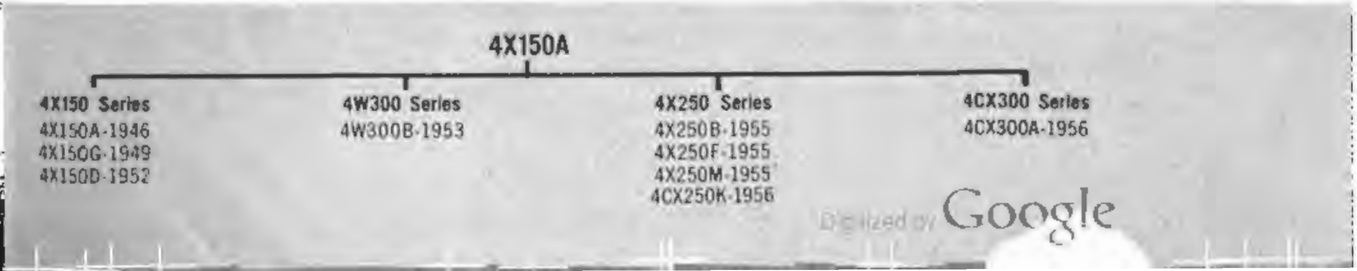
Eimac



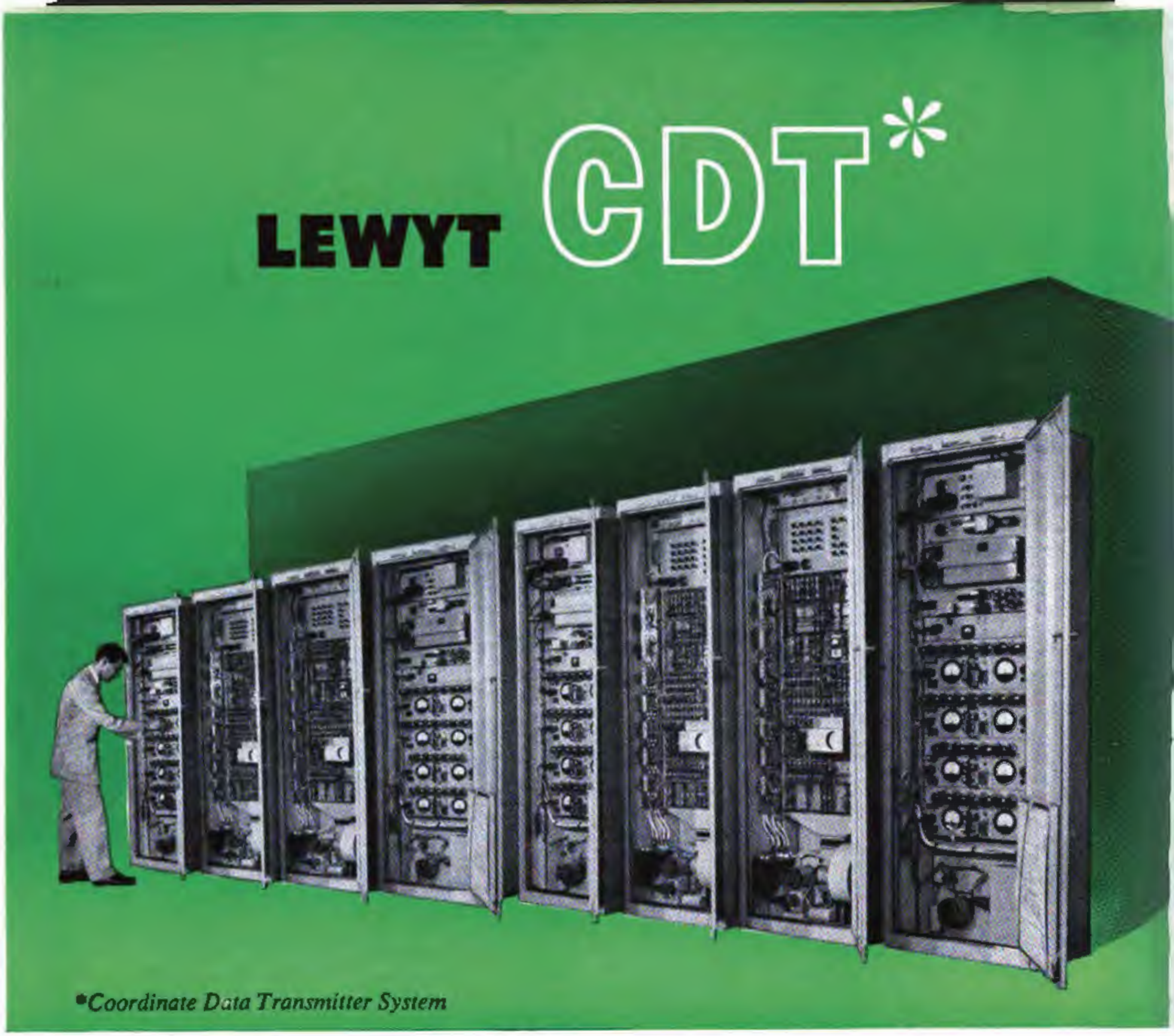
4X150A

4X150 Series
4X150A-1946
4X150G-1949
4X150D-1952

4W300 Series
4W300B-1953

4X250 Series
4X250B-1955
4X250F-1955
4X250M-1955
4CX250K-1956

4CX300 Series
4CX300A-1956



*Coordinate Data Transmitter System

# The brain that interprets 161,800 radar pulses per second!

In **SAGE** – America's most modern air defense system . . . there's no time for "second guessing" or momentary delays of vital information. Interpretation to headquarters must be instantaneous, dependable, and precise!

Designing and building such complex radar data processing equipment requires engineering imagination and resourcefulness... extensive manufacturing and testing facilities.

The Coordinate Data Transmitter System is indicative of Lewyt's ability to develop and produce such equipment. Conceived by the Air Force and developed in close cooperation with M. I. T.'s Lincoln Laboratories, CDT* automatically rejects interference, verifies targets with 99.99% accuracy. Capable of processing millions of radar pulses every minute--this unattended digital transmitter screens, interprets and codes radar information for transmission over telephone lines.

Additional projects in the field of data processing and monitoring equipment, utilizing the latest computor techniques, are in advanced stages of development at Lewyt. *Lewyt Manufacturing Corporation, Long Island City 1, New York.*

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EPA

# SIGNAL

## *Communications-Electronics-Photography*

Journal of the Armed Forces Communications and Electronics Association

VOLUME XI FEBRUARY 1957 NUMBER 6

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# 1957 AFCEA CONVENTION

## Washington, D. C.—May 20, 21, and 22

Once again we wish to stress the importance of making hotel reservations for the 1957 Convention. Even though your Convention Committee representatives have reserved a goodly number of spaces at the Sheraton-Park and Woodner Hotels, you cannot afford to wait too long. It is easier to get a reservation early and cancel it later if necessary. Also available for early reservation are rooms at the new Marriott Motor Hotel just across the Potomac 14th Street Bridge.

The following addresses are listed for your convenience: Sheraton-Park Hotel, Connecticut Ave. & Woodley Road, N.W., Washington 8, D. C.—Woodner Hotel, 16th Street & Spring Road, N.W., Washington 10, D. C.—Marriott Motor Hotel, Twin Bridges, U. S. 1, Washington 1, D. C.

**Program and Exhibits**—All at the Sheraton-Park.

**Sessions**—Top-level coverage from Industry and Government. Plan to bring your family. They will enjoy the Nation's Capitol. For further information, see page 5.

*Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.*

# FIRST silicon transistors meeting NAVY SPECS

For *reliability* under *extreme* conditions... design with TI's military silicon transistors... built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS), MIL-T-19502 (SHIPS), and MIL-T-19504 (SHIPS) – these welded case, grown junction devices furnish the tremendous savings in weight, space, and power you expect from transistorization... *plus* close parameter control that permits you to design your circuits with confidence.

All 20 Texas Instruments silicon transistor types have proved themselves in military use. First and largest producer of silicon transistors, TI is the country's major supplier of high temperature transistors to industry for use in military and commercial equipment.

**degradation rate tests for TI's USN-2N117, USN-2N118, and USN-2N119**

| test | condition | duration | end point at 25°C |
|---|---|---|---|
| lead fatigue | three 90-degree arcs | — | no broken leads |
| vibration | 100 to 1000 cps at 10 G | 3 cycles, each x, y, and z plane | $I_{CO} = 2\mu A$ maximum at 5V |
| vibration fatigue | 60 cps at 10 G | 32 hours, each x, y, and z plane | $h_{ob} = 2\mu$mhos maximum |
| shock | 40 G, 11 milliseconds | 3 shocks, each x, y, and z plane | $h_{fb} = -0.88$ minimum (USN-2N117) |
| temperature cycle | −55°C to +150°C | 10 cycles | |
| moisture resistance | MIL-STD-202 | 240 hours | $h_{fb} = -0.94$ minimum (USN-2N118) |
| life, intermittent operation | $P_c = 150$ mW, $V_c = 30$V | 1000 hours, accumulated operating time | $h_{fb} = -0.97$ minimum (USN-2N119) |
| life, storage | 150° C, ambient | 1000 hours | |
| salt spray | MIL-STD-202 | 50 hours | no mechanical defects interfering with operation |

**LOOK TO TI FOR:** SILICON HF, MEDIUM POWER, POWER, AND SMALL SIGNAL TRANSISTORS
SILICON DIODES AND RECTIFIERS • GERMANIUM VHF, POWER, RADIO, AND GENERAL PURPOSE TRANSISTORS

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# AFCEA CONVENTION 1957

*WASHINGTON, D. C.—May 20, 21, AND 22*
*SHERATON-PARK HOTEL*

Your previous issues of SIGNAL outlined in general activities for the 1957 Convention such as meetings, social events, exhibits, industrial movies, and technical papers. To date, the Association has contracts for 110 out of 160 reserved exhibit spaces. From the 49 technical papers submitted, 12 will be chosen. The final selection of the 12 technical papers will represent those that best conform to the theme of the Convention.

In the near future each member will receive a form to fill out indicating his desires as to each of the following:

MONDAY, May 20

| | |
|---|---|
| Opening Breakfast | $2.25 |
| Keynote Luncheon | $4.00 |
| Buffet Supper and Entertainment | $7.00 |

TUESDAY, May 21

| | |
|---|---|
| Transportation, Lunch, Tour of Naval Research Laboratory | $ 2.75 |
| Reception and Banquet | $10.00 |

WEDNESDAY, May 22

| | |
|---|---|
| Industrial Luncheon | $4.00 |
| Total | $30.00 |

It is important that you indicate on the same form, in the space provided, whether or not your wife will attend. This is desirable since Mrs. Francis Engel must have sufficient information to plan for interesting activities for the ladies. An early report on the ladies planning to attend the Convention will aid materially in arranging for a tour of the White House and getting clearance for those wishing to tour the Naval Research Laboratory.

The program of events for your annual Convention is rapidly being finalized. With the theme of "Marconi to Mars" indicating progress in communications on our planet to radio contact with outer space in this International Geophysical Year, there must necessarily be much information relating to Project Vanguard (Launching of the Earth Satellite). Consequently, the Keynote Luncheon on May 20 will have as its distinguished speaker to cover this important field, Admiral Rawson Bennett, Director of Naval Research. Following the luncheon, there will be a presentation by Admiral Joseph N. Wenger, Director, Communications and Electronics, Joint Chiefs of Staff on Scatter Propagation. The operational requirements, experience to date, impact and problems of this method of communication will be discussed, as well as the joint and single service aspects in this important field.

The entertainment and buffet supper, under direction of the incomparable "Gil" Gilbarte, will conclude the evening event.

On Tuesday, May 21st, technical papers will con tinue from 10:00-12:00 A. M.

At noon, busses will leave the Sheraton-Park for the Naval Research Laboratory, the Directional Center of Operation Vanguard, where lunch will be served. Following luncheon, there will be a conducted tour of the laboratory showing Vanguard developments to date and other new scientific advances relating to the International Geophysical Year. Busses will return to the Sheraton-Park at 4:00 P. M.

The main reception will begin at 7:00 P. M. in the Continental Room and will be followed by the banquet in the Sheraton Banquet Hall. Notice of the beginning of the banquet will be heralded by the famous 35-voice male chorus of the U. S. Army Band. After the invocation, our own George Bailey, Past President of AFCEA and Executive Secretary of the Institute of Radio Engineers, will take over as Master of Ceremonies. The principal speaker of the evening will be Mr. Donald C. Power, President of General Telephone Company and a distinguished leader of the independent telephone industry.

The industrial luncheon at noon Wednesday will feature one of the most unusual events in our convention history. It will be a symposium directed by the Honorable Frank D. Newbury, Secretary of Defense for Engineering, and his Deputy of Electronics, James M. Bridges. Mr. Newbury has been directing application engineering, that most important phase of engineering that converts the theory of research to practical manufacture processes upon which procurement may be accomplished. Following the presentations by Mr. Newbury and Mr. Bridges, there will be a short stretch break, at the conclusion of which there will be a question and answer period. The symposium should be one of the most profitable periods of the Convention, both for our members and for the National Defense.

# the LIFE AND TIMES of the Defense Electronics Industry

**by Dr. W. L. Barrow**
**Vice President for Research and Development**
**Sperry Gyroscope Company**
**Division of Sperry Rand Corporation**

"—STILL THE QUEEN KEPT CRYING 'Faster! Faster!', but Alice felt she could not go faster, though she had no breath left to say so.—However fast they went, they never seemed to pass anything.

'Well, in *our* country,' said Alice, still panting a little, 'you'd generally get to somewhere else—if you ran very fast for a long time as we've been doing.'

'A slow sort of country!' said the Queen. 'Now *here*, you see, it takes all the running *you* can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!' "

This quotation from Lewis Carroll's *Alice In Wonderland* and *Through The Looking Glass* presents a good theme on which to begin a discussion of defense electronics. For this is a field as near to a "wonderland" as can be found today and it is one in which it takes all the running that the government-industry team can do to keep up, in a technological sense, and, indeed, it requires running twice as fast as that to get ahead and stay there. We are truly living in a fast country in which many of us in industrial organizations sometimes feel a bit breathless, like Alice.

The growth of defense electronics has been an accomplishment of revolutionary character and considerable magnitude. In a relatively short time, spurred by the tremendous needs of World War II, those engaged in what we can now call the defense electronics industry have been transformed from an almost non-competitive hard core of companies into a nationwide array of hundreds of highly competitive firms fighting for technological break-throughs, for technical manpower, for increased capital funds, for improved tools, and for an increasing share of business from the Armed Services.

Let us take a look at several factors that contribute to this growth. Of greatest significance is the intensive *research* through which technical advances are made possible. Pacing these advances all the way have been increasingly demanding requirements. Another factor to be considered is the availability of *funds* to support the defense electronics.

### *Rapid Evolution*

As a first example to illustrate the phenomenal progress of research, I will select the dramatic contributions of servomechanisms. Certainly the rapid evolution from the primitive concept of a servomechanism to the present-day sophisticated theory and practice and many-fold applications has been a key contribution of defense electronics. In the marked change from mechanical to electronic apparatus, the servo has helped convert inept manually-controlled weapons into precision devices.

Instruments and automatic control equipment, such as remote-controlled flight instruments, navigation and bombing equipment, and automatic pilots, have thereby evolved from a secondary role in aviation to a key status in the control of today's high-speed, long-range manned aircraft. Similar progress has been made in land and ship based fire-control systems. Missiles and unmanned vehicles of all sorts would, of course, not even be possible without modern servomechanism technique.

No less dramatic has been the ph nomenal development of microwa electronics, particularly radar. role in military systems has beco so extensive that it is, for all prac cal purposes, indispensable. Certai ly, it has become a vital part of tho systems performing the functions detection, tracking, navigation, a missile guidance. Recent develo ments in information theory and scatter propagation are even no opening up new horizons for milita electrical communication. Althou computers are old in military equi ment, the potentialities of electron high-speed digital computers an data processors, of the general cha acter of the UNIVAC®, are so gre no one can yet see the extent to whic they will find usage, and many o ganizations in the defense electroni business will have to run very fa indeed, if they are to "get som where else" in this area.

These systems could not have bee pushed so rapidly except for the equa speed with which the necessary com pounds were made available. Micro wave radar at first jumped forwar as an infant device with the magne tron. It is now going on to the statu of an adult with crystal-controlle high-power klystrons, perhaps one o the most important Sperry contribu tions to defense electronics. Other tubes, and notably the traveling-wave tube, are also rapidly emerging from the laboratories to become valuable components around which important systems are being designed.

Hardly had we begun to achieve some degree of reliability in vacuum tubes, (a serious problem that is still with us) when the semi-conductor de ices, like diodes and transistors, were nveiled to the art as a major breakrough, offering reliability, weight, pace, and power consumption adantages in electronic design beyond ur fondest dreams of only a few ears ago. These examples are but a rief sample of the way in which reearch has turned out major achievenents in a breathtaking sequence.

Let us now consider another major actor in the stimulation of defense lectronics, namely the pressure of ver more stringent requirements. Much of this pressure from requirenents originates from the acceptance of science and technology by the defense establishment. *At every hand in recent years, the most vocal of proponents of scientific and technical progress have been military leaders. In a defense climate influenced so greatly by spectacular atomic and nuclear developments, the military agencies have not only become proponents of more science throughout America, but also adept planners for the technological goals of the future.*

This development is undoubtedly related to the increasing numbers of technically educated officers in the military services. Encouragement within the military of advanced studies for men of scientific bent has been greatly accelerated. The salutary effect of this training is being reflected each day in the give-and-take communications and negotiations between the company scientist and the military project officer. It has made the industry-military team much more productive.

A parallel development has been the enhanced technical stature of the Government sponsored laboratories. Sometimes working independently, but more often hand-in-hand with industry, these laboratories have been responsible for outstanding research, development, and testing accomplishments. With this scientific and technical maturity of the military community, it is not surprising that the descriptions of new missions to be accomplished and the specifications for new equipments and systems often stretch the state of the art and set goals that make us run like Alice and the Queen.

Consider next the influence of the factor of funds, that great American factor—money. Certainly without the tremendous increase in research budgets and planning, defense electronics today would be quite a different thing indeed. Pre-World War II research was budgetarily hampered by limited appropriations. Much that was done then for the military was done on extremely limited Government funds or purely as a company-financed venture; for example, my own company financed the development of the bombsight of World War I and much of the early anti-aircraft development also. The early radar developments were achieved a component at a time and military leaders pleaded for amounts such as $20,000 for their research and development.

### *Funds Appropriated*

Today, the need for a strong national defense posture is echoed not only in the Pentagon and the halls of Congress but by vocal citizens across the land, and funds in vast and ever increasing amounts are appropriated. It has been reported that total military expenditures for "electronics and communications" were:

$0.15 billion in 1948
0.56 billion in 1950
2.1 billion in 1952
2.3 billion in 1954
2.9 billion in 1956.

But these figures do not include very large amounts for the electronic portions of aircraft and guided missiles. No figures for research and development expenditures in defense electronics alone are available, but one can be sure that it is a substantial part of the total amount for all R & D, which has grown from $758 million in 1951 to an estimated $1.5 billion in 1957, or doubled in six years, exclusive of AEC expenditures.

These figures indicate that there is, generally speaking, no serious problem of funding. However, in these days of adequate financial support another problem has arisen, namely the insufficient availability of technical manpower. At every hand we hear of the shortage of engineers, the competition for them, and the need for motivating our youth to technical careers. Thus, the problem of this age does not seem to be money but men.

Not only is the support of research and development an attraction to industry, but there is always the hope that a successful development may lead to production in quantities, with still greater dollars of sales. The inflow of money of such large and annually-increasing amounts into this business of defense electronics provides a tremendous stimulant to its vitality and growth.

### *Some Facts of Life*

Let us now consider some of the other facts of life, some favorable. some unfavorable, that one lives with as a firm in the defense electronics business. First, let us touch upon the effect of procurement policies and practices. These have had marked influence upon the industry.

For most of its life, the defense electronics industry has been plagued with an unpleasant characteristic—the constant difficulty in forecasting its future load in research, development, and production. This situation is to a large degree inherent in the character of defense planning. It is also aggravated by several procurement policies, such as the use of parallel research and development contracts, the placing of follow-on orders to other firms than the one that did the original development, the requirement for multiple sources, the enforced spreading of know-how from the originating laboratory to others, and the slow-but-steady Government encroachment on patent rights. Occasionally, specifications may be changed in the midst of a program because of a change in tactics or in the technical concept desired by the military.

In some cases, there may be fumbling at the start of a program that consumes valuable time and necessitates later undesirable compromises and schedule delays. Some of us are convinced that the shifting of production from one contractor to another in mid-stream makes for unreliable equipment. Consequently, there have been serious ups-and-downs, costly both economically and technically to individual companies and to broad segments of the industry. And due to their closely allied natures, what is costly to this industry is costly to national security as well.

Another reason why it is hard to forecast efficiently is obsolescence. The combination of the needs for advanced weapons and the ability of technology to satisfy them has meant that today's weapon is often obsole by tomorrow. *One may be sure th no electronic device will stay in pr duction for more than a few years best. It is obvious that while it* gre *as well as now, the defense electroni industry had to be adventuresom flexible and competitively adept.* am sure that a JAN-approved cryst ball would be of real help at times

A direct result of rapid obsole cence is that there must be a relativ ly high percentage of a company total investment in men and faciliti devoted to research and developmen perhaps higher than in any oth business. Although varying fro time to time, we would generally e pect about 25% of our manpower be applied to research and develo ment. And since the profit realiz on research and development is le than that from production, the ove all return on investment is signi cantly lowered.

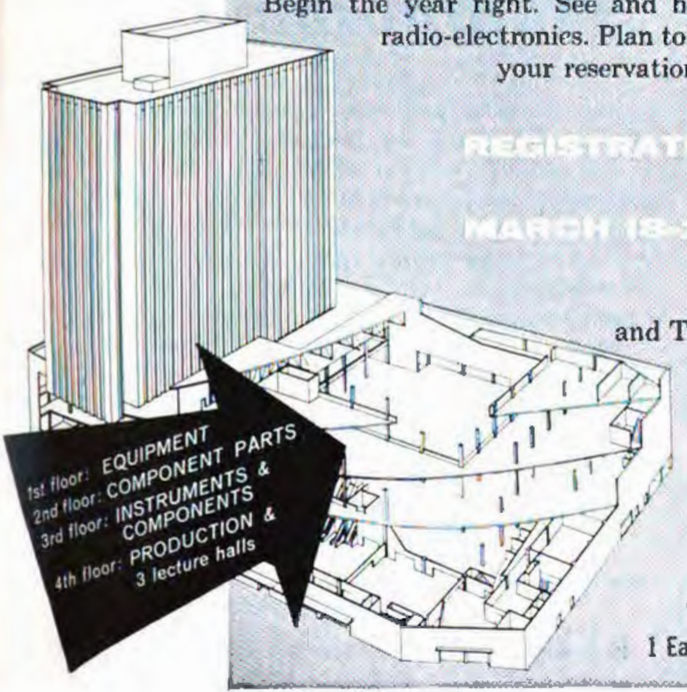
### *Production Financing*

Even if you have a crystal ball, yo will need adequate financial backin to participate to any large extent i defense electronics. There is co tinued effort on contractors to financ their own Government productio While recent pressures by the Go ernment for industry to accept le in progress payments have been re laxed somewhat, companies must b prepared to await payment for work accomplished. For example on fixed-price contracts over $1 million, the maximum income provided by the customer is 90% of direct labor and materials expended on the contract or 75% of all applicable charges. It is not uncommon for companies to have $50-100 million applied to financing Government inventory.

Add to this the fact that many companies today have not yet settled their renegotiations for the years 1952 to date. One can see how financial strength is a prime requirement for anyone seriously considering becoming a key defense electronics supplier.

On the other side of the coin, however, improved procurement polic has been of immense help to the national defense program. The cost-plus-fixed-fee contract has made it possible for the industry to do what it never could have done on a fixed-

(*Continued on page 29*)


1st floor: EQUIPMENT
2nd floor: COMPONENT PARTS
3rd floor: INSTRUMENTS & COMPONENTS
4th floor: PRODUCTION & 3 lecture halls

# Message from Melbourne

A recent short-wave broadcast from Melbourne, Australia . . . received in Syracuse, N. Y. (over 10,000 air miles) with no perceptible flutter or fading . . . is further proof that General Electric's new radio technique . . . Synchronous Amplitude Modulation*. . . is the solution to the problems of long-range radio operations. Its concept and operation are uniquely simple . . . SAM* is compatible with all present forms of radio equipment . . . its operators need no further specialized training . . . yet it preserves complex wave forms even while handling the Doppler effect. Its suppressed-carrier, double-sideband transmission and synchronous reception promise significant savings in weight and cost. Of paramount importance is SAM's* resistance to jamming and interference. Here again, is a vivid example of LMEE's invaluable contribution to progress...in furthering new uses for electronics.

For the very latest information on SAM*...write Section B

LMEE

## *Aviation Electronics Products Include:*

**WEAPONS CONTROL RADAR • SEARCH RADAR • INDICATORS AND DISPLAY • COUNTERMEASURES • NAVIGATION MISSILE CONTROL • AIRBORNE SONAR • COMMUNICATIONS • FUZES • AUTOMATIC TEST • DATA PROCESSING**

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

**LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT**
**FRENCH ROAD, UTICA, NEW YORK**

# GOVERNMENT

### *Blade Clearance Measured in Steam Turbines*

An electronic instrument that continuously measures the clearance between the rotating and stationary blades inside a steam turbine has been developed by the National Bureau of Standards. This rotor position indicator, designed for the Navy Bureau of Ships, will aid in the study of steam turbines under actual operating conditions.

Maintaining safe axial clearance between rotating and stationary blades is one of the problems in steam turbine operation. The NBS rotor position permits accurate determination of blade clearance by measuring the axial distance from the shrouding around the rotor blade tips to the base of the outer stator blades.

The detecting element of the system is a mutual-inductance micrometer probe in printed circuit form on a ceramic base that resists high-temperature steam erosion inside the turbine.

### *U. S. Technical Program to Help Japanese Develop Civil Aviation*

The progress of Japanese civil aviation, now preparing for the jet age through the purchase of new American-made planes, is to be further advanced through a technical training program being arranged by the International Cooperation Administration.

The Japan Air Lines Co., Ltd., is acquiring four jet and four multi-engined propeller driven airliners at a cost of $42.5 million with the aid of a $24.2 million U. S. Export-Import Bank credit.

Concurrent with this expansion of the Japan Air Lines service, the Government of Japan with ICA assistance will undertake the training of aeronautical technicians in many specialized fields.

### *FCC Actions*

The Federal Communications Commission has granted special permission to American Cables & Radio, Inc., the Commercial Cable Co., and the MacKay Radio & Telegraph Co., Inc., N. Y., N. Y., to establish rates and regulations for the handling of press messages to and from Antarctica via the Navy Coastal Station at Balboa, Canal Zone.

Special permission has also been given by the Commission to Globe Wireless, Ltd., San Francisco, Calif., to establish regulations to provide overseas telex service to subscribers of TWX in the United States.

### *Shortage of U. S. Army Signal Corps Personnel*

There exists in the Signal Corps a shortage of personnel in certain electronic fields.

A great number of shortages are in the top three NCO grades. Interested and qualified personnel may apply for training by submitting a formal application to the Chief Signal Officer through command channels.

Several courses available include training in microwave radio equipment repair, radar repair, carrier equipment repair, and field radio repair.

# Contract Awards

### *Army*

Award of a contract for the production of two prototype multi-engine Flying Platforms was announced recently by the Department of the Army. The $500,831 Army contract was awarded to Hiller Helicopters, Palo Alto, California.

The Commerce Department reported that the Army awarded Gilfillan Bros., Inc., Los Angeles, a $2,877,000 contract for guidance equipment for the "Corporal" guided missile.

### *Navy*

The Navy announced recently that it has awarded the following contracts: (a) $29,000,000 to Convair, a Division of General Dynamics Corp., Pomona, California, for the production of guidance and control units for the TERRIER guided missile.

Convair participated in the engineering of the TERRIER missile, which was developed for the Bureau of Ordnance under the technical direction of the Applied Physics Laboratory, Johns Hopkins University. (b) $14,000,000, subject to redetermination at 30% of completion, to the New York Shipbuilding Corp., Camden, N. J., for a guided missile cruiser (CLG) conversion. The cruiser will receive capability to launch TALOS surface-to-air guided missiles aft, while retaining her conventional armament forward. (c) Approximately $600,000 to the Elgin National Watch Company for pilot production of high precision guided missile components, including the Navy's supersonic SPARROW missile. Elgin will make fuzes, safety and arming mechanisms, and related items for the combat interceptor class SPARROW, as well as for a still classified missile. (d) A $19.5 million contract to the Collins Radio Company from BUAER for airborne multi-channel communication equipment in the high-frequency range.

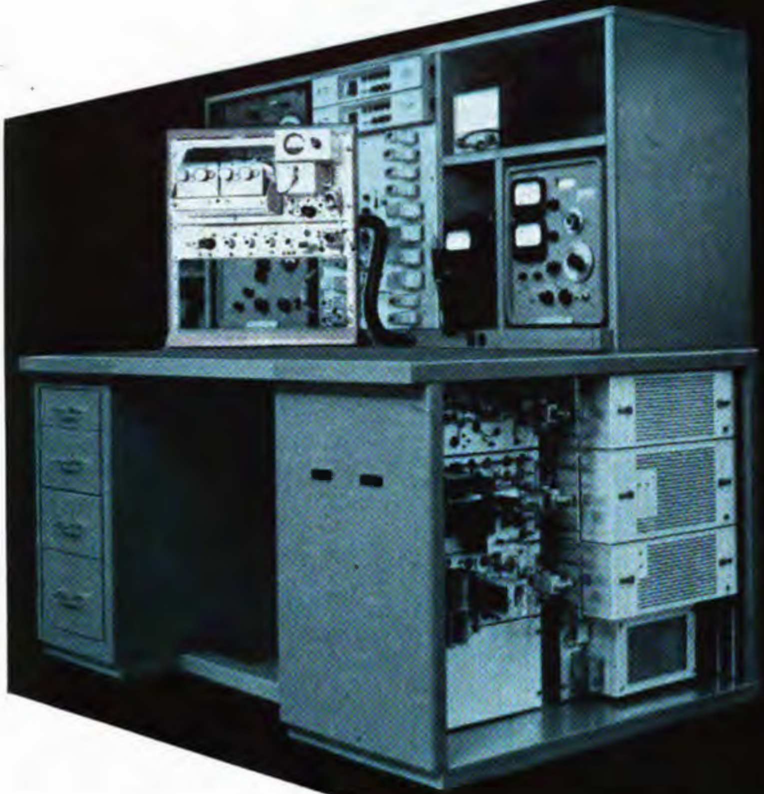
### *Air Force*

A contract for 80 model 310 twin-engine planes for administrative liaison and light cargo use has been awarded to Cessna Aircraft Company's Wichita plant. The contract is expected to amount to over $5,000,000.

The Precision Laboratory, Pleasantville, N. Y., announced recently a contract for nearly $17,000,000 by the Air Materiel Command. The contract calls for additional quantities of GPL developed Doppler navigation systems which are currently used in a variety of Air Force aircraft.

(*Continued on page 17*)

# Accelerated testing



A vital link in our national defense is White Alice—largest Tropospheric Scatter system yet conceived—which is to provide military communications and civilian telephone service throughout Alaska.

With the system now in partial operation, reliability of the equipment becomes essential. This is assured both by the choice of REL for the development and manufacture of the Tropo Scatter radio equipment, and by the remarkable test bench pictured, also designed and built by REL.

Any panel of the White Alice driver exciters or dual diversity receivers can be slipped into the test rack *(left)* and instantly plugged into the bench for immediate testing. This eliminates the bother and delay of cumbersome conventional test procedures, and is an important addition to the overall operating reliability of White Alice.

REL's unique facilities and thirty-five-year experience are available for the solution of your specialized radio problem.

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Canadian representative: AHEARN & SOPER CO · BOX 715 · OTTAWA

*Creative careers at REL await a few exceptional engineers.*
*Address resumes to James W. Kelly, Personnel Director.*

# WIGWAGS ABOUT LINCOLN'S DEATH

**by Mabel E. Deutrich**
**National Archives**

Saturday, April 15, 1865. 12:30 a.m. Instruct your kets to arrest every man who comes near or empts to pass from the city. The President is led!

This was one of the first of many electrifying reports the shooting of President Abraham Lincoln and the bing of Secretary of State William H. Seward to ch the troops camped on the edge of the District of mbia and across the Potomac River in nearby ginia. It was sent by waving torch by the signal de-ment stationed on the roof of the Winder Building, a stone's throw from the White House. The instruc-s were those of General Martin D. Hardin to Colonel les H. Long, commanding Hardin's 1st Brigade at Reno, one of the chain of forts forming a ring nd the city of Washington.

### *The Tragic Shooting*

wo hours earlier President Lincoln was shot while nding a performance at Ford's Theater. Secretary ard, who was home in bed recovering from a carriage dent, was stabbed several times in the face and . His would-be murderer transformed the normally eful Seward home into a bloody battlefield. The etary's son Fred, who tried to restrain the villain and him from reaching his father, received a skull frac-e. Then, before the assassin fled, he stabbed the Secre-y's eldest son, Major Augustus Seward, and his male se, Sergeant George T. Robinson. A similar plot for ing Vice-President Andrew Johnson was not carried because the would-be assassin lost his nerve.

The plot against Johnson, of course, was not known il later, but the city immediately was gripped by fear, oom and despair. All that night and for the next few ys all sorts of wild rumors floated about. A chaotic uncertainty filled the air. Was there more of the plot to be unfolded? Was the Confederacy making one last desperate bid for victory? Did the Secretary of State still live? Were the rumors true that he and his sons had also died? Who had committed the dastardly deeds? Were they identified? Had they been apprehended?

It was vital that the troops in the field be apprised of the calamities. For one thing, they might be able to capture the criminal or criminals. Some of the troops were easily reached by telegraph. Others, much closer to Washington—in fact some just across the river—and hence more apt to be able to apprehend the villains or close their lines of escape, would have been less accessible had it not been for the Signal Corps' flag and torch lines of communications.

The idea of sending messages by flag during the day and by torches at night was the brain-child of Army Surgeon Albert J. Myer. Myer evidenced interest in sign language when he composed "A Sign Language for Deaf Mutes" as his graduation thesis from the Buffalo Medical College in 1851. He was commissioned Assistant Surgeon in the Army in 1854 and shortly afterwards was stationed out west in "the Indian country." It is reported that here his interest in signal messages was further stimulated by the beacon lights and smoke signals the Indians used to send messages from one hill-top to another. By 1860 the Army and Congress had been convinced that personnel could be trained to send messages by flag and torch. Reports of enemy activities and various instructions could be relayed to officers and directions for more accurate firing could be given. The *Official Records of the War of the Rebellion* show that the newly established Signal Corps did indeed provide visual signals during various campaigns and made invaluable observations of Confederate movements thus permitting the Union forces to take the proper steps to meet or counteract many of their plans.

In order to observe and also be in a position to send and receive messages to other relay points, most of the signal stations were elevated. The roofs of buildings and mast heads of ships were utilized, stands were made in tree-tops, and sometimes towers were erected. The essential apparatus, other than the flags and torches attached to poles, was a telescope. This was used not only in making enemy observations but for reading messages wigwagged from other stations. Messages sent and received were recorded in a book and, at the end of the day, the person in charge frequently recorded appropriate "remarks" concerning the weather and other items of interest. Each message station within a Military Department had an identifying code number.

### *Wigwags Record Events*

On the night of April 14, 1865, Lieutenant Paul Brodie was in charge of the small signal detachment posted on the roof of the Winder Building. Among the signal stations with which he had contact, either directly or by relay, were Georgetown Heights and Fort Reno, in Washington; Fort Lyon, Fort Corcoran, Fort Richardson, Fort Ethan Allen, Alexandria, Fairfax Court House, and Falls Church, in Virginia. The messages sent and received by Brodie's detachment early that night (as recorded in his message book which is on file in the National Archives, Record Group 98, Records of the U. S. Army Commands, Department of Washington) reflect nothing unusual. They tell of the illumination of the Capitol and other public buildings, in this way reflecting the feeling of celebration in Washington over General Lee's surrender—the feeling that the long war was reaching its end.

It was not until almost midnight that messages pertaining to the assassination of President Lincoln were sent out. Some of the messages were official communications, others apparently were the passing on of the rumors heard on the streets. The following selected messages from Lieutenant Brodie's record book give us a glimpse into the activities of this eventful time. They illustrate very convincingly early progress in transmitting messages.

*Microton hardness test typifies quality control measures that leave nothing to chance at Automatic Electric*

STANDARDS THAT DETERMINE RELAY QUALITY/

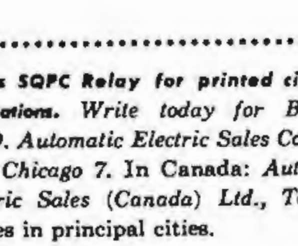
# the ideal relay iron

**Only soft, pure iron assures proper release, even after millions of operations.**

In service, many relays get progressively slower to release, until finally the armature hangs up permanently. Excessively "hard" magnetic relay iron often is to blame. But in all Automatic Electric relays, the magnetic iron is so soft and pure that it saturates quickly, yet the flux dies out instantly. Even after millions of operations!

This improved relay iron is made and rolled to our own exacting specifications. Chemical analysis then makes certain that no magnetic capabilities have been lost. Annealing is rigidly controlled, and grain size and temper carefully checked. Elongation, hardness, permeability, and density tests further safeguard this pampered material. Result: not the *ideal* relay iron, but *the most nearly perfect iron available.*

This is no isolated example. Exhaustive tests prove that all our raw material is equally fine. It's one of the many reasons why Automatic Electric relays enjoy far longer life.



**Series SQPC Relay for printed circuitry applications.** *Write today for Bulletin RH-9. Automatic Electric Sales Corporation, Chicago 7.* In Canada: *Automatic Electric Sales (Canada) Ltd., Toronto.* Offices in principal cities.

**AUTOMATIC ELECTRIC**

*Originators of the dial telephone · Pioneers in automatic control*

GENERAL SYSTEM

(LINCOLN—*Continued from page* 13)

Friday, April 14, 1865

11:50 P.M. To 2231

TELEGRAPH TO ALL YOUR STATIONS THAT NOBODY IS TO BE ALLOWED TO PASS OUT THE LINES THIS EVENING AND HAVE THEM ALL ARRESTED. COMMUNICATE THIS ORDER TO ALL OFFICERS COMMANDING ALONG THE LINE.

By command of Maj. Gen'l. [Christopher C.] Augur.
J. A. Slipper, Capt. and A.AG.

12:00 M
To Cols. [William S.] King and [Charles C.] Meservey.

NOBODY IS TO BE ALLOWED TO PASS OUT THE LINES THIS EVENING AND HAVE THEM ALL ARRESTED. COMMUNICATE THIS ORDER TO ALL OFFICERS COMD'G. ALONG THE LINE.

By command of Maj. Gen'l. Augur.
J. A. Slipper, Capt. and A.AG.

Saturday, April 15, 1865

12:30 A.M.
To Col. [Charles H.] Long, Comd'g. 1st Brig., Ft. Reno.

INSTRUCT YOUR PICKETS TO ARREST EVERY MAN WHO COMES NEAR OR ATTEMPTS TO PASS FROM THE CITY. THE PRESIDENT IS KILLED.

By command of General [Martin D.] Hardin.
G. Wiard, A.AG.

2:00 A.M.
To Comd'g. Officers, 3rd and 4th Brigades. [Cols. King and Meservey].

IT IS REPORTED THAT THE PRESIDENT HAS BEEN SHOT. ALLOW NO ONE TO PASS THROUGH THE LINES UNTIL FURTHER ORDERS.

PUT YOUR COMMAND UNDER ARMS AT ONCE. ALLOW NO ONE TO PASS THE LINES. ARREST EVERY MAN, WOMAN OR CHILD ATTEMPTING TO PASS ANY BRIDGE OR THROUGH THE LINES. SEND THEM TO DEPARTMENT HEADQUARTERS IN THE MORNING.

By command of Gen. [Gustavus A.] De Russy.
L. A. Chamberlin, A.D.C.

4:00 A.M.
To 2231

NO HOPES OF THE PRESIDENT. SECRETARY SEWARD AND HIS SON ARE IN DANGER. THE SECRETARY'S THROAT IS CUT. HIS SON BADLY STABBED. SEND THIS ALONG THE LINE.

2311

5:45 A.M.
To Commanding Officers, 3rd and 4th Brigades.

KEEP THE TROOPS UNDER ARMS UNTIL FURTHER ORDERS, WITH THE SAME INSTRUCTIONS TO SENTINALS.

By command of Gen. De Russy.
L. A. Chamberlin, A.D.C.

8:30 A.M.
To 2311

IS LINCOLN DEAD?

114

8:30 A.M.
To 114

AT LAST ACCOUNTS HE WAS NOT.

2311

8:30 A.M.
To Commanding Officers, 3rd and 4th Brigades.

KEEP THE TROOPS UNDER ARMS UNTIL FURTHER ORDERS, WITH THE SAME INSTRUCTIONS TO SENTINALS.

By command of Gen. De Russy.
L. A. Chamberlin, A.D.C.

8:30 A.M.
To 2311

IS SEWARD KILLED?

114

(*Continued on page* 16)

(*LINCOLN—Continued from page* 15)

8:30 A.M.
To 114
No.
2311

8:55 A.M.
To 2311
Any news? No one is allowed to come across the bridges.
2231

8:55 A.M.
To 2231
The President is dead.
2311

9:45 A.M.
To 2311
Col. King wishes to know the particulars in regard to Lincoln.
114

9:45 A.M.
To Col. King
Can not get them. The President is dead.
2311

11:00 A.M.
To Cols. King and Meservey.
The President was shot about ten last p.m. while sitting in his private box at Ford's Theater and remained insensible till he died this a.m. John Wilkes Booth the actor is the suspected assassin. Secretary Seward was stabbed at the same hour at his residence. Major Seward is dead. No hope for Fred W. Seward. Secretary Seward is in danger.
2311

11:00 A.M.
To the line.
Major Clarence Seward has just died.
2311

11:25 A.M.
To Cols. K[ing] and M[eservey].
The President died this a.m. and Major Clarence Seward has just died.
Gen. De Russy.

12:15 P.M.
To 2231
Booth captured this a.m. ten miles this side Baltimore.
2342

12:30 P. M.
To Cols. King and Meservey.
Major Seward is still alive but quite low. The President's remains are now at the White House. Booth captured ten miles this side Baltimore.
2311

12:45 P.M.
To Gen. De Russy.
I have just come from Department Headquarters. Major Seward is still alive but quite low. The President's remains are now at the White House. I have notified Cols. King and Meservey. Departments are being draped this morning.
Lieutenant [Paul] Brodie
Signal Officer.

1:45 P.M.
To Gen. De Russy.
If you will be pleased to send a message by signal to Col. Taylor or some other officer at Department Headquarters asking to be informed as to the true condition of the Secretary of State and his sons, etc., I can then furnish you reliable reports. As it is, I find it difficult to learn truth or falsity of the many reports being stantly circulated.
2311

2:15 P.M.
To Col. [Joseph H.] Taylor, Chief of Staff.
Will you please inform me as to the condi of the gentlemen who were injured last eve by the assassins?
Gen. G. A. De Russy.

2:15 P.M.
To Gen. Hardin.
We hear that Booth has been arrested. I so?
C. H. Long, Commanding [1st] Brigade.

3:15 P.M.
To Gen. De Russy.
Mr. Seward is doing well. Mr. F. W. Sewar in a critical condition. Major Seward is sligh wounded.
A. E. King, A.A.G.

Sunday, April 16, 1865

6:35 PM.
To 2311
Any news? Is the capture of Booth confirm
2231

6:35 P.M.
To 2231
No news. The capture of Booth is contradic in the morning papers.
2311

7:00 P.M.
To Gen. De Russy, Cols. King and Meservey.
Secretary of State is much easier this p.m. son Fred is still senseless.
2311

On the day of the funeral the Signal Detachment w able to perform one last function for their former co mander-in-chief. Lieutenant Brodie's "remarks" for t day contain the following:

Wednesday, April 19, 1865

The funeral of the late President took place toda At 9 a.m. I made arrangements to notify by signals th battery near St. John's Church, the time when the co umn moved. About 10 a.m. it was decided that th battery would be too near Secretary Seward, and it wa ordered that I make arrangements to signal to Cit Hall. In less than an hour communication was opene between City Hall and Winder Building. I rode to th City Hall just in time to see the battery arrive on th ground. Informed the commanding officer as to th arrangements. Placed Privates Nye and Bellows front of White House, Private Coombs at corner o 17th St. and Pa. Ave. near the War Department, Private Dodge on the Winder Building, and Sergeant Willard Roe and Private Washington Reed on the roof of City Hall. The signals worked well, and from the time the word "Forward" was given, only four seconds were occupied in transmitting the fact to the battery at City Hall. The first gun was fired simultaneously with the first sound of music as the column moved. I joined the procession among the mounted officers among whom I saw Lt. Col. [William J. L.] Nicodemus, Signal Corps; Capt. H. R. Clum, Signal Corps, and others of the Corps. From 10 a.m. till 5 p.m. no communication was had with signal stations across the Potomac.

These, then, are the wigwags and messages which recorded the passing, about niney-two years ago, of a beloved President.

SIGNALGRAM—Continued from page 11)

A $6 million contract for miscellaneous spare parts nd modification kits for the B-47 Stratojet bomber has een granted Douglas Aircraft Co., Inc., Tulsa, Okla.

Sperry Gyroscope Company won a $6 million conract for development of radar systems. The equipment s believed to be the smallest for its size and range.

# ~ INDUSTRY ~

## Experimental Radar Station

Stanford Research Institute has transformed one of the olling hills west of Palo Alto into an experimental radar tation with installation of a giant 61-foot diameter anenna and 100-megacycle transmitter.

The equipment is being used by SRI's Engineering Division to gather data about the reflection from meteor and auroral ionization of very high frequency and ultra high frequency radio signals.

A SRI team has been assigned to install and operate a similar radar unit at College, Alaska. The northern station is part of an associated program being carried out in conjunction with the Geophysical Institute, University of Alaska. The Alaska installation will have a lystron transmitter in the 200-400 megacycle range and a 61-foot diameter parabolic antenna. The SRI research team will observe the scattering of radio signals by meteor trails in the frequency range exceeding 100 megacycles.

Sponsoring the two-phase program is the Rome Air Development Center, Air Research and Development Command, Griffiss Air Force Base, New York.

## Hungarian Refugees Tour Federal Telephone and Radio Company Plant

Forty-seven Hungarian refugees got a look at American industry in action when they toured the huge electronic manufacturing plant as guests of Federal Telephone and Radio Company, Clifton, N. J., a division of International Telephone and Telegraph Corporation.

At the twenty-four acre plant they saw for the first time what a "free enterprise" production system can do.

The huge typical American plant and the manner in which it is operated proved to be an eye opener for many in the group who had been subjected for years to propaganda belittling the American labor system. Among the experiences which they commented on were: the quiet, efficient clean production lines; the fluorescent lighting; the high quality of clothing worn by plant employees while at work; the fact that Negroes worked side by side with Whites in responsible positions contrary to what the group's former masters had told them; and the typical plant cafeteria with its abundance of food.

## Improved Electronic Brain

Lockheed scientists, working with a giant new "electronic brain" have come up with some new wrinkles in the way of improving the device's ability to solve complicated problems and have already devised some important programming short-cuts.

Two new systems, unglamourously dubbed MISHAP and FAP, are sets of general instructions fed in the machine and stored in its "memory." With MISHAP (missiles high speed assembly program) so stored, the operator may feed the computer instructions using familiar alphabetic and decimal characters instead of the binary system which expresses all common numbers in terms of the numbers "0" and "1."

MISHAP allows a computer operator to communicate with the machine in a common and easily understood alphabetic and arithmetic combination. Also, the computer automatically assigns storage space in its "memory" to the various bits of information being programmed. Formerly, this had to be done by the operator, and the process was subject to clerical errors which are now eliminated. The missile division's mathematical and computer service department reports that MISHAP halves the time programmers must spend on any particular problem.

The Floating Arithmetic Package (FAP) when "memorized" by the computer allows the programmer to use certain computing "skills" not built into the machine. The main "skills" are floating point arithmetic, standard transcendental sub-routines, input and output on punched cards or magnetic tape, and diagnostic routines.

Lockheed's computing system primarily uses magnetic tape for input and output of information. This, the Lockheed experts say, is an entirely new technique in the field which will result in faster computations.

## Revolutionary "Videotape" Recorder

The Ampex Corporation recently delivered pre-production models of their revolutionary "Videotape" recorder, that records picture and sound on magnetic tape, to the CBS television network.

The first use of the "Videotape" recorder by the network will be to overcome the time differential between New York and the West Coast. Thus, West Coast viewers will now be able to enjoy the same flawless quality of live programming that the Eastern viewer has become accustomed to, because of the improved picture quality available via magnetic tape as compared to present fast photographic processes. Perhaps even more important than the reproduction of recorded programs with "live" quality are the operational and economic advantages the Ampex "Videotape" recorder offers the television industry. Programs can be recorded directly from the TV camera, from a TV receiver, from television transmission lines or from microwave relay systems, and then rebroadcast immediately, or delayed indefinitely. The tape requires no processing and can be erased and reused many times.

## RCA Head Notes Future of Color TV

"RCA's four point goal for color television in 1957 is to produce and sell 250,000 color sets, to double the number of color programs on the air, to attract sponsors to the new and productive medium, and to encourage others in the industry to enter the field."

Commenting further on the new segment of the television business, Gen. Sarnoff said, "RCA is firmly convinced that color television will provide a greater and more interesting service to the public, a profitable business for broadcasters, manufacturers, distributors and dealers, and a rewarding medium for advertisers. The future of television is in color."

## IRE National Convention

50,000 radio engineers and scientists are expected for the annual Institute of Radio Engineers National Convention and Radio Engineering Show, which will be held at the Waldorf-Astoria Hotel and the New York Coliseum, March 18-21, 1957.

A comprehensive program of fifty-five technical sessions is being set up by the Technical Program Committee with the assistance of all the IRE Professional Groups. Thirty-three sessions will be held at the Waldorf and twenty-two at the Coliseum. Two highlight sessions will be "Future Use of Air Space" and "Microminiaturization —The Ultimate Technique."

# Transportation Tax

## On Property and Accessorial Charges

**by Kennedy C. Watkins**
**Tax Attorney, Washington, D. C.**

Editor's note: *The following article discusses a case based on a recent decision by the United States Court of Claims and pertains to certain types of taxable transportation services. Some of these services fall outside the field of the Communications and Electronics industry. Those services which do concern these industries may very well be applicable to many of the readers of* SIGNAL *who handle and ship products. It is for this reason that we are pleased to publish this article by Mr. Watkins.*

OF CONSIDERABLE PRESENT interest and potential value to manufacturers and shippers using for-hire transportation is a recent decision by the United States Court of Claims in the case of *Swift and Co.* vs. *U. S.*, decided October 2, 1956. This decision involves, apparently for the first time, a provision in the regulations of the Commissioner of Internal Revenue which has been in effect since 1942.

### *Regulations Defined*

In substance and in pertinent part, these regulations provide that transportation include accessorial services furnished in connection with a transportation movement, such as loading, unloading, blocking and stacking, elevation, transfer in transit, ventilation, refrigeration, icing, storage, demurrage, lighterage, trimming of cargo in vessels, wharfage, handling, feeding and watering livestock, and similar services and facilities. (Regs. 113, sec. 143.1(d))

The shipper in this test case shipped its product by rail carrier throughout the United States. Its bill for transportation charges consisted of the following items which were separately stated by the carrier:

1. the line haul charge;
2. demurrage charges and, with respect to perishable commodities, charges for ice supplied by the carrier together with charges for switching incidental to icing the cars containing the shipper's property; and
3. the charge on the total of 3% representing the Federal excise tax on the amount paid for the transportation of property.

The sole question for decision was whether the phrase "amount paid . . . for the transportation . . . of property" as used in the statute included charges for icing, salting, switching and demurrage as accessorial charges, thereby subjecting them to tax. Consistent with his regulations, the Commissioner asserted the tax which was paid by the shipper and collected by the carrier. On denial of the shipper's claim for refund, suit was brought in the Court of Claims.

What does "transportation of property" mean? What did Congress intend by the use of this phrase in the taxing statute?

While the Court, in its decision, noted that the term "transportation" had been broadly defined for purposes of the Interstate Commerce Act, it was careful to point out that "the statutory definition of transp tation contained in an act desig for the purpose of regulating int state commerce does not control t meaning of that term in a differe act designed for the purpose of i posing a tax on shippers." Contin ing, the Court pointed out the a sence in the taxing statute of any de nition of this term and stated t fundamental rule of statutory co struction that, in these circumstanc "the ordinary and commonly unde stood meaning shall be attributed the terms employed." Such being t gist of the case, what accessorial ser ices to the transportation of propert if any, did Congress intend to tax What, in ordinary and accepted pa lance, should be included in this cat gory?

### *Court Answers Questions*

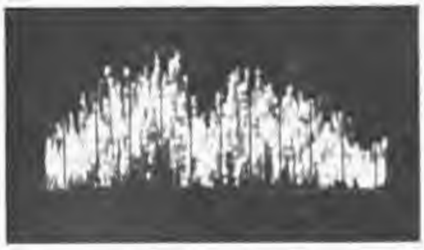
The Court answers these questio as follows:

> "We believe that Congress intende to impose a tax on the amount pai for actual transportation and no on all of the additional service that may be furnished by the car rier. We believe that payment fo any movement of cargo from one

# *How you can "squeeze" 64 simultaneous messages into a single frequency*

Breaking communication bottlenecks is a specialty of the Hoffman CV-157 Dual Sideband Converter. In one quarter the space of previous sideband converters it achieves maximum use of today's limited frequency bands, relieves traffic overloads. The CV-157, designed and developed by Hoffman, receives independently modulated AM signals with a highly suppressed carrier and splits them into two sidebands. Result: up to 75% greater effective range without increasing transmitter power—2 to 32 times more traffic capacity without increasing frequency bandwidths. As many as 64 dualtone teletype channels, or various combinations of teletype, facsimile and AM voice can be handled by the CV-157. Write today for additional data on this and other advanced communications techniques now under evaluation at Hoffman.

Scope pattern taken from Hoffman CV-157 showing two dualtone teletype channels on upper sideband, carrier partially suppressed. Each sideband can carry 32 teletype channels at one time.



One AM voice channel (made by continuous vowel sound) on each sideband, carrier completely suppressed. CV-157 carries two 3KC voice channels on each sideband.

AM voice on lower sideband, dualtone teletype channel on upper. With suitable multiplexing equipment, the CV-157 handles 64 simultaneous dualtone teletype channels.

ALL PHOTOS UNRETOUCHED FROM PANALYZOR MODEL SB-8

Electronics and Mechanical Engineers
Significant developments at Hoffman in the fields of VLF, HF, VHF, UHF, forward scatter and tropospheric communications, single sideband and advanced ECM techniques have created important positions for engineers of high calibre. Please address inquiries to Vice-President of Engineering.

**Hoffman LABORATORIES, INC.**
A SUBSIDIARY OF HOFFMAN ELECTRONICS CORPORATION
3761 South Hill Street • Los Angeles 7, California

*TRANSPORTATION*
*(Continued from page 18)*

point on the line to another,
cluding, *but* not limited to, s
things as lighterage, switchi
backhauling, are amounts paid
transportation. Amounts paid
ventilation, refrigeration, icing
salting are payments for th
services and not payment for tra
portation within the meaning
section 3475. The above-mentio
services are not intended to be
inclusive, but only illustrative
the distinction between amou
paid for actual transportation
amounts paid for additional se
ices. While the writer of this op
ion believes the above should
clude demurrage, the majority
the Court believes otherwise. Th
demurrage is not included in
services which are not taxable."

The result of the decision to
shipper was a refund of the tax w
interest on the amount paid for ici
and salting. The effect of this
cision is much broader and rai
doubt, not so much with the theo
of taxing amounts paid for servic
accessorial to the transportation
property, but rather as to the natu
of such services as illustrated by t
enumeration in the Commissione
regulations. Until the law or t
regulations are changed or the U.
Supreme Court rules on this questio
this case will stand; a limited victo
for the shipper in this narrow an
with the burden on the carrier st
to collect the tax.

It is not believed that the Co
missioner will change his position o
just this case. Doubtless he will se
to have the Department of Justice fi
a petition with the Supreme Cou
for certiorari (a writ requiring th
court to specify more fully) withi
the 90 days allowed therefor from th
date judgment is entered. As a mat
ter of legal forecasting, it would ap
pear that if such a petition is filed
it will be denied, in which event th
Commissioner will continue to litigat
this question in all other courts than
the Court of Claims, hoping to de
velop a conflict which might precipi
tate a review of the issue on its merits
by the Supreme Court. Until this ob
tains and if the situation otherwise
remains in *status quo*, limited recov
ery of tax on some accessorial charges

*(Continued on page 27)*

# AFCEA Group Members

## Communications—Electronics—Photography

*ed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their*
*mbership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of*
*key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the elec-*
*ics and photographic fields, available for advice and assistance to the armed services on research, development, manufactur-*
*ing, procurement, and operation.*

Admiral Corp.
Air Associates, Inc.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
Almo Radio Co.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Argus Cameras, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Berkshire Transformer Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Clevite Transistor Products, Division of Clevite Corp.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Compagnie Francaise Thomson-Houston
Convair, Division of General Dynamics Corp.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
Dukane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co.
Haloid Co.
Hammarlund Manufacturing Co., The
Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
Hoover Electronics Co.
Hopkins Engineering Co.
Hughes Aircraft Co.
Hycon Eastern, Inc.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Business Machines
International Resistance Co.
International Telephone & Telegraph Corp.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
Kay Lab
Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.
Koiled Kords, Inc.
Lansdale Tube Co., Division of Philco Corp.
Lavoie Laboratories
Leich Sales Corp.
Lenkurt Electric Co.
Lenz Electric Manufacturing Co.
Lewyt Manufacturing Corp.
Librascope, Inc.
Loral Electronics Corp.
Machlett Laboratories, Inc.
Magnavox Co.
Maida Development Co.
Mallory, P. R., & Co., Inc.
Material Telephonique Co.
Merit Coil and Transformer Corp.
Michigan Bell Telephone Co.
Microwave Associates, Inc.
Montgomery Co., The
Motorola, Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co.
Mycalex Corporation of America
National Co., Inc.
Nelson Technical Enterprises
Nems-Clarke, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
New York Telephone Co.
North American Philips Co., Inc.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Otis Elevator Co., Electronic Division
Pacific Mercury Television Mfg. Corp.
Pacific Telephone & Telegraph Co.
Packard-Bell Co.
Page Communications Engineers, Inc.
Peninsular Telephone Co.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Radiart Corp.
Radio Condenser Co.
Radio Corporation of America
Radio Corporation of America, Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Radio Receptor Co.
Raytheon Manufacturing Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Remington Rand, Division of Sperry Rand Corp.
Remler Co., Ltd.
Rocke International Corp.
Saxonburg Ceramics
Sigma Instruments, Inc.
Society of Motion Picture & Television Engineers
Sonotone Corp.
Soundscriber Corp.
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Telephone & Cables, Ltd.
Stanford Research Institute
Stelma, Inc.
Stewart-Warner Corp.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products, Inc.
Technical Materiel Corp., The
Technology Instrument Corp.
Tele-Dynamics, Inc.
Telephonics Corp.
Teletype Corp.
Tensolite Insulated Wire Co., Inc.
Texas Instruments, Inc.
Times Facsimile Corp.
T.M.C. (Canada) Ltd.
Trad Electronics Corp.
Triad Transformer Corp.
Transitron Electronic Corp.
Tung-Sol Electric, Inc.
United Telephone Co.
United Transformer Co.
Waterman Products Co., Inc.
Webster-Chicago Corp., Government Division
West Coast Telephone Co.
Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheelock Signals, Inc.
Wickes Engineering & Construction Co.
Wilcox Electric Co., Inc.
Willard Storage Battery Div., Electric Storage Battery Co.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

## *AFCEA CHAPTERS—National Director of Chapters: RAdm. Henry C. Bruton, USN*

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***Region B:*** George C. Ruehl, Jr., 2118 St. Paul St., Baltimore, Md. ***Delaware, District of Columbia, Kentucky, Maryland, Ohi Pennsylvania, West Virginia and Virginia.***

***Region C:*** Ralph S. Grist, So. Bell T&T Co., Atlanta, Ga. ***Southeastern States along Atlantic and Gulf coasts—from Nort Carolina to Louisiana including Tennessee.***

***Region D:*** Col. George L. Richon, Hq. Fourth Army, Fort Sam Houston, Tex. ***New Mexico, Texas, Oklahoma, Arkansas.***

***Region E:*** John R. Howland, Dage Television Div., Thompson Products, Inc., W. 10th St., Michigan City, Ind. ***Michigan, Indiana Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Wyoming Colorado.***

***Region F:*** Col. Lloyd C. Persons, 1807 16th Ave., San Francisco, Calif. ***Arizona, Utah, Nevada, California, Idaho, Oregon Montana and Washington.***

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***SOUTH TEXAS:*** Pres.—Col. Albert J. Snider, 1822 AACS Group, Randolph AFB, Tex. Sec.—S. J. Keane, Southwest Research Institute, Box 2296, San Antonio

***SOUTHERN CALIFORNIA:*** Pres.—Charles A. LaHer, RCA Victor Div., 1560 N. Vine St., Hollywood. Sec.—Jack Warner, Jr., 4000 Warner Blvd., Burbank.

***SOUTHERN CONNECTICUT:*** Pres.—Lincoln Thompson, Raymond Engineering Lab, Inc., Smith St., Middletown. Sec.—John N. Higgins, KIP Electronics Corp., 29 Holly St., Stamford.

***SOUTHERH VIRGINIA:*** Pres.—Lt. Col. Melvin M. Lawson, Hq. CONARC, Ft. Monroe. Sec.—Gerald R. Sauer, 463 Cedar Drive, Hampton.

***SWITZERLAND:*** Pres. — William P. Lear, Lear Radio, Geneva; Sec. — Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

***TINKER-OKLAHOMA CITY:*** Pres.—Loyd G. Dorsett, Dorsett Labs., Inc., Norman. Sec—Col. William L. Gregory, 1800 AACS Wing, Tinker AFB.

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***WASHINGTON:*** Pres.—M. C. Richmond. Western Electric Co., 713 Cafritz Bldg., 1625 Eye Street, N. W. Sec.—George Sheets, 712 Cafritz Bldg., 1625 Eye Street, N. W.

### *ACTIVE STUDENT CHAPTERS*

Iowa State College, Ames, Iowa
New York University, N.Y.C.
Northeastern University, Boston, Mass.
Norwich University, Northfield, Vt.

# Chapter News

### ;usta-Fort Gordon

arvey Christen, an executive of the :heed Aircraft Corporation, Georgia sion, was guest speaker at the chap- October meeting. He presented nformative account on the history ,ockheed and its contributions to tary and civilian requirements.

ew officers were elected at the No- ber 15th meeting. Chosen to head chapter for 1957 was Col. Braxton Small, TSESS, with other officers ıed as follows: honorary presidents rig. Gen. R. T. Nelson, commanding eral, SCTC, Fort Gordon; W. O. Dowell, Southern Bell; Col. Otto T. r, SCTC; and J. C. Woodward, thern Bell, retiring president; vice sidents — E. H. Gibson, Southern l; Lt. Col. D. W. Bowman, SCTC l F. A. Saxon, Georgia Power; secre- y—Lt. Col. W. O. Beasley, TSESS; asurer—B. Moody Wilson, Southern ll.

Board of directors—Col. Lowrey ore, Maj. Charles Picciuolo, Col. C. Dunlap, Col. Philip Rose (all from rt Gordon); and T. M. Baker, E. L. ach, J. C. Woodward and J. E. edlove (all from Southern Bell).

The program for the evening in- ded a talk on "Communications, venth Army" by Lt. Col. David W. wman, and several films of actual allations of communications equip- nt used during combat by the venth Army.

### ltimore

The chapter inaugurated the holiday ason with a pre-Christmas dinner rty on December 8th. Held at the ficers' Club of Fort George G. Meade, e affair was attended by some 200 embers and guests. Chapter business s dispensed with and the evening was voted to a social hour, dinner and nce.

### ecatur

At a recent meeting of the chapter's oard of directors, 2nd Lt. Joseph W. ndrasak, 9521st TSU, Decatur Signal epot, was appointed secretary-treas- rer to succeed CWO Alfred A. Mulzet.

The chapter is now engaged in con- ucting an electronics training course hich is open to all its members at ominal cost.

### etroit

Two very successful meetings marked he chapter's fall activities. The first ok place at the Civil Aeronautics Ad- ministration, Detroit-Wayne Major Air- port, on October 20th. This installation as the responsibility of Air Traffic Control in Detroit and other areas in Michigan. The tour included the Detroit Air Route Traffic Coutrol Center, Interstate Airway Communications Station and the U. S. Weather Bureau.

The December 12th meeting was held at the Headquarters of the 30th Air Division at Willow Run Air Force Station. The program was arranged by Col. James I. Vanderhoof, chapter member, and consisted of an unclassified tour of a Control Center of an Air Division, a technical discussion and a question and answer period.

Dinner at the Air Terminal was followed by an informal gathering at the Officers' Club where Colonel Vanderhoof was host. Special guest of the evening was Col. John R. Howland, Regional Vice President, who was making his first visit to the chapter since his appointment in October. Another guest was Casimer J. Gogulski, 1956 AFCEA-ROTC Gold Medal Honor Award winner from the University of Michigan.

### Kansas City

The speaker scheduled for the December 6th meeting was Mr. R. B. Alexander, Assistant Project Manager, Engineering, of Western Electric Company, with the DEW Line as the subject. Unfortunately, bad flying conditions prevented Mr. Alexander from arriving in time to present this program and it was re-scheduled for the January meeting.

The Bell System film, "Our Mr. Sun," which dramatizes the role of the sun in the universe, was presented as a substitute program with considerable success. The film was telecast over the CBS network on November 19th and inaugurated the Bell System's new series of one-hour color television programs on science, a series that has been four years in preparation.

### London

The British Broadcasting Corporation was host to members and guests of the London Chapter on November 28th. Highlights of the meeting were tours of BBC's new Television Centre and Riverside Television studios.

Program arrangements were made by BBC's Chief Engineer, R. T. B. Wynn, and the head of the Engineering Information Department, L. W. Turner.

Following the tours, which gave the group an insight into British television techniques, the gathering adjourned to the Clarendon Restaurant for a social hour and dinner.

### Nagoya

The chapter, in conjunction with the officers of the following Communications and Electronics organizations, gave a Communications-Electronics cocktail party at the Maruei Hotel on Decemer 30th:

Directorate of Communications-Operations, Hq. Fifth Air Force; 1809th AACS Group, 1808th AACS Wing; 5th Communications Group, 5th Air Force (Gifu); 1st Communications Squadron, 5th Air Force; Director of Maintenance-Engineering, Hq. Fifth Air Force; 848th AC&W Squadron, 41st Air Division (Gifu); Air Defense Division (AC&W), Hq. Fifth Air Force; Communications Section, 6101st Air Base Wing; Det. 3, 6922nd RG (Mobile), 6920th Security Wing; SSO 5th Air Force, 49th Fighter Bomber Wing.

Augusta-Fort Gordon Chapter installed new officers for 1957 at its December meeting. At center left, outgoing president, J. C. Woodward, congratulates and hands gavel to newly elected president, Col. B. E. Small. Looking on are Col. Otto T. Saar (left), 1955 president, and now honorary president, and E. H. Gibson, of Southern Bell, first vice president.

### New York (*Chapter N*

A lecture-demonstration on the
sistor, the mighty midget that is st
lining communication equipment
cepts, featured the chapter's Dece
19th meeting at the Belmont Plaz
tel. Mr. L. R. Blasius, communica
consultant of the New York Telep
Company, presented the program
discussed and demonstrated the
cations of the transistor in the
trial, domestic and military fields.

The chapter's annual elections p
into the presidency Col. Benjami
Oliver, Jr., Assistant Vice Presi
American Telephone and Tele
Company, who served as Chairm
AFCEA's 1955 National Conventi

Other officers were selected a
lows: vice presidents—Henry R.
New York Telephone Co.; Edwi
Carlson, Mutual Life Insurance
Col. Ludwig R. Engler, RCA Com
cations; treasurer—Maj. Theodo
Pope, Bell Telephone Laborat
secretary—Lt. Col. David Talley,
eral Telephone and Radio Corp.
cording secretary—Royal F. Je
Western Electric Co.

Directors: Vice Adm. Walter S.
derson, George W. Bailey, Col.
dore L. Bartlett, Thomas Brown.
RAdm. Roy W. M. Graham, Lt.
Hallahan, J. V. L. Hogan, Frederic
Lack, Maj. Gen. Francis H. Lan
Maj. Gen. Raymond C. Maude, Do
F. McClure, Col. Julian Z. Millar,
Thomas H. Mitchell, Milton G.
tress, Jr., RAdm. Ellery W. Stone.
Col. Allen E. Wharton.

### Northwest Florida

This chapter also featured the
sistor at its December meeting.
lecture-demonstration, entitled "
Mighty Midget—The Transistor,"
presented by Mr. D. W. Cusic, re
sentative of the Southern Bell
phone and Telegraph Company, Pe
cola.

Mr. Cusic traced the progress of
transistor from its conception in
Bell Laboratories to the present
Many examples of the wide-scale
of transistors by the telephone indu
were given. Implemented by work
laboratory models, the program
sented many capabilities of transis
and their application to industry
daily life.

### Philadelphia

The chapter's Christmas party
held at the Navy Officers Club, Ph
delphia Naval Base, on December
and was attended by 150 members
guests.

This annual social event of the ch
ter enjoyed its traditional success.
program began with a cocktail h
and was followed by dinner and da
ing, with music furnished by the N
Combo.

### Pittsburgh

December 14th was the date of
Pittsburgh Chapter's annual holic
celebration. (*See next page*)

ɫld at the East Liberty Armory, a ·d turnout of members and guests l and danced in a holiday atmos- e, with an orchestra and vocalist ıg the mood. Valuable door prizes, a grand prize consisting of an color television set, highlighted ·estivities.

### amento

)ur Mr. Sun," the Bell System film h predicts developments in the of solar energy, was the program ıre of the December 6th meeting at Signal Depot Officers' Club.

mong the interesting features in the are: attitudes toward the sun held ıncient man; physical properties of sun—size, weight, composition; the e surface—the corona, sunspots, r explosions; how the sun burns; the sun produces food; and man's mpts to harness the sun's tremen- s energy.

uring the business session, Lt. Col. rence M. Godfrey of the Sacramento ıal Depot was elected chapter presi- ı for 1957. Capt. Robert J. McMor- ·, also of Sacramento Signal Depot, ı re-elected secretary.

### *n Francisco*

The Stanford Research Institute at ılo Park was host to the chapter on cember 6th, with over 150 members l guests attending.

Following a congenial get-together l dinner, the group reconvened at the titute's auditorium at Stanford Vil- ge. Here members of the research ff gave a brief outline of the several ases of research work being done at I. This includes studies in basic and plied sciences as well as research in e field of economics. The Institute also engaged in research for foreign mpanies and governments.

The group was divided into small its and given a personal escort rough the laboratories. The tour in- ıded a visit to "ERMA," the Elec- ·nic Recording Machine-Accounting on to be installed for a large banking ganization, and visits to the vacuum be, the antenna and color television boratory.

### *ott-St. Louis*

Major General Gordon A. Blake, As- stant Deputy Chief of Staff, Opera- ıns, USAF, and a National Director f the AFCEA, was the principal speak- · at the chapter's fifth anniversary anquet on December 7th. Other dis- nguished guests were: Lt. Gen. harles T. Myers, Commanding Gen- ral, Air Training Command Head- uarters, Scott AFB, and Mrs. Myers; laj. Gen. E. H. Underhill, Vice Com- ıander, Air Training Command Head- uarters, and Mrs. Underhill; John M. Black, Vice President, Southwestern Bell Telephone Company; AFCEA's National President Percy G. Black and Regional Vice President John R. How- and.

Discussing the importance of electronics in military operations, General Blake said, "A keen awareness of the vital defense role to be played by electronics is forcefully exemplified today by our prodigious outlay of funds and effort to build a Distant Early Warning line as the keystone for our countering action against attack." He went on to point out the function of the DEW line in the present and future pattern of defense operations, describing some of the technical obstacles and transportation and construction problems which had to be overcome in building this radar warning system.

He cited two new communications techniques — ionospheric and tropospheric scatter—which provided the answer to the greatest technical difficulty, that of developing a reliable communications system which would tie the warning net together.

The General's talk was supplemented with slides and the recent Western Electric Company film on the DEW line. General Blake also had available for examination by his audience a section of a DEW line plastic radome which covers the search antennas of rotating radar units and which stands up under winds of 180 miles an hour.

The chapter was also addressed by President Black who gave a comprehensive report on association activities in the U. S. and overseas, and by Regional Vice President Howland who pointed out the aims and objectives of AFCEA chapters.

Approximately two hundred members and guests turned out to celebrate this fifth anniversary of the chapter's founding. The banquet was held at Augustine's Restaurant in Belleville, and was followed by a dance.

### *Switzerland*

The Switzerland Chapter held a luncheon meeting at the Hotel du Rhone, Geneva, on December 12th. Chapter President John Gayer welcomed several distinguished visitors, including Harold G. Cowgill and M. H. Woodward, Chairman and Vice-Chairman, respectively, of the U. S. Delegation to the International Telegraph Consultative Committee.

The main item of business was the election of officers for 1957. William Powell Lear, Lear Radio, was chosen president, with the other new officers as follows: vice president for Berne—Col. Robert Miller, SigC; vice president for Geneva—Gerald C. Gross, International Telecommunications Union; vice president for Zurich—Robert F. Holtz, General Manager, RCA Laboratories; secretary—Robert V. Lindsey, C.C.I.R., International Telecommunications Union; treasurer—Cdr. Henry F. Nichol, USNR, American Consulate General.

The following committee chairmen were selected: program—Jack Reid, RCA International Division, Geneva; membership—Robert H. Berle, new TWA Operations Manager, Geneva; co-chairman for associate members—Maj. Clifford Stead, R.Sigs.

### *Tokyo* (*Chapter News*)

Vice Admiral Roscoe F. Good, Commander Naval Forces, Far East, addressed the November 30th luncheon-meeting at the Petty Officers Club, Yokosuka Navy Base, which was attended by 127 chapter members and guests.

He said, in part: "Years of duty in the Fleet—before, during the following two World Wars and Korea—have served only to intensify the sense of importance and urgency which attaches to communications and electronic research, development and application. Other years of duty as a Service Force Commander and as the Deputy Chief of Naval Operations for Logistics have given me knowledge and understanding of the interrelation of military requirements—problems complicated by a fast moving technology that turns such matters as design, production engineering, scarce materials, plant capacities and skilled labor shortages into one relentless struggle against obsolescence. These problems must be dealt with successfully if the military is to have the magic "Black Boxes" in the numbers and at the times and places it needs them.

"All operating forces are also fully aware of their continuing problems of installation and in-service maintenance. In the field, too, industry has helped tremendously by making technical representatives available — around the world and around the clock. Of course, we would like to have industry turn out equipment that needs no maintenance and perhaps someday it will. In the meantime, competent technical representatives are indispensable.

"As the Japanese Self Defense Forces expand in accordance with the six year or some subsequent plan, both Japanese industry and the military service will be confronted by similar problems. I am sure that contacts made at meetings such as this will be helpful in resolving them.

"I recognize, of course, the close liaison between industry and the military is one of the fundamental objectives of your association. The role of communications and electronics in military operations today is a controlling one and a vital one. Nothing we could do would over-emphasize its importance nor lessen the basic need for adequate and progressive industrial support.

"This afternoon you will tour the Ship Repair Facility, Yokosuka, one of the most important elements supporting our operating forces. It is of interest not only because of peculiarities of shipyard equipment and tools but because it is 95% manned by Japanese workmen. It is a working demonstration that the technical and professional standards of the U. S. Navy and the Japanese MSDF can be met by Japanese technicians and equipment. Similar examples can be shown by other military services. This is a good omen for the future."

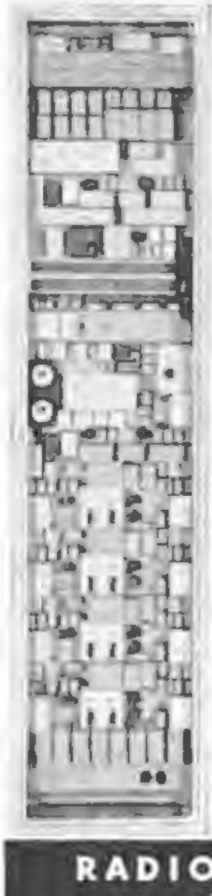
The guided tour of the U. S. Navy Ship Repair Facility was arranged by Capt. J. R. Moore, Commanding Officer of Ship Repair Facility, Yokosuka.

Vice Admiral R. F. Good, Commander Naval Forces, Far East, is shown addressing
**meeting of the Tokyo Chapter. Seated at the right is Rear Admiral A. E. Jarrell, Comm**
**Fleet Activities, Yokosuka. A tour of the Ship Repair Facility, Yokosuka, followed the me**

### *Washington*

Dr. W. L. Barrow, Vice President for Research and Development, Sperry Gyroscope Company, Division of Sperry Rand Corporation, delivered a candid appraisal of the defense electronic dustry before the January lunch meeting of the Washington Chapt

The enthusiastic reaction of the resentative audience of industry military members was such that major portion of Dr. Barrow's sp appears on page 6 of this issue for benefit of all SIGNAL readers.



*TRANSPORTATION*

*(Continued from page 20)*

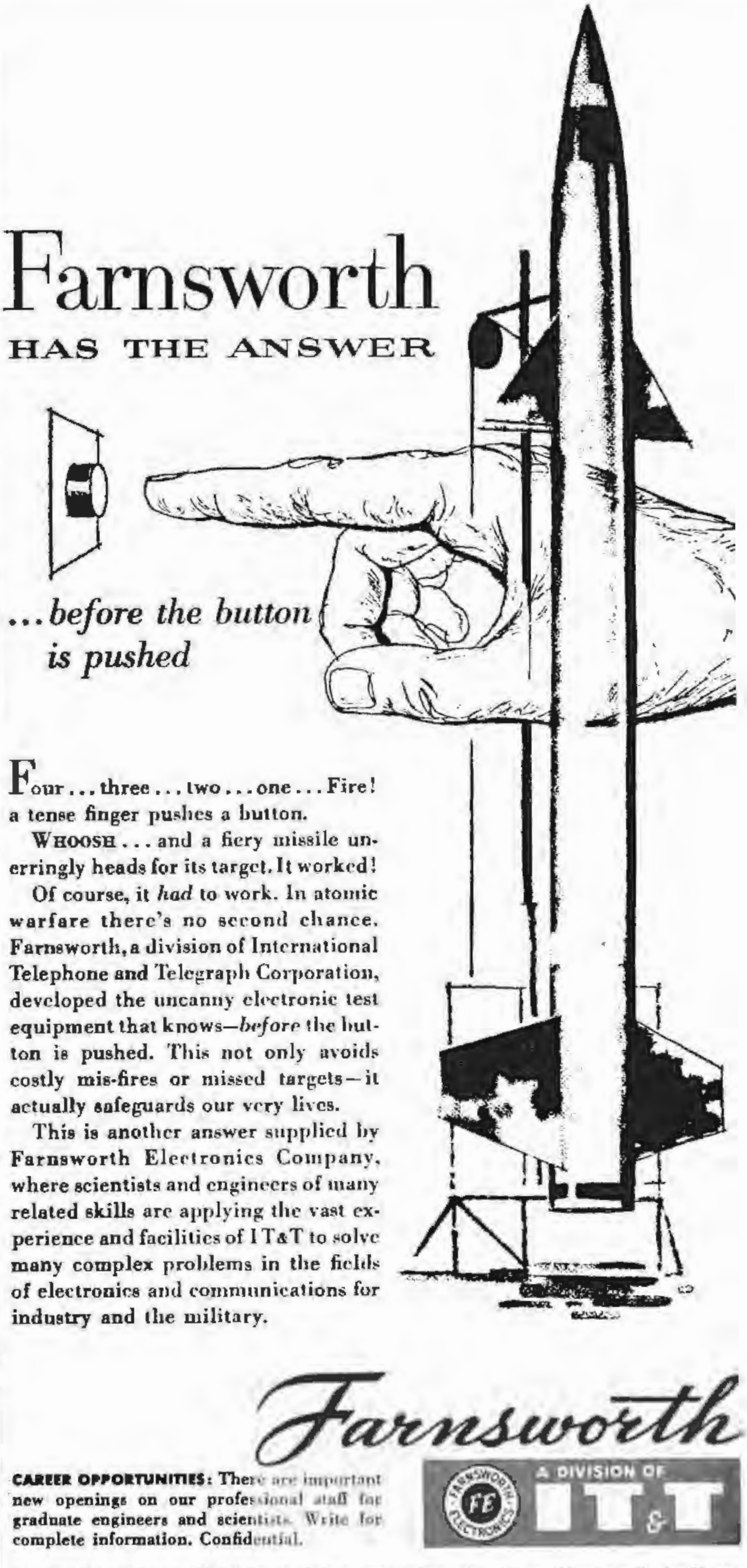
/ be had by first paying them, ıg a claim for refund thereof ich, after denial, will permit the itution of suit in the Court of ims.

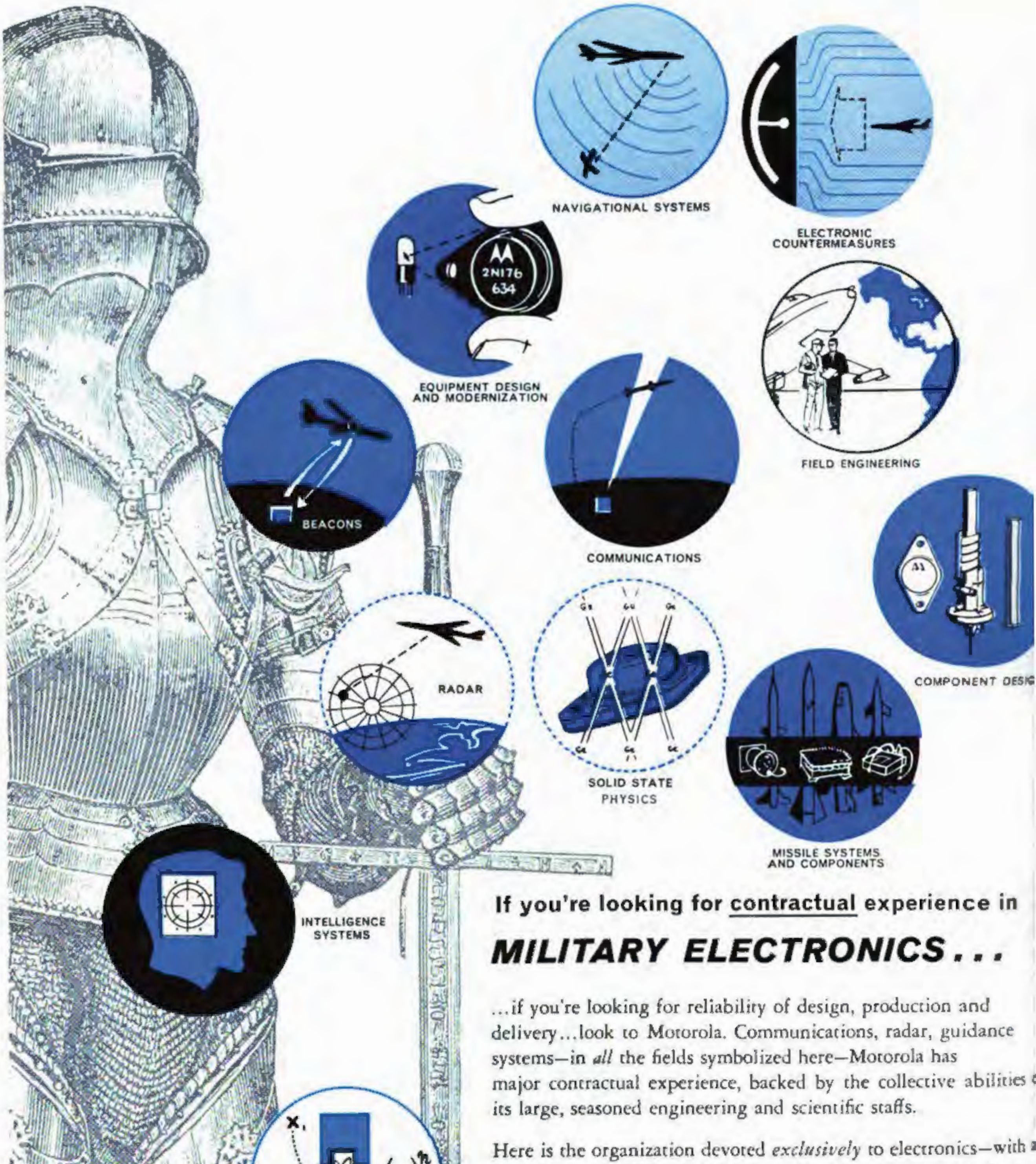
***Determining Factors***

n reaching its conclusion in this e, the Court logically pointed out h considerable telling effect that ngress, in imposing this tax on ppers, could not have intended t they should pay a tax simply ause a carrier performs a service connection with a transportation vement of their property for which amount is charged when, if it were ne by a person other than the carr, no tax would be due. While the rity of this is apparent in the cirmstances of this case where separte charges were made, what hapns when such services as refrigerat-g may be included as part of the nsportation charge? To state the estion would seem to answer it.

As indicated by this decision, the stinction, which apparently should : made, is dependent upon whether e service performed by the carrier, r which an additional charge is ade, is incident to the actual movent of the property by the carrier ı the course of transportation. If ı, the tax should apply. Applying is test along with the other one sugsted by the court, i.e., if someone her than the carrier performs the rvice, it would not be taxable, ould result in a significant change ı the practice and administration by e Commissioner of Internal Revene of this provision in his regulaons. That he is not going to depart, owever, from his former position is emonstrated by a recent ruling. In evenue Ruling 56-590, C.B. 1956-7, 23, he holds that while "stringing ipe" for oil and gas pipe lines is not er se taxable transportation of roperty, if it is done by the carrier hich hauled the pipe, it is accesorial thereto and a charge therefor s subject to tax. No tax is due, he oes on to say, if one other than the arrier of the pipe separately conracts with the oil and gas pipe line ompany to string the pipe.

As stated at the outset, the potentiality of this decision warrants following it with interest.





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**MOTOROLA**

**MILITARY ELECTRONICS DIVISION** 2710 N. Clybourn Ave., Chicago, Ill.
Other facilities: Phoenix, Arizona and Riverside, California

*ELECTRONICS INDUSTRY*

*(Continued from page 8)*

e basis. Its inherent latitude has le many of the most significant ntific and technical break-throughs sible. Government sponsorship feasibility studies and the like have de measurable advances possible all segments of the industry.

n outstanding characteristic of sent day procurement is pressure. it isn't pressure on costs, it's on rter lead time between weapon a and weapon in being. More en it's pressure on both. Then re is the pressure to incorporate nultitude of design changes to the uipment throughout production.

### *Industrial Complex*

Out of its expanding needs, the vernment has shaped a policy of ouraging and creating competi-, and in each area of this business finds many aggressive companies. host of small companies have rung up throughout the country to ecialize in components, parts, and b-assemblies. Many other com-nies have sizeable organizations d deal in equipments and systems. o this industrial complex has been dded a number of large companies ho have joined the defense elec-onics bandwagon. In contrast to e limited laboratories of the early ioneers, we now find giants of the utomobile, communications, and ectrical industries devoting limitless boratories to defense electronics.

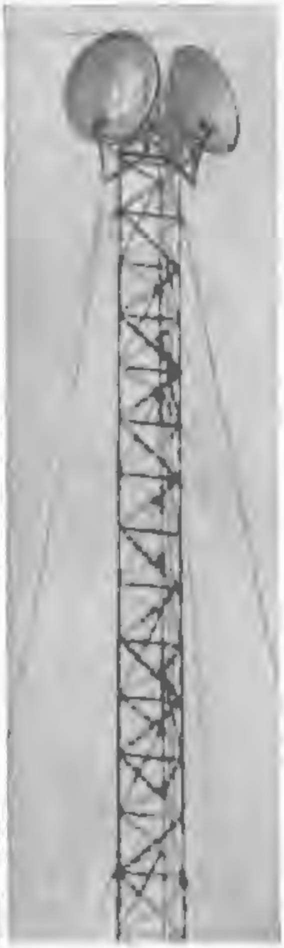
And today, there is underway a rge-scale movement by the major ircraft companies to enter the elec-tonics field directly through elec-ronics laboratories and divisions of heir own. The additions of such or-ganizations to the industry have not nly added millions of square feet of levelopment and production facili-ies, but they have in certain respects changed the nature of the competi-ion. Those devoted to the industry must also take into account certain organizations which have a somewhat preferred position in the complex. These are the university laboratories, institutional laboratories, military laboratories and other non-profit entities which constantly provide a challenge to the free-enterprise industries in the field. The key word in the industry today is competition.

An important industry trend—and you may have wondered how I managed not to mention it before—is the weapon systems concept. Here, too, competition exists, but in this case the key word is capability. To win, manage, and successfully bring to laudable completion the total respoosibility for a large weapon system program calls for a multiplicity of talents and abilities.

Only the very large companies, well-steeped in weapon systems philosophy and well-experienced in the management of large magnitude programs, can successfully execute such programs. It is in this area particularly that the aircraft, automotive and other industrial giants are changing the competitive environment for many old-line companies in defense electronics. Even the largest companies must often depend on Government facilities or support where peculiar requirements of the system cannot be met by the company. An individual company often cannot be expected to supply the larger, rapidly changing test facilities required for a major weapon development. These facilities, in the missile field, for example, must be specially designed for the most part and represent considerable capital outlay. This need has been answered by making Government furnished facilities and Government operated test locations available to contractors where necessary to complete its assignment.

### *Proprietary Rights*

Before closing this review of some of the major aspects of the industry, an important but little publicized problem should be mentioned, namely the problem of proprietary rights. In simplest terms, it is most difficult for industry to protect technical data which it wants to preserve for its own use in the face of a continual military trend to neutralize the rights provided under the Patent Statutes. Following what the government considers a mandate by the Armed Services Procurement Act to maximize competition, it often passes technical data from owner to non-licensed manufacturers. Although the Government agrees in principle that industry is entitled to compensation, it usually exhausts every avenue to get such data free and pass it on without compensating the proprietary owner.



# ITEMS OF INTEREST

## From Government, Industry and the Services

### Bell Labs Report On "Whiskers"

Bell Telephone Laboratories has announced the discovery of the fact that atomic radiation causes the growth of hairlike metallic strands on metals. "Whiskers," as the strands are called, appeared on certain types of telephone equipment and caused short circuits.

This fact is important since the use of tiny electronic parts in important industries has been accelerated. "Whiskers" could grow between minutely spaced metal surfaces and cause short circuits—a fact which must be taken into consideration when new electronic equipment is made.

Since the scientists at Bell have found these "whiskers" on platings of zinc, tin, and cadmium, the use of these metals has been discontinued and non-whisker sprouting metals have been put in their places.

### New Radar in London

The world's first completely crystal controlled all-weather surveillance radar has come into operation at London Airport. This system departs completely from conventional surveillance radar practice concentrating on the 3 cm and 10 cm operational bands. The system operates on the 50 cm band and is almost impervious to weather conditions. It incorporates a moving target indicator system to eliminate permanent echoes. The complete crystal control ensures high operational stability.

### Electronics in South Africa

The importance of industry in the Union of South Africa is rapidly growing. Every year existing plants are being reorganized and developed; new and up to date equipments are being introduced to serve new manufacturing programs.

These expanding industries, like industry throughout the world today, rely increasingly on the use of electronics. Consequently there is a demand in South Africa for the development of an internal electronics industry that will be able to meet the growing requirements.

To help in this development and to increase and strengthen their service in the Union both technically and commercially, Mullard Overseas Limited of London has joined the South African Company to organize a technical service department, the object of which will be to provide information on the latest electronic developments and supply application information and technical advice. This service is considered essential to any industry that uses electronic equipment.

### Innovation in Recorded Music

Recorded music with up to eight hours of uninterrupted playing time, comparable in quality to any Hi-Fi recording, is now available in a small package not larger than twice the size of an average pocketbook edition. This novel invention was developed after fifteen years of intensive research by the Tefifon-Company in Germany and may revolutionize the entire music reproducing industry, superseding the long-playing record as well as music prerecorded on tape.

Distributed in the United States by the Audio-Master Corporation, this new tone reproducer combines the simplicity of a record with the advantages of tape, yet it is neither tape nor record. The sound is an engraved process on pure vinylite with an average of 82 grooves on a ½-inch band and is self-contained in a cartridge the size of a small book, 6 x 5½ inches.

To play a Sound Book, the windowface is first slid back and the soundband extended in a loop which is then placed around the playing wheel of a special playback machine in the same manner that a record is placed on a turntable. The needle is then set against the soundband and the music starts instantly. If a specific tune or movement is desired, the music selector spots it immediately. In play, the soundband revolves in the form of a figure eight, winding and rewinding automatically, thus eliminating the winding, rewinding, or spooling necessary in ordinary tape playback machines.

Furthermore, the Tefifon soundband cannot break as is the case when tape is handled by inexperienced hands. Since Tefi-tape is engraved, it cannot be erased erroneously, thereby destroying a valuable and expensive recording.

Of utmost importance is the fact that Tefi-tape can be mass produced quickly and inexpensively in the same manner as records are pressed,
Tefi-tapes are not limited to only
hour of play as in an LP record
can play 2, 3, 4, and even 8 hour
interruptedly.

### Peaceful Use of Atomic Ener

Small, easily transportable nuc
power plants may soon be gener
electricity in remote mining
and serving as atomic workho
for scores of other industrial use
comparatively undeveloped count

The dream of the ultimate peac
use of atomic energy may becom
reality in this, a bid by The Ha
Siddeley Group Ltd. of Britain,
leadership in the "new indus
revolution."

This project is important bec
it will provide easily transporta
small reactors to countries w
will not be able to build their
for a long time to come.

Work has been begun on a liq
metal fuel type of reactor w
promises to make more efficient
of uranium. The U. K. Atomic
ergy Authority has said that this
one of Britain's most advanced p
ects.

Applications of these lines of
search are expected in the generat
of electricity, including plants for
mote areas such as may be requi
in the mining industry, for mar
propulsion and for the production
process heat.

### New B.B.C. Television Studios

The British Broadcasting Corpo
tion has recently put into operatio
use new television studios in W
London, which represent the wor
most advanced design in studio te
niques.

The electronic equipment inclu
ten camera channels, together w
Vision Mixers of an entirely n
type, and a considerable quantity
ancillary equipment, most of wh
has been supplied by Marconi Wi
less Telegraph Co. Ltd. of England.

The Vision Mixing equipment
of particular interest, being of a v
advanced type. Very flexible in o
eration, it has been designed to me
all requirements. It will simplify t
smooth presentation of such items
captions appearing over backgrou
shots, and will prove particular
valuable at the beginning and endi

productions, where such presenta-
n must be changed rapidly.

## Colonel Shannon Retires

olonel Frank J. Shannon, Special
istant for Electronics to the Di-
tor, Directorate of Maintenance
gineering at Headquarters, Air
teriel Command, has recently re-
d, after more than 26 years of
ive and reserve duty. He is a mem-
of the Armed Forces Communi-
ions and Electronics Association.

## New Position for Curtis

Mr. Sidney R. Curtis has recently
come Senior Vice-President of
omberg-Carlson.

A native of Rochester, N. Y., the
w vice president has been with the
mpany since 1925 when he received
s degree from Yale University. He
vanced rapidly, occupying many
portant executive positions through
e years. Before his recent promo-
on he was Vice President in charge
Government Contracts and head of
e new Electronics Division.

Mr. Curtis is a senior member of
e Institute of Radio Engineers,
he Armed Forces Communications
d Electronics Association, and is
ice Chairman of the Military Prod-
cts Division of the Radio Electron-
s Television Manufacturers Asso-
iation.

## General Lanahan Made President Of Federal Electric

Major General Francis H. Lanahan, USA (Ret) has been elected President of Federal Electric Corp. of Lodi, N. J., which is the field service and maintenance subsidiary of International Telephone and Telegraph Corp.

He joined Federal Electric in 1955, accepting the post of vice president and general manager, shortly after his retirement from the U. S. Army Signal Corps. The following year, he was elected executive vice president.

General Lanahan joined the Signal Corps in 1926. During World War II he was Chief Signal Officer for the Allied Expeditionary Forces in Europe. Later, he returned to the U. S. to serve as Commanding General of the Signal Corps Center at Fort Monmouth, N. J. In 1951, he was again assigned to overseas service in Europe as the first Chief Signal Officer of the Supreme Headquarters of the Allied Powers in Europe (SHAPE). In 1952, he returned to the U. S. as Deputy Director of Logistics for the Army until his retirement.

## Fermi Professorship To Be Established At University of Chicago

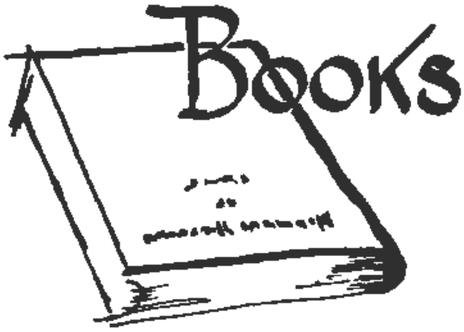
Bell Telephone Laboratories plans to endow an Enrico Fermi Distinguished Service Professorship at the University of Chicago in memory of the world renowned nuclear physicist.

Often referred to as "the architect of the atomic age," Enrico Fermi is perhaps best known as the first man to achieve the controlled release of nuclear energy. His classic experiment in this field was carried out at the University of Chicago where, on December 2, 1942, the first controlled nuclear chain reaction was demonstrated. Other achievements of his include studies which led to artificially produced radioactivity and to the control of thermal neutrons, used in several types of modern power reactors. In 1938 Dr. Fermi was awarded the Nobel Prize "for his identification of new radioactive elements produced by neutron bombardment and his discovery, made in connection with this work, of nuclear reactions effected by slow neutrons."

## New Air Force Interceptor

The Air Force's latest all-weather jet interceptor, the Convair F-106A, was test flown for the first time at Edwards Air Force Base, Calif.

The F-106A is equipped with the most advanced electronic fire control system and armament yet developed for an Air Force interceptor. The interceptor and its deadly air-to-air armament are designed to operate at stratospheric altitudes.



***MICRORECORDING — INDUSTRIAL AND LIBRARY APPLICATIONS, by Chester M. Lewis and William Offenhauser, Jr., vol. VII. Interscience Publishers, Inc., New York, N. Y. 456 pages, $8.50.***

Modern microfilming covers the whole process of recording, reproducing and viewing, indexing and storing all the recorded data that should be accessible to the user. Book literature covering microrecording in general is rather scanty.

Although it is specifically aimed at industrial and library applications, the wide range of technical information covers the microrecording process, films, cameras, readers, and copying. Chapters include business and legal requirements for research retention; processing, projection, and enlargement; and information classification.

***THE OSCILLOSCOPE AT WORK, by A. Haas and R. W. Hallows, Philosophical Library, New York, N. Y. 171 pages, $10.00.***

Mr. Hallows has translated this volume from its French counterpart, but his many additions and changes render the work more than a mere translation.

A practical guide to applications of the cathode-ray oscilloscope in its many areas of use in the electronics field, this manual concentrates particularly on the application of the oscilloscope in radio and television.

Following a study of measuring electrical magnitudes, the text discusses audio-frequency and radio-frequency amplifiers. The elements of these amplifiers are delineated by photographs showing the distortions that result from poorly adjusted frequencies.

In the section devoted to oscillators, the text illustrates how to deliver a voltage at a required frequency with minimum distortion.

The closing chapter is devoted to improvements and additions such as eliminating the backstroke and using an electronic switch.

It is the author's premise that the oscilloscope has great promise for important new applications in the tronics field.

***THE GENERATION OF ELECT CITY BY WIND POWER, by E. Golding. Philosophical Library. York, N. Y. 318 pages, $12.00.***

In this age of electrical power, possibilities of inexhaustible sour of energy from which power can generated are being considered se ously. This book gives an accou of the research and development the last few years that have been voted to conquering the wind.

A discussion of wind—its struct and energy—is followed by a crit of existent wind-driven machines. T bulk of the book is devoted to evaluation of these machines, physics and economics involved. determine the expediency of leashi wind in large quantities to genera electricity.

The text points out that in us wind as a source of power, the gre est difficulty is that the network, in which the power is fed from win driven machines, must receive power at any time.

This problem can be overcome, author concludes, when wind is co bined with several energy sources maximum power in the generation electricity.

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Type M20
VARIAC

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- ★ High and low temperature lubrication (mil grease)
- ★ Iridite treated aluminum parts
- ★ Fungicidal treatment of all phenolic parts
- ★ NEW, nickel-plated brush holder

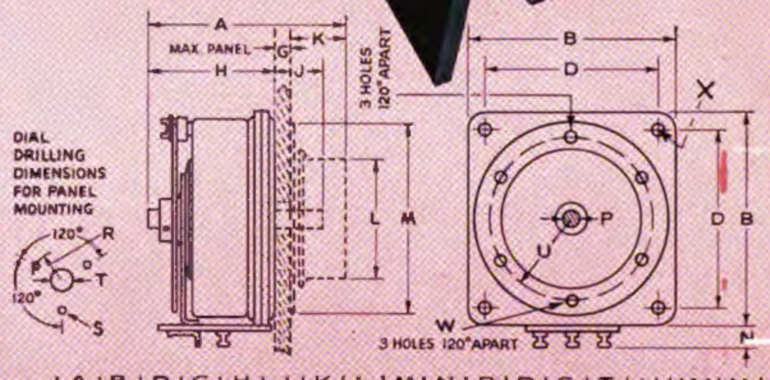
Operates at any frequency tween 350 and 1200 cycles. New brush assembly removle radially for easier accesility; has low sprung weight, l springs, pigtails to carry rrent, improved heat trans to radiator, limited travel.

As in other "M" high-frequency VARIACS, the M20 Series features stamped base and radiator for improved shock resistance and protection; improved heat transfer between coil and base for cooler operation.

## pecifications type M20 Variac

| | |
|---|---|
| **Input Voltage:** | **115 volts, 350 to 1200 cycles** |
| **Load Rating (kva)** | **3.0** |
| Output Voltage | 0–115 or 0–135 |
| Rated Current (amp) | 20.0 |
| Maximum Current (amp)* | 26.0 |
| No-Load Loss at 400 c. (watts) | 27 |
| Dial Calibration | 0–115 and 0–135 |
| Angle of Rotation (deg) | 319 |
| No. Turns on Winding | 169 |
| D-C Resistance, 20°C. | 0.153 ohm |
| Driving Torque (oz.-in.) | 30–60 |
| Replacement Brushes | VBT-8 $2.00 |
| Net Weight (lbs.) | 13 |
| Code Word | CAVIL |
| Price | $48.00 |
| Ball Bearings (surcharge) | 8.00 (add "BB" to Type No.) |

*For 0 to line-voltage output connection only



| | A | B | D | G | H | J | K | L | M | N | P | R | S | T | U | W | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M20 | 5 11/16 | 7 1/2" | 6 1/4" | 1/2" | 3 9/16" | 1 1/2" | 1 5/8" | 4 1/2" | 7 | 17/32" | 1/2" | 5/8" | #31 | 5/8" | 3" | 1/4-28 | 3/8 |

## type M20 Variac® Assemblies

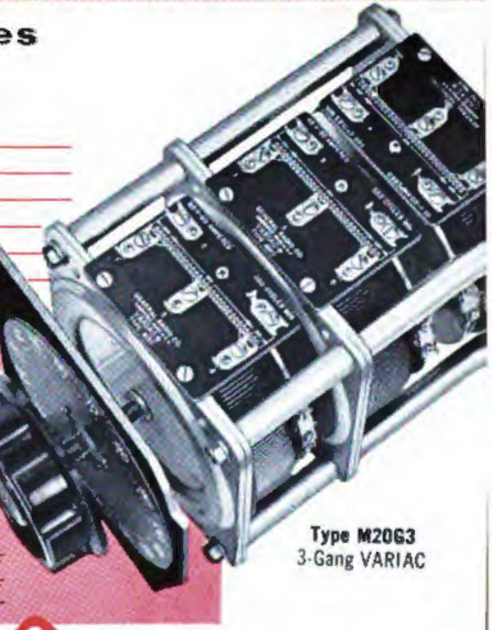
### for 350 to 1200-Cycle Service

M20G2
2 VARIAC

| | 2-Gang<br>M20G2<br>Uncased | 3-Gang<br>M20G3<br>Uncased |
|---|---|---|
| Dial Calibration | 0-10 | 0-10 |
| Driving Torque (oz.-in.) | 60-120 | 90-180 |
| Net Weight (lbs.) | 26½ | 38½ |
| Code Word | CAVILGANDU | CAVILGANTY |
| Price | $107.00 | $155.00 |
| Ball Bearings (surcharge)* | $ 10.00 | $ 12.00 |

*Add suffix "BB" to Type Number

| | A | B | D | E | G | J | K | L | M | N | P | R | S | T | V | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M20G2 | 7 3/16" | 7 1/2" | 6 1/4" | 3 1/8" | 1/2" | 1 1/2" | 1 5/8" | 4 1/2" | 7 | 17/32" | 1/2" | 5/8" | #31 | 5/8" | 1/4-28 | 7/32 |
| M20G3 | 10 3/4" | 7 1/2" | 6 1/4" | 3 1/8" | 1/2" | 1 1/2" | 1 5/8" | 4 1/2" | 7 | 17/32" | 1/2" | 5/8" | #31 | 5/8" | 1/4-28 | 7/32 |



Type M20G3
3-Gang VARIAC

# GENERAL RADIO Company

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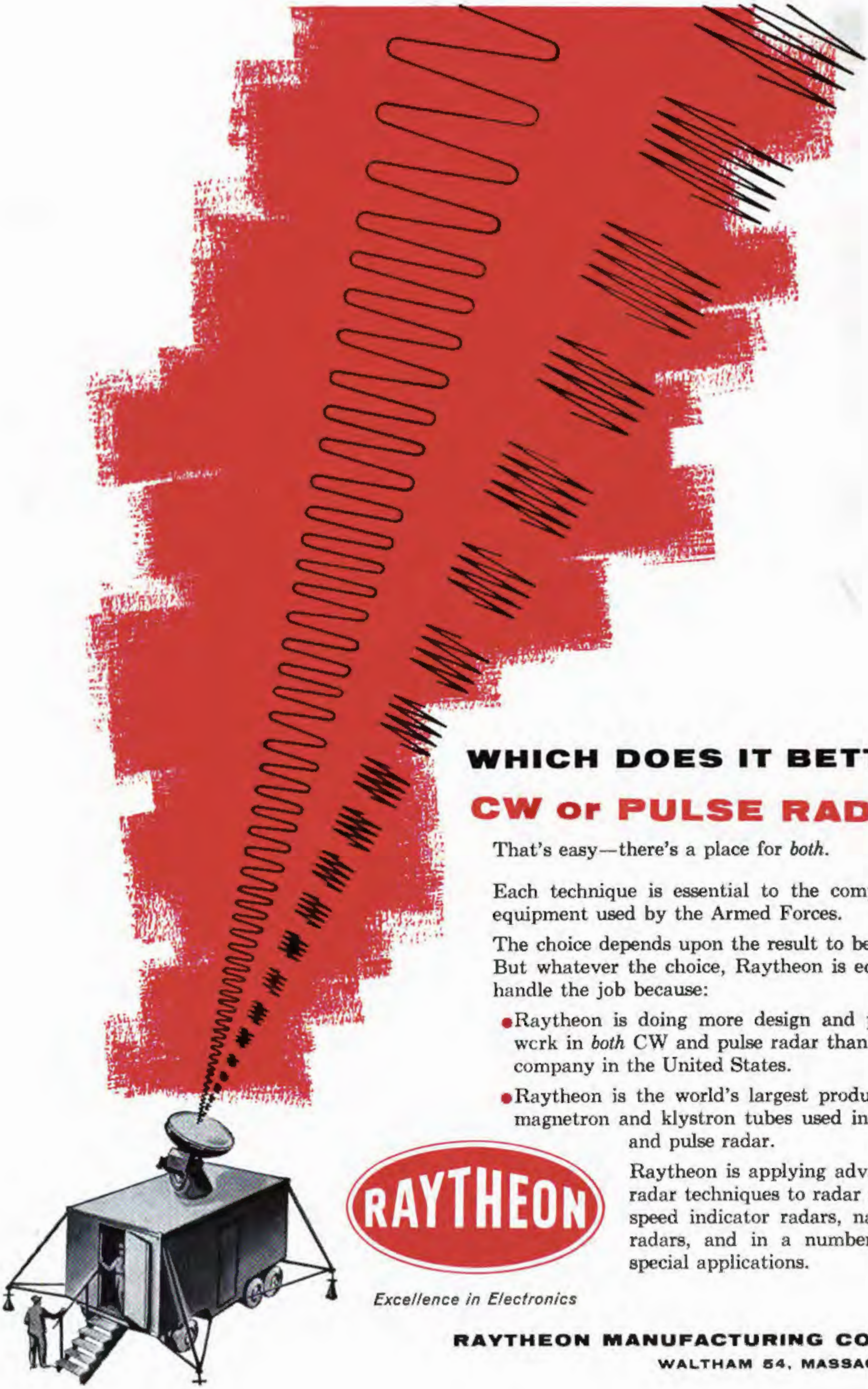


# WHICH DOES IT BETTER –
# CW or PULSE RADAR?

That's easy—there's a place for *both*.

Each technique is essential to the complex radar equipment used by the Armed Forces.

The choice depends upon the result to be achieved. But whatever the choice, Raytheon is equipped to handle the job because:

- Raytheon is doing more design and production work in *both* CW and pulse radar than any other company in the United States.
- Raytheon is the world's largest producer of the magnetron and klystron tubes used in both CW and pulse radar.

Raytheon is applying advanced CW radar techniques to radar altimeters, speed indicator radars, navigational radars, and in a number of other special applications.

RAYTHEON

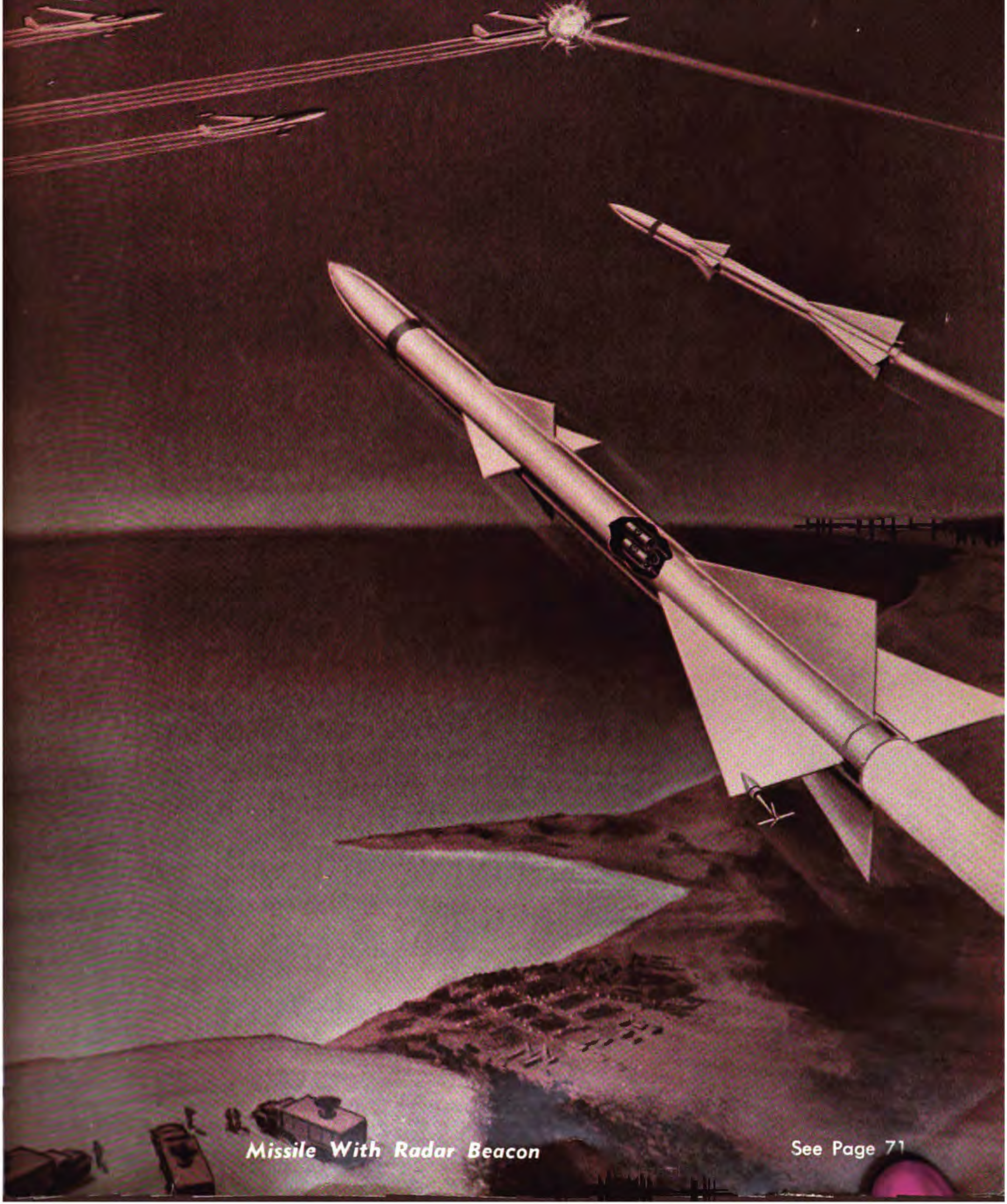
*Excellence in Electronics*

**RAYTHEON MANUFACTURING COMPANY**
**WALTHAM 54, MASSACHUSETTS**

March 1957

Communications—Electronics—Photography

# SIGNAL



Missile With Radar Beacon

See Page 71

# DOTS

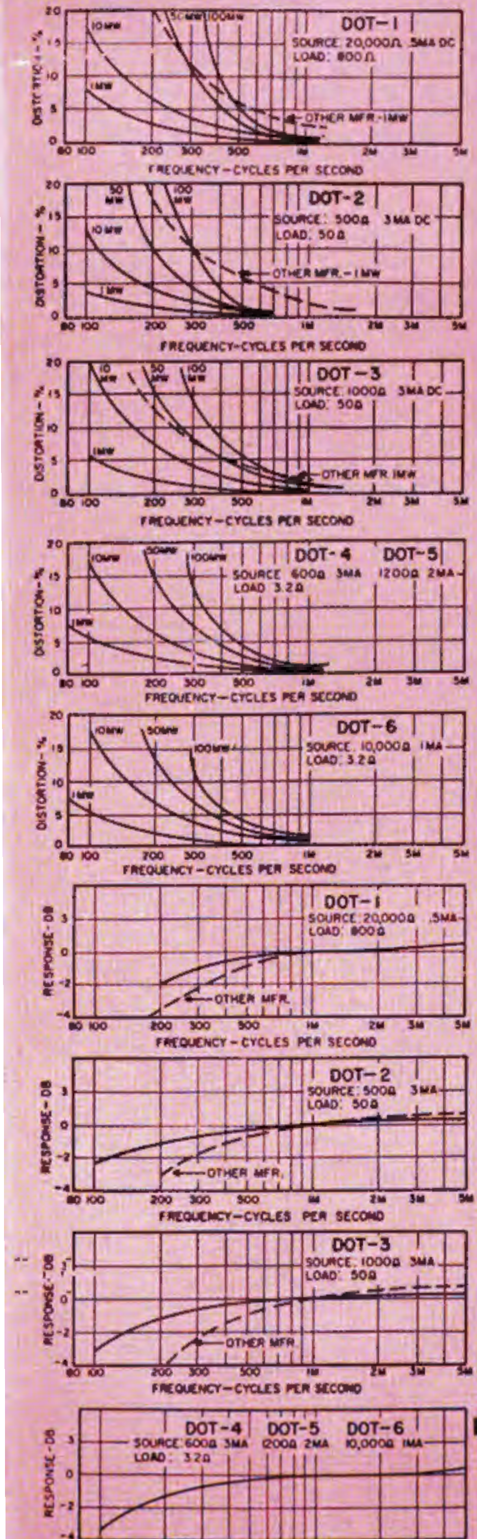
## Deci-Ouncer Transforme

### REVOLUTIONARY TRANSISTOR TRANSFORMERS

of unequalled power handling capacity and reliabi

### TYPICAL DOT PERFORMANCE CURVES

Power curves based on setting output power at 1 KC, then maintaining same input level over frequency range.



*DOT units have been designed for transistor applications only . . . not for vacuum tube service **Pats. Pending

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| Type No. | Application | Level Mw. | Pri. Imp. | D.C. Ma.‡ in Pri. | Pri. Res. |
|---|---|---|---|---|---|
| DOT-1 | Interstage | 50 | 20,000<br>30,000 | .5<br>.5 | 850 |
| DOT-2 | Output | 100 | 500<br>600 | 3<br>3 | 60 |
| DOT-3 | Output | 100 | 1000<br>1200 | 3<br>3 | 115 |
| DOT-4 | Output | 100 | 600 | 3 | 60 |
| DOT-5 | Output | 100 | 1200 | 2 | 115 |
| DOT-6 | Output | 100 | 10,000 | 1 | 1000 |
| DOT-7 | Input | 25 | 200,000 | 0 | 8500 |
| DOT-8 | Reactor 3.5 Hys. @ 2 Ma. DC | | | | 630 |
| DOT-9 | Output or driver | 100 | 10,000<br>12,500 | 1<br>1 | 930 |
| DOT-10 | Driver | 100 | 10,000<br>12,500 | 1<br>1 | 930 |
| DOT-11 | Driver | 100 | 10,000<br>12,500 | 1<br>1 | 930 |
| DOT-12 | Single or PP output | 500 | 150 CT<br>200 CT | 10<br>10 | 11 |
| DOT-13 | Single or PP output | 500 | 300 CT<br>400 CT | 7<br>7 | 20 |
| DOT-14 | Single or PP output | 500 | 600 CT<br>800 CT | 5<br>5 | 43 |
| DOT-15 | Single or PP output | 500 | 800 CT<br>1070 CT | 4<br>4 | 51 |
| DOT-16 | Single or PP output | 500 | 1000 CT<br>1330 CT | 3.5<br>3.5 | 71 |
| DOT-17 | Single or PP output | 500 | 1500 CT<br>2000 CT | 3<br>3 | 108 |
| DOT-18 | Single or PP output | 500 | 7500 CT<br>10,000 CT | 1<br>1 | 505 |
| DOT-19 | Output to line | 500 | 300 CT | 7 | 19 |
| DOT-20 | Output or matching to line | 500 | 500 CT | 5.5 | 31 |
| DOT-21 | Output to line | 500 | 900 CT | 4 | 53 |
| DOT-22 | Output to line | 500 | 1500 CT | 3 | 86 |

‡DCMA shown is for single ended useage (under 5% distortion—100MW—1KC) . . . for push pull, DCMA any balanced value taken by .5W transistors (under 5% distortion—500MW—1KC)

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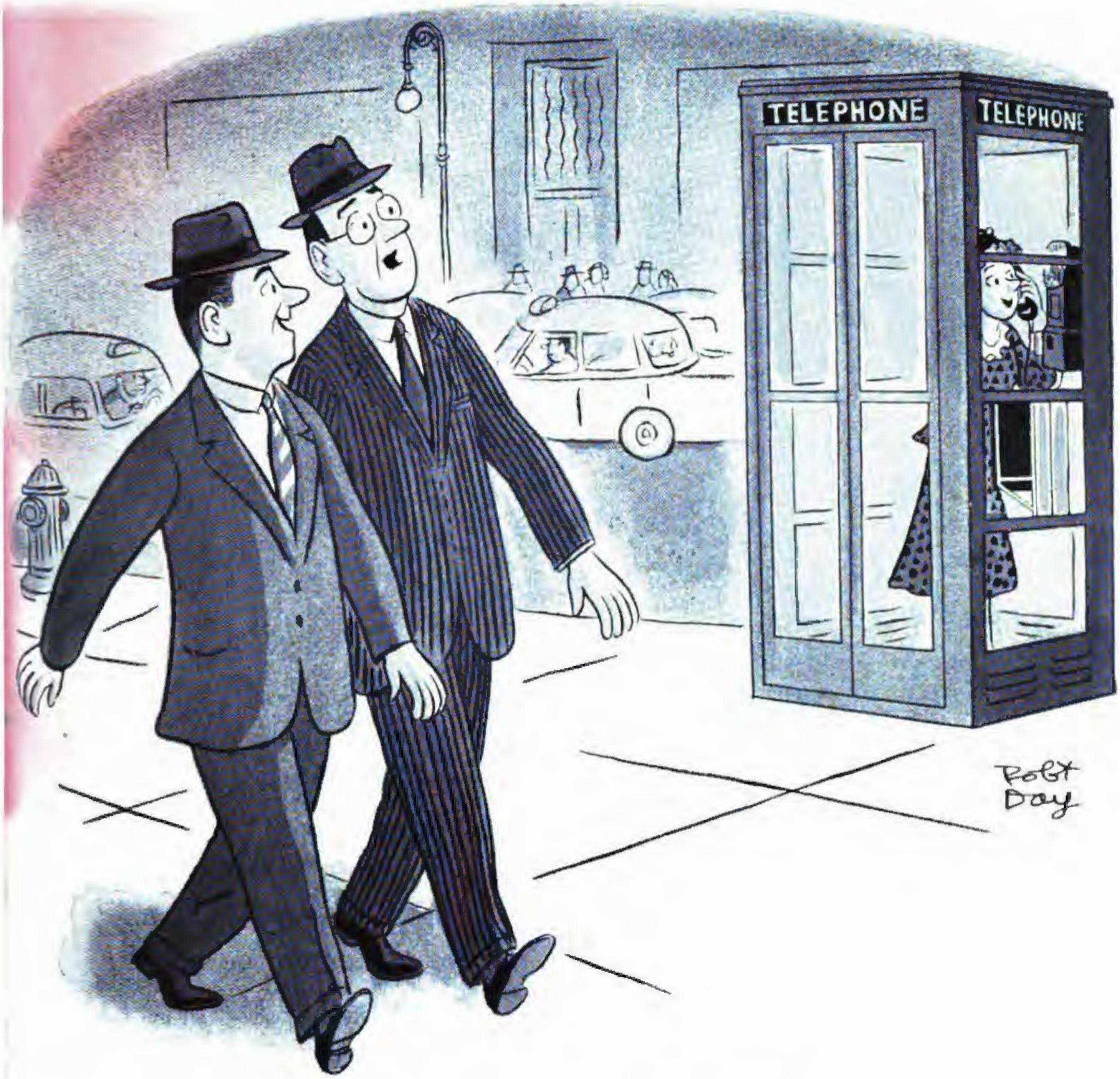

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*Pictured at left: Lewyt's Coordinate Data Monitor, employs new, improved techniques to synchronize rotation of PPI display with that of remote radar antennas.*

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# SIGNAL

## Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XI MARCH 1957 NUMBER 7

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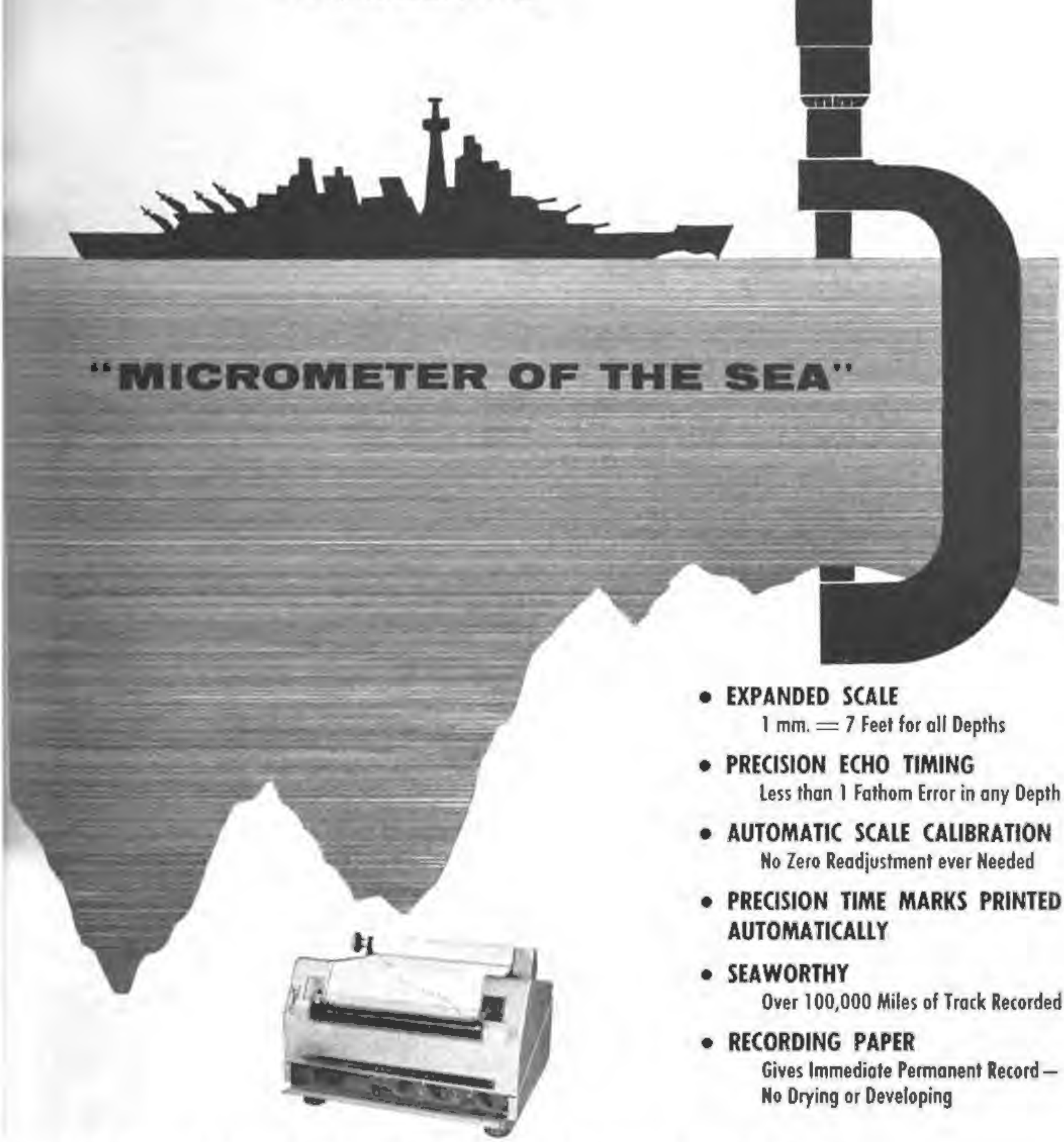

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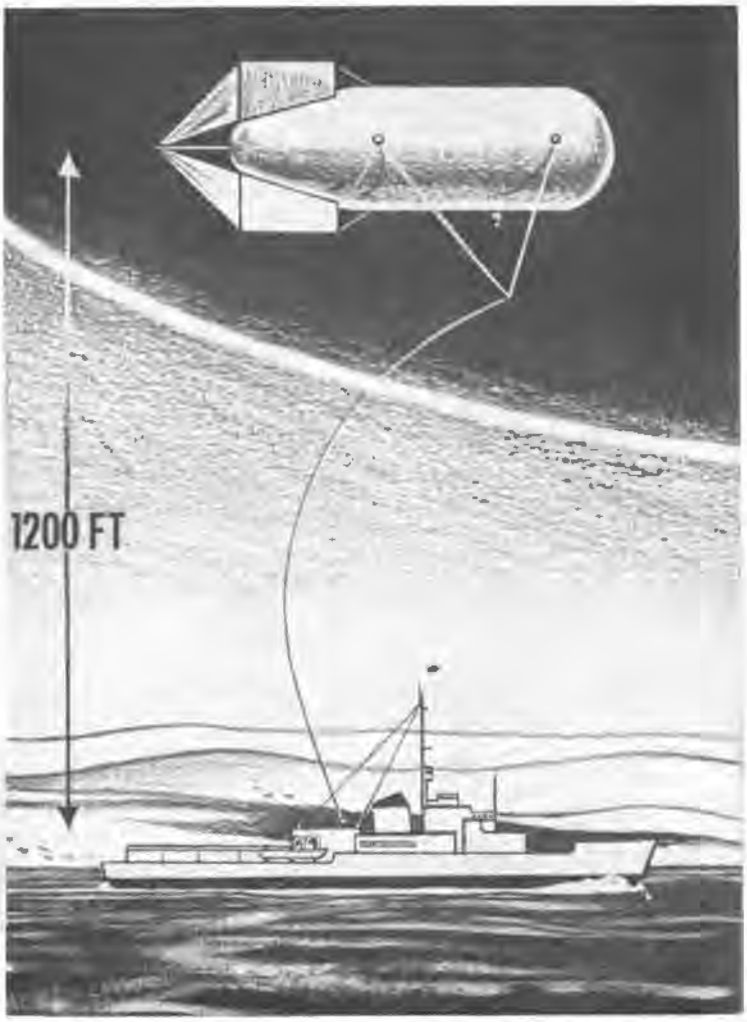
# Recent Developments in Naval Communications-Electronics

## An address presented to the South Carolina Chapter of the AFCEA

by Rear Admiral
**H. C. BRUTON, USN**
DIRECTOR OF NAVAL COMMUNICATIONS



A 1200-foot balloon-supported antenna, developed by the Naval Research Laboratory, enables effective communications from polar latitudes using low frequencies, near 200 kilocycles.

I WOULD LIKE TO DISCUSS BRIEFLY some recent developments in communications-electronics by or within your Navy.

Stability and other considerations delayed the introduction of single sideband techniques into the Fleet after the single sideband had already proved itself in reliable day-to-day use in our point-to-point circuits. With improvements in equipment and techniques and the need to take the final step, the Chief of Naval Operations last year established the firm policy that all future procurement of M/HF equipment for ships and large naval aircraft must have a single sideband capability, or be readily adaptable to employ single sideband. Once the step was taken, all hands became enthusiastic about our single sideband conversion program, which is aimed particularly at today's needs for communications between widely dispersed ships and formations of the atomic-age Navy.

Our objective is, first, to establish a single sideband, single-channel, voice capability, and as soon thereafter as possible, to utilize this technique for multi-channel RATT (Radio Teletype) and data transmission.

We now have a limited quantity of commercial-type single sideband equipment in the Fleet for demonstration and special uses. We have an approved program for militarized single sideband equipment for many of our ships, but the equipment for this program is not expected to be ready for installation for about two years. Meanwhile, we expect to keep the single sideband technique alive in the Fleet, by meeting our most critical, immediate needs with the procurement of additional, though limited quantities, of the best commercial equipment available.

We in the military communications business, as with our friends in commercial communications, are constantly looking for new techniques or methods by which to give better service. An important recent advance of this nature is the application of forward scatter techniques to communications. This technique, undoubtedly familiar to most of you, uses radio propagation via VHF/UHF tropospheric scatter or VHF ionospheric scatter. By this means, it has been found that extremely reliable communications can be maintained almost continuously, over distances of about 300 to 400 miles from the transmitter using tropospheric scatter, and from about 600 to 1400 miles from the transmitter using ionospheric scatter techniques. You can readily appreciate the military's interest. Because of this interest, the Joint Communications-Electronics Committee of the Joint Chiefs of Staff organization (the coordinating body for all military communications) has developed and recently approved a plan for the military use of ionospheric scatter. This plan is world-wide in scope, and is completely joint in that it designates in specific areas a single military service to provide the circuitry for use by all military departments. The Navy is charged with the responsibility for providing circuitry and facilities across the North Atlantic, and between the continental U. S. and Alaska.

### *Frequency Problems*

The radio frequency considerations in regard to scatter communications are a problem of some magnitude, since, for example, the optimum frequency range over which ionospheric scatter works is approximately 25 to 60 mcs. A glance at the International Frequency Allocation Table will show that there are many important existing communication services in this frequency band. Another factor complicating the frequency problem is the scatter receiver, which, of necessity, must be so constructed as to be highly sensitive to bring in the weak scatter signal. This makes the circuit relatively vulnerable to interference in the immediate area surrounding the receiver. Still another important factor is the high power required at the transmitter end of the circuit.

In spite of these and other difficulties, we feel that some provision for the use of scatter is a "must," because of its many advantages.

The possibilities of scatter are such, that some day we hope to employ it in the Fleet. The adaptation of scatter techniques to the requirement of non-directional transmission is a real problem.

### *Powerful Transmitter*

1956 marked the year when we really got underway with our new Very Low Frequency Radio Station in Washington County, Maine, the most northeasterly county in the United States. $4,000,000 was appropriated in Fiscal Year 1956 to buy the transmitter. The site has been firmly selected after a most thorough and extensive survey by highly competent engineers. About 3000 acres of land will be required for the operational buildings and the complex antenna and ground system. The antenna is expected to be the most efficient type that is possible to build within a reasonable dollar-limit.

The Maine transmitter itself may be rated as high as 2000 kilowatts (twice as powerful as the Jim Creek transmitter in the State of Washington), and we shall be disappointed if this new station is not the most powerful and effective station of its kind in the world. Certainly, it will be the world's most powerful Hi-Fi amplifier, as it will operate in the vicinity of 15,000 cycles, a little high for an old fellow like me to hear even with its high power. Budgetary and other matters permitting, we hope to have this station in operation by about mid-1960.

### *Future Planning*

Completion of this new station will provide the Navy with four high-powered VLF stations. To cover the Western Pacific, we also now operate under lease a medium-powered (250 K.W. alternator) Japanese VLF transmitter at Yosami, Japan. Our future planning provides for a fifth VLF station at Guam.

At the present time, we operate these expensive, powerful VLF stations on single channel, slow speed CW, because, even at their present limited capacity, the propagation characteristics of VLF frequencies provide advantages, particularly for

**Among the many problems facing naval communicators in the antarctic are extreme, high winds, unusual atmospheric conditions, auroral phenomena, abundance of snow, and temperatures of 80 degrees below zero.**

naval use, that are unattainable at other frequencies.

We hope that developments now underway will soon permit the operation of these stations at teletypewriter speeds, and eventually, on multi-channel RATT. When that occurs we will be getting a real return on our large investment in all of these stations.

### *Extension of Data Transmission*

The Navy is expanding the use of data processing and transmission ashore, based on our operating experience with electrical transmission by wire, of personnel data between Norfolk, Virginia, and Washington, D. C. Personnel accounting activities on both the East Coast and West Coast are already connected directly to the Washington headquarters by means of punched card transceiver equipment and leased landline facilities. We are planning the extension of this service, by radio links, to major overseas manpower data relay stations. Also planned for calendar years 1957 and 1958, is the extension of data transmission to personnel accounting machine installations at all Naval District headquarters, training centers, receiving centers, and air training commands in the continental United States.

Data transmission is also being used increasingly by the Navy in supply management and operations. The Naval Aviation Supply Office in Philadelphia is now connected with selected supply stocking activities in the continental United States, through punched card transceiver equipment and connecting leased lines. Connections to more supply stocking activities, both continental and overseas, are planned.

It is also through data transmission that control and coordination will be exercised over new weapons systems and tactical formations of the atomic-age Navy afloat.

New techniques are being developed for shipboard use to transmit rapidly from ship to ship, the vast quantities of data required for air offense and defense, missile control, and anti-submarine warfare.

### *Significant Developments in Weather Communications*

The year 1956 recorded several significant developments in weather communications which have improved mankind's defenses against the weather. Two of these developments are the Navy's Automatic Weather Radio Stations, and Transosonde, or "Trans-Ocean Sounding System."

The Navy's Automatic Weather Radio Station consists of a free-floating buoy about thirty feet long. Equipped with a radio transmitter, the buoy is automatically programmed to transmit meteorological information, consisting of atmospheric pressure, air temperature, seawater temperature, and wind speed and direction, in a pre-determined sequence, at intervals of six hours for a period of two months, over a range of 1,000 to 1,200 miles. Although the average power of the transmitter is only 15 watts, it utilizes pulse techniques, providing the equivalent of up to 250 watts of radiated power.

### *Balloons Offer An Answer*

These radio robots are already providing the nation with hurricane and other weather information in the tropical Atlantic, the Caribbean and the Gulf of Mexico, whether or not ships are in the vicinity. Thus the Navy is now employing automatic radio devices to spy on the hurricane enemy, day and night, in the national interest.

As for Transosonde, a quick look at a map of the Pacific Ocean shows hundreds of thousands of square miles without even an island or atoll. There is no place except the sea in which to establish weather outposts —or so it would seem. In the continental United States, there are 66 stations reporting upper atmospheric

**USS ELDORADO in arctic waters "talked" with Navy amateurs at Little America, under the Navy's liberalized policy permitting licensed amateurs to man amateur radio stations in ships on isolated or unusual duty.**

conditions. Yet in the Pacific Ocean, the place of origin of the weather for the United States, our sources of information are scant compared to what they should be, and to what they are going to be, for weather information is vitally important not only to our national defense, but also to the economy and well-being of the Nation as a whole.

To Navy meteorologists, balloons offered an answer. Early in 1956, twenty unusual weather communications balloons were launched from Japan, with remarkable results, and with them was launched a new system of weather coverage.

These forty-foot plastic balloons, of a thinness of a cellophane cigarette wrapper, carry instrumented gondolas over distances of thousands of miles, gathering and transmitting vital weather information.

### *Navy's Amateur Radio Operations*

The Navy proposes to inaugurate the Transosonde system on a regular basis. This would provide radio-transmitted weather reports from about 108 mobile Pacific locations, which would compare favorably with the 66 stations now located in the continental United States.

Of particular interest to radio amateurs are the Navy's Amateur Radio Operations. In our Naval Reserve program, the Naval Reserve Training Centers and Electronics Facilities (consisting of 530 activities throughout the United States) are all active in amateur radio, in addition to their regular military training program activities.

### *Radio Staitons at Antarctica*

Until very recently, amateur operation in Navy ships was prohibited. The Navy in 1956 liberalized this policy to permit radio amateur stations in some ships that are on isolated or unusual duty, provided the Commanding Officer desires the station, that it can be manned by Navy personnel who are licensed amateurs, and that the station and its operation meet all FCC requirements. One of the first ships so authorized was the *USS Eldorado*, a communications-command ship engaged in Arctic Dew Line re-supply operations. During this operation Navy amateurs on board not only handled considerable traffic of a morale nature, but also established communications from points nearly Pole to Pole. A twenty minutes solid contact was established between the amateur station on board the *Eldorado* in arctic waters, and the Navy-sponsored amateur station at Little America in the antarctic.

We now have two Navy-sponsored amateur radio stations at Antarctica and others are expected to be established.

### *Amateurs Fill Vacuum*

The Navy has always recognized the importance of the amateur radio operator. He has proved his value during floods and other disasters, and in national emergencies when the skills of radio amateurs were a definite national defense asset. In 1917 when the United States declared war, there were approximately 6000 radio amateurs, and more than 4000 of them rendered valuable service in the military forces. During World War II, the radio amateurs again filled the vast vacuum in our military requirements for trained operators and technical personnel.

In the United States there are now in excess of 125,000 radio amateurs. Many of these are professionals engaged commercially or militarily in the electronics field. They enjoy radio as a hobby, yet often apply professionally the knowledge gained from their amateur activities. The Navy encourages its personnel to participate in amateur radio. Many Navy shore activities have been authorized to operate amateur radio stations and surplus equipment often has been provided for this purpose. We in the Navy recognize that the opportunity to construct equipment, experiment, and improve operating abi enhances the value to the Navy participating personnel.

### *Propagation Problems*

Our Naval Research Laborator were largely responsible for ma significant developments in commu cations-electronics during 1956. mention a few, Navy scientists d veloped the SKYHOOK, advanced Earth Satellite program, and ma radio contact with the planet Mars.

Propagation problems found the earth's polar regions were motivation for the development improved antennas for reliable tra mission on frequencies at or near 2 kilocycles. As one answer, the Nav Research Laboratory developed SKYHOOK, a helium-filled, zeppelin type balloon supporting a 1,200 fo

The ice-cold planet Mars emitted enough heat for Navy scientists to pick up the signals 35 million miles away with a dish antenna 50 feet in diameter.


ANOTHER EXAMPLE OF HOFFMAN LEADERSHIP
WHAT GUIDES
THE GUIDED MISSILE?


ACTUAL SIZE

antenna, which would enable a ship or fixed station to communicate effectively from the polar latitudes using low frequencies. A balloon-supported antenna has also been used by at least one shipboard VOA transmitter.

### *Radio Contact With Mars*

During 1956, the Naval Research Laboratory also completed its earth satellite model under Project Vanguard, and advanced preparations to carry communications toward space during 1957. The instrumented satellite will contain unique communications equipment. Project Vanguard may be expected to awaken more interest in space communications and sustain it longer among the peoples of the earth, than virtually any recent, single event.

Projecting communications beyond the satellite, radio contact with the planet Mars was accomplished by the Navy in the Fall of 1956. Even though Mars is a cold planet, its heat alone is responsible for the radiation of electromagnetic energy which made possible the reception of the planet's radio waves on earth. Mars' surface heat is estimated at about 32 degrees Fahrenheit. Even so, the ice-cold planet emitted enough heat, and the Navy's dish antenna and receiving equipment were sufficiently sensitive to pick up the signals 35,000,000 miles through space. Mars' wavelengths measured about 3 centimeters.

### *Hazards of Antarctica*

The Navy has been assigned responsibility for providing communications at Antarctica, in support of the national effort in connection with the International Geophysical Year. This responsibility includes provision of adequate communications for the U. S. scientific effort, for all military services involved, and for the United States press.

Communications problems of Antarctica are complicated by extremely high winds, unusual atmospheric conditions, auroral phenomena, lack of conventional grounds, the abundance of snow, and, of course, the human element. Temperatures drop to more than -80 degrees Fahrenheit. Winds often exceed 100 miles per hour. Geomagnetic storms occur frequently. Atmospheric moisture is virtually not present.

Atmospheric pressure, air temperature, sea water temperature, wind speed and direction, are transmitted automatically by the Navy's new free-floating weather buoy.

In the antarctic, it is possible to lay bare antenna wire directly on the ice, and because of the good insulation property of ice, to obtain excellent communications results. But because this procedure is hazardous, antennas must be elevated on solid piling. In holes for the antennae poles, a mixture of snow and water instead of concrete or cement is poured, with equally effective results. In short, they are using the materials at hand.

One of our unusual propagation problems at the South Pole is due to the fact that the geographical South Pole is situated in a saucer at about 9500 feet elevation, whereas the surrounding territory rises to a polar plateau.

Our Navy McMurdo Sound station is located directly adjacent to Mt. Erebus, an active volcano. Not only must we contend with the volcanics of the mountain, but also with its mineral content, for this mineralized volcano stands between our rhombic antennas at McMurdo Sound and Radio Balboa, Canal Zone.

Nations participating with the United States in the antarctic during the IGY are cooperating to keep radio interference among the several international stations at a minimum. In this common effort, the United States has been allocated four stations, and other nations a total of seventeen. The nations represented in this international cooperative communications effort, in addition to the United States, are Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, the Union of South Africa, the United Kingdom and the USSR.

### *An Alternate Route*

In this undertaking, United States naval radio frequencies have been authorized for use by and for communications among the U. S. stations in the antarctic, for the duration of the International Geophysical Year. Communications with the United States are being conducted by continuous wave (CW) radio-teletypewriter, facsimile, and, of course, voice. Generally, intercommunications among United States stations in the antarctic will be conducted by military operators using naval procedure.

The main communication channel between Antarctica and the U. S. is a duplex radio-teletypewriter circuit between McMurdo Sound and Balboa, C. Z., and thence via the Naval Communication System. This circuit is presently in operation approximately 5 hours daily, being limited by propagation conditions. During this operational period, McMurdo Sound transmits all the operational, administrative and press traffic that has accumulated since the preceding day, which at times exceeds 40,000 groups.

Directional rhombic antennas are used on both ends of this circuit. A 1-KW transmitter is employed at McMurdo (the best frequency is 17 mcs this time of the year). The transmitter employed by Balboa, where major naval communication facilities are available, may have as much as 20 KW power output.

There are usually from six to ten correspondents who file press messages with McMurdo. All are good writers, and the press load seems to indicate that some are quite prolific.

An alternate route from Antarctica to the United States has been planned, via New Zealand and the Pacific Island Chain, and is now being activated. This route will provide a supplemental RATT capability. We are bending every effort to provide adequate communications service for the important scientific effort of the International Geophysical Year.

• • • ▬ • ▬

*Rear Admiral Henry C. Bruton, USN, a Naval Academy graduate, received a Master of Science degree from the University of California, a Juris Doctor degree from George Washington University and is now serving as Director, Naval Communications. Admiral Bruton is also First Vice President and National Director of AFCEA. Recently he was made an honorary member of the Veteran Wireless Operators Association.*


USCG

# Electronic Computing Industries
## OPTIMISM VS. JUDGMENT

by Howard Engstrom
NATIONAL SECURITY AGENCY

THE TERM "ELECTRONIC computing" covers a wide range of equipment. It is used in this article in the sense of the large-scale internally programmed digital computers which have made so many contributions to the scientific and business life of the country during the past five years.

The great impetus to this art came from the military during World War II. The impact of military needs on scientific progress is not a new thing. It probably began with Archimedes, who helped his cousin, the tyrant of Syracuse, to defend the city against the Romans in 212 B.C. I quote from Plutarch's "Life of Marcellus" in this regard.

"The King prayed him to make him some engines, both to assault and defend, in all manner of sieges and assaults. So Archimedes made him many engines, but King Hieron never occupied any of them, because he reigned the most part of his time in peace without any wars."

### *Practical Electronic Devices*

The electronic computing engines were constructed during World War II and some of them made significant contributions to our victory. However, it was not really until the end of World War II that the general purpose electronic computing devices began to be delivered. The conviction of their practicality and the faith in the future rested principally among those people who had been working in the field for the military during the war. The Defense Department in general was convinced of the necessity of pursuing research and development in this area in the solution of military problems. American industry in 1946 was, however, not so convinced. As a result, in the post-war period, many individuals, with faith in the future of the field, established small independent companies which were financed by the Defense Department. Some of the universities, such as Harvard, Princeton, and the University of Pennsylvania, also carried on research and development in the logical structure and component development in the field. Again in these universities the program was stimulated essentially by individuals who had faith in the future of large-scale computing devices. University management was not convinced, and in some cases still remain unconvinced, that the field of logical structure design of computing devices was one with proper academic stature.

### *It's Big Business*

About 1950 many of the problems, with respect to memories, input-output devices and peripheral equipment, had been solved so that well balanced large-scale computing devices were put into operation. At this point, big business became strongly interested in the field. Many of the small companies, who had had a difficult financial struggle to keep going, were merged with the large companies so that in the early 1950's the electronic data processing industry achieved a financial stability as well as a technical maturity. It is difficult to estimate the phenomenal growth of the industry. It is certainly true that the present volume of business in electronic data handling equipment is in excess of one billion dollars per year. Speculations as to its ultimate position are difficult but certainly, the industry will not reach a saturation point before expanding by, at least, a factor of ten.

The delivery of many of these equipments to industry and Government has opened up a tremendous activity in the field of applications. The most important aspect of electronic computation in the last several years has been precisely in the area of a better understanding of the value of this equipment in our scientific and business problems.

### *Problem Areas*

Although the industry has achieved technical reliability and financial stability, there are many areas in which serious problems still exist.

The enthusiasm with which electronic data handling and automation possibilities have been greeted is astonishing. I should not like to state categorically that the field has

(Continued on page 28)

**EARLY TELETYPEWRITER**

**TELETYPE MODEL 28 PRINTER**

# 50 YEARS THAT CHANGED THE PICTURE

The need for a reliable printing telegraph instrument that would provide a typed record of the message for both sender and receiver brought the company now known as the Teletype Corporation into the picture in 1907. From the halting performance of the original page printer to the smooth 100 words per minute of today's precision equipment has been a major step in communications.

But today Teletype equipment is often far more than a communication instrument. It is a basic element in production control systems . . . its ability to transmit and reproduce text and punched tape is harnessed to office automation . . . it provides a "conveyor system" for channeling complex raw data to a computing center thousands of miles away—and getting the answers back in a twinkling.

Indeed, Teletype machines have made many of the dreams of 1907 a daily part of today's business world. And the horizons widen daily as new dreams occupy our engineers and keep our laboratories humming.

If you would like a copy of our booklet, "The ABC's of Teletype Equipment," write to Teletype Corporation, Dept. S-3, 4100 Fullerton Ave., Chicago 39, Illinois.

*1957 Golden Anniversary Year*

TELETYPE

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# Armed Forces Communications and Electronics Association

*SALUTES*

*TEN YEARS OF NATIONAL MILITARY UNIFICATION*

**armed forces day**

**MAY 18, 1957**

# project VANGUARD poses a problem . . .

$$V = \int_0^t a\,dt$$

provide a
CONTINUOUS SOLUTION
to this time integral . . .

## . . . and REEVES comes up with the solution

Placing the earth's satellite in its pre-determined orbit requires precision to the nth degree. The second-stage of the three-stage rocket which will carry the satellite up to its orbit must be separated shortly before its trajectory bends back towards the earth.

Separation of the second stage is controlled by a coasting time computer designed and built for the Martin Company of Baltimore by Air Associates, Incorporated.

The Reeves Instrument Corporation has designed and is building for Air Associates the "speedemeter" needed for computing the second-stage coasting time as a function of the burn-out speed. Essentially an integrating accelerometer, it provides a continuous record of velocity as the rocket speed builds up and feeds this information into the control unit's computer.

The control unit, after the computed coasting time has elapsed, triggers the system. Stage two is separated and stage three gives the satellite the final acceleration required for insuring that the satellite circles around the earth.

Because of its vast experience in design of precision gyros and accelerometers, Reeves has been assigned the task of developing an important instrument for use in one of man's great ventures, Project VANGUARD.

17RV56A

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**I.R.E. SHOW, New York Coliseum, March 18-21, 1957.**

**Reeves**
INSTRUMENT CORPORATION

**REEVES INSTRUMENT CORP.** A SUBSIDIARY OF DYNAMICS CORP. OF AMERICA, 215 EAST 91st ST., NEW YORK 28, N. Y.

Guests at the National Bureau of Standards Open House were among the first to see the Bureau's electronic digital computer, SEAC, located on the NBS grounds. In the background is the computer proper, consisting of arithmetic and control units and power supply. At left is a magnetic tape auxiliary memory. At right are the control console and input-output equipment.

# a progress report on SEAC

by Margaret R. Fox

DATA PROCESSING SYSTEMS DIVISION
NATIONAL BUREAU OF STANDARDS

OVER SIX AND A HALF YEARS AGO, in May 1950, the National Bureau of Standards announced completion and successful operation of SEAC, Standards Electronic Automatic Computer, by the staff of its Electronic Computer Laboratory. The computer, designed and constructed in less than two years, was achieved under the sponsorship of the Office of Air Comptroller, Department of the Air Force, which was pioneering in the application of the relatively new digital technology to its large-scale problems of logistics and management. [Fig. B, Page 20]

On June 20, 1956, SEAC celebrated the sixth anniversary of its dedication and the completion of over six years of productive operation, most of which has been on a round-the-clock schedule. The following schedule for that day indicates the utility and versatility of this system which was to have been only an "interim installation:" [Fig. A, Page 20]

Although SEAC was basically designed as a high-speed computer for scientific problems, which inherently have small or moderate input-output requirements, the original system has been augmented sufficiently to undertake data-processing problems of the type that require a great deal of data manipulation and a relatively small amount of actual computation.

The versatility of use as indicated by the many types of problems that have been solved by SEAC is in keeping with the original design of the system as a nucleus to be expanded to meet problem-solving requirements and to test technological advances in the computer field. *It has indeed been a proving ground for new engineering techniques and the tool on which to try out model problems in massive data processing.*

### *Army-Sponsored Program*

The story of SEAC is essentially the history of the development of digital electronic computing machines by and for the Government following the successful application of the ENIAC, Electronic Numerical Integrator and Calculator, to Army Ordnance ballistics problems. On February 1, 1946, an Electronics Section was established within the Ordnance Development Division of the National Bureau of Standards as a joint endeavor of the Office of the Army Chief of Ordnance and the Bureau. The Army-sponsored program for the development of basic elements and organs for electronic digital computing machines was assigned to this section primarily because it involved a combination of electronic instrumentation and electron tube problems on which work was already in progress in connection with the proximity fuze program. In addition, there existed a certain amount of technical appreciation of the fundamental ordnance computing problems to be handled by such machines and, hence, a general knowledge and understanding of the requirements of the basic elements for such machines.

The Army Ordnance work program encompassed research and development on electronic methods and means for carrying out, at high speeds, complex scientific computations, initial efforts were directed to the development of memory devices, input-output equipment, and conversion equipment for transducing data onto input media and converting data from output media into usable form, as well as, investigation of the basic elements for use in the computing function. Rapid advances in the digital computer art soon resulted

(*Continued on page* 20)

# SIGNAL MAGAZINE

## WELCOMES

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## WASHINGTON, D. C.

## INTERNATIONAL PHOTOGRAPHIC EXPOSITION, 57

**MARCH 22-31**

***national guard armory***

SIGNAL magazine welcomes the International Photographic Exposition of 1957, to Washington, D. C.

From March 22 to 31, more than 200 photographic firms throughout the free world will display their newest products and techniques that will far surpass in size, scope and content any international trade fair ever held in the United States.

More than half a mile of prize-winning photographs from many international contests will be exhibited in a huge gallery. Photography's contribution to man's progress will he reviewed in a 400-foot long epic, which will include aspects of industry, photo-journalism, education, medicine, and such sciences as radiology, nuclear research and social science.

In the evenings from March 25 to 29 inclusive, the Exposition will be a dramatized report to the trade on progress, research, equipment, techniques and products.

General Electric's 25,000 candle power flash of "photo lightning," the world's largest photo lamp, will illuminate the sky atop the armory every night and the entire International Exposition will be transformed into a spectacular show for the public: a "World's Fair of Photography."

| *Schedule* | | *Trade Show Hours* | *Hours For The Public* |
|---|---|---|---|
| *Fri.,* | *March 22* | | *7:45 pm to 10:30 pm* |
| *Sat.,* | *March 23* | | *2:00 pm to 10:30 pm* |
| *Sun.,* | *March 24* | | *2:00 pm to 9:30 pm* |
| *Mon.,* | *March 25* | *12:00 noon to 7:30 pm* | *7:30 pm to 10:30 pm* |
| *Tues.,* | *March 26* | *12:00 noon to 7:30 pm* | *7:30 pm to 10:30 pm* |
| *Wed.,* | *March 27* | *12:00 noon to 7:30 pm* | *7:30 pm to 10:30 pm* |
| *Thurs.,* | *March 28* | *12:00 noon to 7:30 pm* | *7:30 pm to 10:30 pm* |
| ***Fri.,*** | ***March 29*** | ***12:00 noon to 7:30 pm*** | ***7:30 pm to 10:30 pm*** |
| ***Sat.,*** | ***March 30*** | | ***2:00 pm to 10:30 pm*** |
| ***Sun.,*** | ***March 31*** | | ***2:00 pm to 9:30 pm*** |

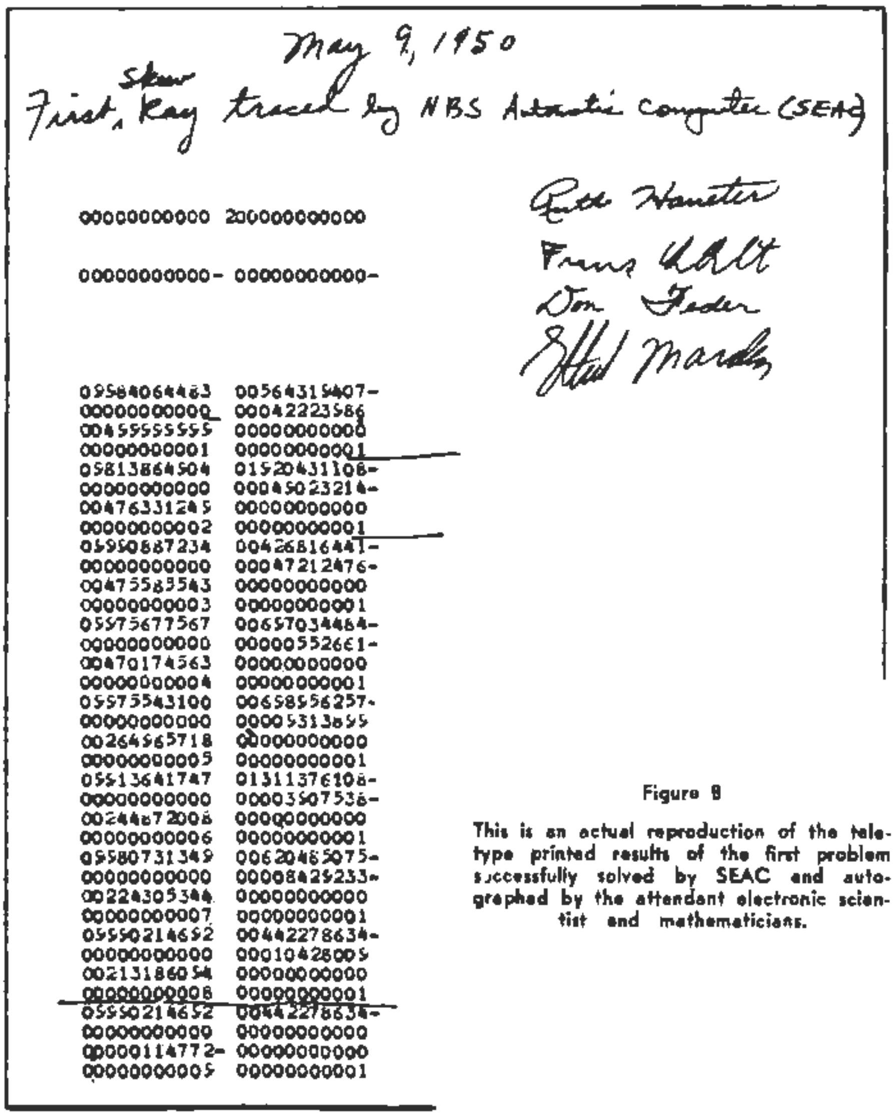
## A WORLD'S FAIR OF PHOTOGRAPHY

### Operating Log for June 20, 1956

| *Time* | *Description of Problem with Comments* |
|---|---|
| 0000-0730 | 1. Radiation diffusion—6 hrs, 30 minutes plus 1 hour down time. |
| 0730-1305 | Scheduled Maintenance and Engineering—5 hrs. 35 minutes. |
| 1305-1323 | 2. Transistor amplifier—18 minutes. |
| 1323-1340 | 3. Integral for scattering functions—17 minutes. |
| 1340-1400 | 4. Electron penetration—20 minutes. |
| 1400-1420 | 5. Collision integrals used in transport theory—20 minutes. |
| 1420-1440 | 6. Research in mathematical geophysics—20 minutes. |
| 1440-1500 | 7. Standard deviation—20 minutes. |
| 1500-1510 | Training period—10 minutes. |
| 1510-1520 | 8. Tables of Coulomb wave functions—10 minutes. |
| 1520-1540 | 9. Nuclear scattering—20 minutes. |
| 1540-1600 | 10. Continuation of Problem 1—20 minutes. |
| 1600-1622 | 11. Vibrations of a circular disc—22 minutes. |
| 1622-1635 | 12. Continued fraction—13 minutes. |
| 1635-1640 | 13. Continuation of Problem 2—5 minutes. |
| 1640-1705 | 14. Ray tracing, II—25 minutes. |
| 1705-1720 | 15. Continuation of Problem 2—15 minutes. |
| 1720-2400 | 16. L-Shell conversion coefficients—5 hrs., 30 minutes plus 1 hr., 10 minutes down time. |

| | | |
|---|---|---|
| Good computation | 16 hrs. | 15 minutes |
| Down Time | 2 | 10 |
| Scheduled maintenance and engineering | 5 | 35 |
| | 24 hrs. | 00 |

Figure A



May 9, 1950

First skew Ray traced by NBS Automatic Computer (SEAC)

Ruth Haueter

Franz L Alt

Don Feder

Ethel Marden

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09584064463  00564319407-
00000000000  00042223586
00455555555  00000000000
00000000001  00000000001
05813864504  01520431108-
00000000000  00045023214-
00476331245  00000000000
00000000002  00000000001
05950887234  00426816441-
00000000000  00047212476-
00475583543  00000000000
00000000003  00000000001
05575677567  00657034464-
00000000000  00000552661-
00470174563  00000000000
00000000004  00000000001
05575543100  00658556257-
00000000000  00005313855
00264565718  00000000000
00000000005  00000000001
05513641747  01311376108-
00000000000  00003507538-
00244872008  00000000000
00000000006  00000000001
05580731349  00620485075-
00000000000  00008429233-
00224305344  00000000000
00000000007  00000000001
05550214652  00442278634-
00000000000  00010428005
00213186054  00000000000
00000000008  00000000001
05550214652  00442278634-
00000000000  00000000000
00000114772- 00000000000
00000000005  00000000001
```

Figure B

This is an actual reproduction of the teletype printed results of the first problem successfully solved by SEAC and autographed by the attendant electronic scientist and mathematicians.

in an expansion and reorientation of the original program to include the design of rudimentary calculating systems.

### *Census Computer Sought*

Meanwhile, NBS was entering the computer field through another channel. In 1945, the Bureau of the Census, with its immense task of sorting, tabulating and editing census data, became convinced that it would be practicable to apply an automatic electronic digital computing machine, similar to ENIAC but more flexible, to its large-scale statistical and tabulation problems. It requested the Science Committee of the Department of Commerce to evaluate the potential application of such computers to the compilation of census data and the wider exploitation of modern statistical methods in the preparation of census reports. The National Bureau of Standards was called in to advise the Committee and the Bureau of the Census concerning the feasibility of construction of an automatic electronic computer suitable for the needs of the Bureau of the Census in light of the state of development of the art. As a result, the National Bureau of Standards was made responsible for the selection of a supplier and for the technical supervision of the construction of a census computer. At that time it did not appear unreasonable to expect such a system to be in operation by late 1948.

About the same time, the National Bureau of Standards undertook a study of Government-wide needs for such machinery, and there was established the Applied Mathematics Executive Council, on which were represented all interested Government agencies. Many of these agencies, including the Army Map Service, Office of Air Comptroller, Office of Naval Research, and Air Materiel Command, took the lead of the Bureau of the Census and asked the National Bureau of Standards to negotiate with suppliers for computers for their applications. Meantime, a series of delays occurred, partly due to technological troubles encountered by the contractors in the design and construction of these "first-of-a-kind" devices and partly due to time consumed by such factors as security investigations, resolution of patent problems, and con-

(*Continued on page 22*)

# NOW . . . Big News in Microwave Multiplex Channeling Equipment!

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## New RCA Type MV-124 with All Channel Units Identical and Interchangeable

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A control console and external selector together with input and output magnetic wire drives were added to the initial equipment.

Both single-channel and multi-channel tape drive mechanisms have been added as an auxiliary memory.

tract negotiations. Costs also were rising rapidly, and the combination of increased prices and delayed delivery resulted in the decision for the National Bureau of Standards to undertake the construction of an "interim" machine.

In the summer of 1948, the urgent need of the Office of Air Comptroller for a computer, on which mathematical investigations of techniques for solving large logistics programming problems could be performed, led to a crash program of development and construction at NBS. By this time, the Bureau was engrossed in an extensive and expanding consulting and advisory service, a joint activity of the Applied Mathematics and Electronics Divisions which was based on a broad program of research, development, construction, procurement, and eventually testing and evaluating high-speed automatic digital electronic computers.

In order to expedite the physical realization of a minimum computing installation to serve the OAC's needs until more complete systems were commercially available, it was decided to utilize the EDVAC, Electronic Discrete Variable Automatic Computer, design insofar as practicable. The staff charged with the design and construction of the new computer had been closely associated with the evolution of the EDVAC, and engaged in the design and construction of the input-output and auxiliary equipment to complete the installation at Aberdeen Proving Ground. The basic concept was to provide a flexible minimum machine capable of handling certain important classes of mathematical problems that are readily solvable by the digital type of machine.

As it became increasingly apparent that no other equipment would become available for several years, the machine was planned and constructed as a nucleus to which improvements and sub-assemblies could be added to increase its problem-solving capabilities in accordance with future requirements. In addition, it was destined to be used as an engineering proving ground for evaluating new computer components and techniques.

### *Design and Function*

Design of the SEAC was begun in June 1948, and construction got under way early in 1949. Its function was like the other large-scale automatic machines then in development, having sections which carry out the four basic functions of input-output, memory, arithmetic and control. Purposely, the design was kept simple, and the list of basic operations was kept as short as possible. The internal memory, based on a design of the Moore School of Engineering and built under contract to specifications developed at NBS, consisted of mercury relay lines with associated recirculation amplifiers and mixing, distributing and selection circuits, capable of storing 512 45-binary-digit words, or eight words to a line.

The original installation consisted of the computer proper, operating at a basic repetition rate of one megacycle; the acoustic memory, a manual keyboard for direct input; and a teletype printer for direct output. Punched paper tape was used to provide indirect operation. Both numbers and instructions were represented by hexadecimal notation (base 16). Seven basic orders—addition, subtraction, multiplication, division, comparison, logical transfer, and input-output control—were chosen as a result of a study which indicated they were the minimum convenient for solving most of the problems then anticipated.

### *Expansion and Improvement*

Almost before the first real problem, skew ray calculations in optics, was solved by SEAC on May 9, 1950, work was under way to expand the installation, and several units have been incorporated in the system. The first major improvement was the addition of a high-speed electrostatic memory which holds 512 words stored on 45 Williams tubes, effectively doubling the memory size. All 45 tubes simultaneously supply the computer with 45 binary digits in parallel with average access time of

(*Continued on page* 24)

## MILITARY FIELD SERVICE

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For its vital computation phase of SAGE (continental air defense system) Burroughs responsibility to the Air Force begins with research . . . extends through engineering, development, production, testing, and installation . . . and includes essential field training, service and engineering.

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12 microseconds. Although SEAC is a serial machine in all other respects, provision was made in the original design for the use of both serial and parallel types of memory. Conversion of the word form from serial to parallel, and vice versa, is accomplished by means of a shift register with a special flexible control.

The original input-output devices were modified teletype equipment. The input was fed from either a tape reader or keyboard, and the output sent to either a printer or tape punch. Magnetic wire and magnetic tape units have been added to increase the speed of the computer on problems requiring considerable input-output or auxiliary memory capacity. An external selector capable of selecting under computer control any of ten different input-output units is also available. [Fig. 1]

Another major change permits the operator a choice between two modes of operation, the four-address and the added feature of three-address, by merely throwing a few switches on the control. The main distinction between four- and three-address modes of operation is in the method by which the instruction sequencing is indicated. In the three-address system, however, a special automatic "floating address" feature was included, aimed at shortening and simplifying the work of the programmer by permitting him to utilize standard routines or lists of instructions which have already been compiled for carrying out certain frequently used operations.

Early in 1956 the Williams memory was modified and improved to store 1,024 words, which, with the 512-word acoustic memory, has made a total of 1,536 words available for the past six months. Latest addition to the installation was the NBS Card Transcriber which went into regular operation in July. The equipment reads standard 80-column cards at a rate of 200 per minute and converts the data to a four- or six-bit binary code on magnetic wire for direct input or temporary storage as a magnetic recording. [Fig. 2]

Some measure of the expansion of the SEAC through engineering improvements can be made by comparing the original number of vacuum tubes and germanium diodes with the present number. In the original installation there were approximately 750 tubes and 10,500 diodes; in the present SEAC there are about 1,300 tubes and 16,000 diodes.

An unplanned event that interrupted the usual schedule occurred late in 1954. SEAC and the entire laboratory, of which it was a focal point, were transferred from their original site to a building about a block away. To move any computing installation is a major engineering accomplishment, but to move an essentially experimental laboratory model which, somewhat like Topsy, had just "growed," required careful preplanning and preparation. However, it did present an opportunity to generally improve its physical layout and connections. On November 21, 1954, SEAC was shut down and the entire installation moved to the newly prepared site. By the end of December, all the signal leads had been connected and the signals were being checked out.

### High Efficiency Quota

Debugging had progressed so well that the first engineering test routines were run on January 7, 1955, and on January 22, scheduled computation was resumed for evening and early morning shifts. Full three-shift operation was resumed on February 21, just three months from the day that it was deactivated. Demand for computing time continued to increase and scheduled round-the-clock operation was reinitiated late in February.

In the more than six years that SEAC has been in operation, its work loads in computation have been many and varied. In spite of a considerable amount of time being utilized by the engineering work associated with the expansion of SEAC and the trial of new techniques, approximately 19,200 hours of scheduled computation time have been logged through November 9, 1956, with an average efficiency of about 75%, the total good time over the total scheduled time. It may be of interest to note that efficiency so far in fiscal year, 1957, has averaged 84 per cent.

### Contribution to the Air Force

Fundamentally, SEAC's very being was a result of its anticipated service to the Office of Air Comptroller, U. S. Air Force, in the application of scientific methods to management. Their basic problem was to construct a "mathematical model" of Air Force operations consisting of sets of equations which spell out the re-

Fig. 1, left: Inscriber: punched paper tape to magnetic wire converter.

Fig. 2, right: Transcriber: punched card to magnetic wire converter.

lationship of all Air Force activities to national military objectives and the requirements of every Air Force activity for personnel, supplies, equipment and facilities of all kinds. The computational load was so great, however, that it took months with conventional computing equipment to compute programs and requirements data. SEAC, which is capable of adding 4,000 13-decimal-digit numbers per second or performing 400 long divisions of such numbers per second, contributed immeasurably to reducing this time lag so that budget and program could be kept more reasonably consistent.

### *Assisting the Atomic Energy Commission*

A second major contribution to the science and security of our country was made by SEAC in performing important calculations necessary to the development of the H-bomb by the Atomic Energy Commission. A representative sampling of problems performed in its sixth year of operation includes the following: For the Department of Defense and the AEC, problems have been undertaken in radiation diffusion, award of procurement contracts by linear programming, integrals involved in supersonic flutter, heat convection, complete degradation in the neutron, reflex klystron efficiency, missile trajectory, dynamic behavior of aircraft structures, molecular vibration, and many others. The Bureau has operated SEAC as an NBS facility since January 1954 when the Air Force formally transferred its entire accountability to them. Problems in meteorology, thermodynamics, optics, air-conditioning, numerical analysis, crystal structure, thermal stresses, temperature and compressibility properties of air, and others too numerous to mention, have been solved for the technical divisions.

### *Promising Future*

One of the most interesting currently proposed uses is to have SEAC perform some of the tedious work of designing and developing scientific computers and data processors. Other studies are being undertaken to have SEAC do automatic coding. The future of SEAC, probably the oldest general-purpose automatic digital computer in the country, looks very promising in spite of its length of service and the expanding state of the art.

In the general data-processing field, SEAC has recently been used to demonstrate the feasibility of at least three unusual and interesting problems. A study was initiated for the Public Housing Agency in which SEAC was used to explore the feasibility of using automatic data processing equipment to check the reports of eligibility of occupants of the 400,000 units of low-rent housing under PHA jurisdiction. These reports, which contain a great volume of statistical data, are submitted annually, and must be checked for internal consistency and then audited for compliance with the rules and regulations governing occupancy. Erroneous and missing data results in correspondence to the field for correction before the reports are submitted to Statistical Tabulation for preparation of the various requisite reports. The editing task has been successfully tried out on SEAC, and the automatic checking of the raw data to produce corrections, correspondence and the desired tabular reports is now being programmed.

### *A Cooperative Project*

Under a cooperative project with the Patent Office aimed at ultimate mechanization of patent searching, a general-purpose topological search routine was prepared and successfully demonstrated using SEAC to search through the encoded data on 250 chemical compounds in response to coded questions. The data file was transcribed on magnetic tape and then subjected to a data-checking routine which eliminated compounds with data errors in coding or punching. When a question of the presence of certain specified elements was posed to the remaining file of 208 compounds, the routine caused SEAC to search each compound in turn for all combinations of the specified elements. Whenever such a pattern was found, the patent page and line numbers were automatically printed out.

*(Continued on page 50)*

# THE IMPACT OF MILITARY REQUIREMENTS on ELECTRONIC DEVELOPMENTS

**By Col. Richard J. Meyer**
**Chief, Research and Development Division**
**Office of the Chief Signal Officer**

THE MOST OUTSTANDING development during the past year by the Army is its general acceptance and broad application of electronic data processing equipments [EDP]. These devices had, heretofore, been considered for computers in fire-control systems and a relatively few other applications. Today our military supply system operating on a world-wide basis is becoming dependent on the successful and reliable application of this equipment. The horizons for its eventual application seem unlimited and far-reaching.

### *Military Can Take No Chances*

I have just learned that a big department store in Cleveland has an electronic computing system which will perform the most phenomenal things. When a customer buys "X" items, the salesman records the sale on the cash register, indicating whether it is cash or charge plus other essential data; the stock control room automatically debits the inventory by stock number; at the billing office the customer's account is charged, and periodically, inventory and billing strike a total. The only manual operation is to put the requisitions or bills in the mail box. Now in a big store, there are many cash registers and considering that these all feed into one central computer, this becomes a truly outstanding and understandable machine.

Let us assume that one transistor in this EDP equipment gets tired and instead of printing "one" ten consecutive times, slips a gear and only prints "one" nine times. The results might favor the store or the customer. There obviously would be many complaints when the bills were received but no one would be hurt *physically*.

Consider, now, a missile—a missile of which we have produced thousands and upon the accurate performance of which the defense of our country is dependent.

Word comes from the computer inherent to the weapons system, of which this missile is a part, that a hostile target is within range. The missile is fired but New York City is splattered. Why? Because the computer threw nine instead of ten "ones" and the missile, accepting the erroneous data, missed its target. In this case an unreliable component can mean our destruction. In a weapons system comprising a mechanical-electronic complex, every component *must be reliable*.

The foregoing comments were introduced merely to stress the point that the military can take no chances. The military must have reliable components and the requirements for reliability are most rigid.

In the department store, the environment is, for practical purposes, constant. Consider the problems the military face: temperatures from —80 degrees F. to +165 degrees F., or higher; pressure from normal atmospheric to, in the case of missiles, unknown; acceleration from 0 to 40,000 g's; contamination from pure air to intense neutron and gamma radiations; vibration of widely varying frequency and amplitude. These are the military problems.

In spite of these exacting complexities, let us now consider the progress, trend, and future promise of electronic components in general but with specific attention to the transistor.

From the announcement of the discovery of the transistor in June of 1948, progress in the electronic field in the military has been phenomenal. No sooner does the military decide to employ a transistor in circuit *a*, than someone in industry announces a better transistor for the same circuit or another to replace the tube still being used in circuit *b*. The result—not chaos but procrastination and ultimate delay. Why? Because industries' engineers and the military—proud of their professional standing—do not wish to be in the position of designing obsolescent equipment. Furthermore, eager to lead the field, they quickly realize that with this latest transistor which industry just announced they can do many more things for the same price, considering size and weight only, than was initially predicted. This might bring them an added laurel. Saying it another way, progress in solid state devices has been so rapid that design engineers cannot keep up with the component development. So many new and intriguing components have recently become available that engineers are like children at Christmas—they don't know which toy to pick up first.

Nevertheless, the Army, as a matter of policy, has been in the process of transistorizing each equipment for which this is feasible. In fact, for combat area use (for receivers and low power transmitters up to 70 megacycles frequency) the policy has been not to use vacuum tubes if transistors can do the job.

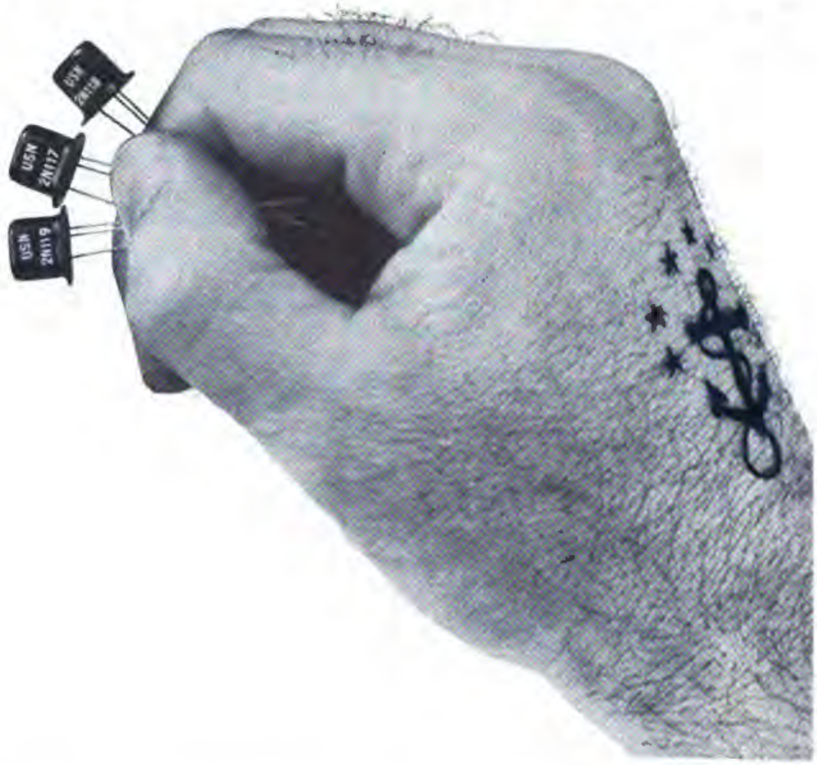
### *Much Time Is Required*

At the present time the Army has only one completely transistorized equipment in actual production. It must be realized that five to seven years are usually required for experimental breadboard models to reach the production phase. There are 12

*(Continued on page 28)*

**TI PROGRESS REPORT ON MILITARY TRANSISTORS**

# FIRST silicon transistors meeting NAVY SPECS



For *reliability* under *extreme* conditions... design with TI's military silicon transistors... built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS), MIL-T-19502 (SHIPS), and MIL-T-19504 (SHIPS) – these welded case, grown junction devices furnish the tremendous savings in weight, space, and power you expect from transistorization... *plus* close parameter control that permits you to design your circuits with confidence.

All 20 Texas Instruments silicon transistor types have proved themselves in military use. First and largest producer of silicon transistors, TI is the country's major supplier of high temperature transistors to industry for use in military and commercial equipment.

**degradation rate tests for TI's USN-2N117, USN-2N118, and USN-2N119**

| test | condition | duration | end point at 25°C |
|---|---|---|---|
| lead fatigue | three 90-degree arcs | —— | no broken leads |
| vibration | 100 to 1000 cps at 10 G | 3 cycles, each x, y, and z plane | $I_{CO}$ = 2 $\mu$A maximum at 5V<br>$h_{ob}$ = 2 $\mu$ mhos maximum<br>$h_{fb}$ = −0.88 minimum (USN-2N117)<br>$h_{fb}$ = −0.94 minimum (USN-2N118)<br>$h_{fb}$ = −0.97 minimum (USN-2N119) |
| vibration fatigue | 60 cps at 10 G | 32 hours, each x, y, and z plane | |
| shock | 40 G, 11 milliseconds | 3 shocks, each x, y, and z plane | |
| temperature cycle | −55°C to +150°C | 10 cycles | |
| moisture resistance | MIL-STD-202 | 240 hours | |
| life, intermittent operation | $P_c$ = 150 mW, $V_c$ = 30V | 1000 hours, accumulated operating time | |
| life, storage | 150° C, ambient | 1000 hours | |
| salt spray | MIL-STD-202 | 50 hours | no mechanical defects interfering with operation |

*"Visit Our Booths (No. 2816 to 2820) at the 1957 I.R.E. Show, New York"*

**LOOK TO TI FOR:** SILICON HF, MEDIUM POWER, POWER, AND SMALL SIGNAL TRANSISTORS
SILICON DIODES AND RECTIFIERS • GERMANIUM VHF, POWER, RADIO, AND GENERAL PURPOSE TRANSISTORS

***pioneer producer of silicon transistors***

**TEXAS INSTRUMENTS**
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

## Electronic Computing Industries

(*Continued from page 14*)

been much oversold, but I do think the *over optimism* of engineers and scientists, in connection with the field, is a definite fact. This optimism causes serious complications. If an industry or the Department of Defense relies upon estimates of delivery and performance which are made by engineers, they must have some degree of confidence in the technical and financial judgment involved. There have been too many cases of long delays in the delivery of vital equipment on time, even though it may operate at only one-half the speed which may be technically feasible.

### *Engineering Manpower*

Another aspect of the industry which should be considered rather seriously is that of *engineering manpower.* On the basis of scientific optimism, the Defense Department is pursuing many projects in electronic computing. These projects result in many contracts with private industry. The usual procedure following the award of one of these major contracts is for any industry to proselyte engineering personnel from its competitors. As a result there is an inflationary spiral of salaries for engineering and scientific personnel. It may be well to say that a man is worthy of his hire. I do not subscribe completely to this point of view. It is within the power of technical people to assist in rectifying the situation, and thereby avoid the loss of a great deal of dignity in participating so actively in this mad scramble for personnel. Proper action on their part will provide tremendous assistance to the national defense in assessing proposed employment changes, not only on the basis of salary, but on the basis of the technical merit of the projects concerned and the potential achievement in a technical sense. It is certainly their responsibility to see that our industrial and defense program is on a sound basis.

These criticisms of over-optimism and personnel instability are not designed to detract tremendously from the achievement of technical people over the past ten years in the creation of a tremendous industry which is one of the important elements of our national defense. There are many excellent achievements which witness to the continued dynam vance in the art as well as the try. However, the soundness of position in American economic is clearly dependent upon *pers integrity*. Therefore, more atte should be given to the two p made with respect to dependab in the matter of prediction achievements in regard to money and engineering manpo

### *Participation in Fundament Problems*

The great German novelist, Tho Mann, once said, "What perple the world is disparity between swiftness of the spirit and the mense unwieldiness, sluggishn inertia, permanence of matter."

As far as the arts with which are concerned, this statement m well be reversed. We have develo computing equipment of tremend speed and capacity and what p plexes the industry and the Dep ment of Defense is the sluggishn of the human spirit in participat in their fundamental problems.

* * *

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## Impact of Military Requirements on Electronic Developments

(*Continued from page 26*)

equipments now in the pre-production or service test stage. It is expected that when these models go into production—in approximately two years—five million transistors will be used for the initial production. In addition, 59 equipments are now in varying stages of development and will probably be in a production status in three to five years. One can guess that they will probably utilize 100,000,000 transistors. An estimate as to the number of transistors the Army will eventually use is very much dependent upon the world situation, appropriations from Congress, and the state of the transistor and component art. However, if one uses the present programs as a criterion, the quantities of transistors for use in military equipments is still exponentially increasing. In the event of partial mobilization similar to the Korean conflict, the expected use would be 10,000,000 transistors just for portable radio equipment, such as the Walkie-Talkie.

The most promising developments for immediate transistor application are in the fields of carrier, switching equipments, and computers where large quantities of these devices will be utilized in single equipments. However, many transistors will be used in power supplies, short range portable radio sets, portable television cameras, facsimile equipments, beacons, etc. In addition, the Ordnance Corps is making maximum utilization of transistors in their missile programs now under active development.

### *Improvement of Technique*

The transistor will, without a doubt, be one of the principal components for automatic assembly and printed circuit techniques. Work is still needed in the automation field to improve the technique for utilization of transistors. It seems that the transistor is too small for automatic assembly processes now in use and that the package, of which it is a part, has been designed larger than is necessary.

Since the advent of the transistor in 1948, the Army Signal Corps has been a leader in all the programs e couraging and expanding the tra sistor art. In the past fiscal year, about $15,000,000 was contracted with major transistor manufacturers for feasibility studies, development of diffusion type transistors, and research in solid state devices.

Listed below are a few of the items currently in development and an indication of the quantity of transistors the Army expects to use per item:

| | |
|---|---|
| Multiple Target Coordinate Data Set | 300 |
| Single Target Coordinate Data Set | 235 |
| Teletypewriter Set, Electronic | 345 |
| Frequency Meter | 98 |
| Central Office Switchboard, Automatic | 4300 |
| Converter, Digital Data | 110 |
| Switching Center, Teletypewriter | 2000 |

In this short discussion, an attempt has been made to indicate the Army's need for reliability of electronic components, the trend of its electronic development program, and the impact of military requirements in the nuclear age on electronics development.

* * *

Dr. J. E. Barkley, director of research, takes a reading in the dark tunnel during study of new infrared techniques being conducted by the Mechanical Division of General Mills.

# What else can infrared do?

Infrared detection devices have become almost commonplace. These invisible rays are now used in photography and several other industrial and military applications. But the full capabilities of infrared have not yet been determined. Dr. Barkley and his staff, working from an extensive background in current uses of infrared, are researching several possible applications right now.

These studies in basic infrared technology represent but a single phase of General Mills' over-all program of advanced exploration in theoretical and developmental physics, electronics and mechanical design.

*Findings in this "research for tomorrow" are being translated regularly into practical applications for industrial and military use today. If you have product or production problems, you can profit from these applications, and from our high-level production facilities.*

### CAN YOU BENEFIT FROM HIS SKILL AND EXPERIENCE?

Skilled craftsmen, who are as proud of the precision products they produce as they are of the highly specialized machines they use, work with exacting care which comes only from many years of experience. Mass production and on time delivery of electro-mechanical and mechanical devices is routine at General Mills.

**Send for Production Facts** New booklet shows our facilities, names our customers—introduces you to on time, precision manufacturing. Write Mechanical Division, Dept. SG-3, General Mills, 1620 Central Ave. N. E., Minneapolis, Minn.

**MECHANICAL DIVISION**

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*CREATIVE RESEARCH AND DEVELOPMENT + PRECISION ENGINEERING AND PRODUCTION*

# The Part Played by Training in the Story of ELECTRONICS

**by RAdm. DWIGHT M. AGNEW, USN (Ret.)**

**Vice President for Public Relations**
**Capitol Radio Engineering Institute**

WHEN YOU THINK OF THE STORY of Electronics and its related industrial development your natural tendency is, perhaps, to think of the major inventions and discoveries, and of the men who invented or discovered them. Such a list might include Benjamin Franklin and his kite, Thomas Edison and the "Edison Effect" as well as his carbon filament, Marconi and his first successful transoceanic wireless, or DeForest and his triode vacuum tube; all these in the line of early discoveries and inventions. Or if you think of military communications, you probably think of Admiral Hooper, the "father" of Navy Radio, and General George O. Squire who, because of his visionary "wired wireless," might be called the "father" of Army Communications. Or if you are in the industrial field, you might think of Allen DuMont and his promotion of the cathode ray tube, or W. R. G. Baker of General Electric, or Colpitts and Hartley of Bell Laboratories, or Kolster of Mackay Radio and Telegraph, or Sarnoff of RCA, or dozens of other names, all leaders in their field. But what really made it possible for the electronics industry to develop to the position of eminence it holds today?

### *"Hams" Stimulate Growth*

The idea of radio had captured the minds of men, thus motivating the early "Hams;" few in number at first, but increasing over the years to the tens of thousands we now have. (Many of the early "Hams," by the way, are among the leaders in the electronics industry today.) The ever-increasing number of people keenly interested in electronics provided considerable growth-stimulus to the industry. Added to this, the war and its resulting vast military requirement provided further stimulus of such urgency that the rate of growth was bound to be explosive. The nucleus of trained technicians plus the training capacity afforded by the Nation's Technical Schools and Institutions prevented this extremely rapid growth from becoming chaotic. And so to round out the story of electronics, we need to tell something of the training aspects. The whole story cannot be told without mentioning how many "Hams" and other thousands of ambitious individuals got the necessary training to provide the skilled technicians, first to permit the growth, then later to support the industrial giant electronics has become today.

### *CREI Pioneers in Technical Training*

Just as there were pioneers in the field of discovery and invention, so also there were pioneers in the field of electronic training. In this field Mr. E. H. Rietzke, the founder and President of Capitol Radio Engineering Institute, has earned a similar position of eminence. Mr. Rietzke and his role in establishing the first advanced course in radio is synonymous with the CREI Story. The start of the CREI Story really begins in 1924 when he came to Washington, as a Chief Radioman, to establish the Navy's famous "Bellevue Course" at the Naval Research Laboratory. The development of that course took three and one-half years, and for the next twenty years it was the foundation of all the courses prepared for the thousands of electronics people the Navy trained and developed. This course, organized and directed by Mr. Rietzke, was the first advanced vacuum tube course given anywhere.

In 1926 Radio Broadcasting was fast becoming a substantial business, so much so, that many of the civilian visitors to Bellevue expressed the thought that there was an urgent need for a similar course for the advanced training of radio technicians. This oft-expressed thought provided the germ of the idea that caused the establishment and growth of CREI. Upon seeing the need, Mr. Rietzke started preparation of the first CREI course in 1926. Having reached the decision to establish CREI, he decided to get out of the Navy in the spring of 1927. In June of that year he incorporated CREI. The Navy, however, persuaded him to continue at Bellevue for the next year, authorizing him to devote all of his spare time to his newly established school. In 1928 he left the Navy to give his full time to CREI. Even though the depression of 1929 came only a little more than two years after CREI's establishment, the school grew and prospered. The extreme job-scarcity of the depression made a good advanced Home Study course attractive to many ambitious young professional radiomen seeking the best possible means for self-improvement.

In 1932 CREI expanded its plant facility and its staff. It was at this time that the Residence School was opened. The initial Residence School course started with an intensive nine months program which firmly established CREI's reputation as an outstanding technical institute. It enjoys that reputation today. The curriculum of the Residence School now requires approximately twenty-eight months (three school years).

### *CREI Trains Thousands*

CREI is unique in the annals of technical schools in that it combines a Residence School in excess of 500 students and a Home Study or correspondence school of over 12,000 active students. Both the Residence School student and the Home Study student follow the same course and use identical texts, the only difference being that the Home Study student does not have the benefit of the laboratory work done by the Residence student. For this reason, he must be (or have been) actively engaged in some phase of the electronics industry; CREI cannot and will not enroll


Mr. Eugene H. Rietzke, Founder and President of the Capitol Radio Engineering Institute.


Executive Offices of the Home Study Division and the Residence School, located at 3224 16th St., N. W., Washington, D. C. Both day and night classes are conducted.


Students collect data on phase inverter experiment.

beginners in its correspondence program. The curriculums for both Residence and Home Study courses are accredited (and have been for the past eleven years) by the Engineers' Council for Professional Development. The ECPD is a body, composed of nationally recognized engineering and educational societies, whose function is accreditation of the curriculums of engineering colleges and technical institutes. Based on this accreditation, the Board of Education of the District of Columbia authorizes the award of an Associate Degree in Applied Science for successful completion of the CREI Residence School course.

Prior to World War II the Residence School was quite small—on the order of 50-60 students. However, in August 1941 the Army Signal Corps asked CREI to take a pilot class of 100 enlisted men to be trained as radio technicians. By July 1942 this activity had developed into a military enrollment of 875 Signal Corps students. During the winter of 1942-43 CREI built, established, and operated school facilities capable of training 1000 students, and feeding and housing 700. This was at Silver Spring, Maryland. After the completion of the Army Training contract, hundreds of Coast Guard technicians were trained there. In all, CREI trained approximately 5000 men for the Army and the Coast Guard. Also during the war, thousands of trained electronics technicians were needed by the war industries. This CREI helped to accomplish by operating under contract as a Branch of the University of Maryland in the ESMWT program of the U. S. Office of Education. To meet the Navy's great war-time need, CREI also prepared a special correspondence course for Navy Radio Technicians, using material already available in its standard courses. 320,000 lesson assignments were supplied to the Navy. Since the war, literally thousands of ex-GI's have taken CREI courses, Residence and Home Study, under World War II and the Korean Bill of Rights. The present home study enrollment includes several thousand active military electronics personnel.

Over the years CREI has maintained its position of leadership by always keeping abreast of the fast-growing electronics industry. Evidence of the high esteem industry places on Capitol Radio Engineering Institute training is amply demonstrated by the dozens of Group contracts and Company-sponsored training plans the leading companies in the electronic and aviation fields maintain with CREI. Some of these programs are with small companies involving a few students; others are with large companies in each of which hundreds of students are enrolled. Some of the plans have been in operation up to ten years. Thus CREI, now in its thirtieth year, looks forward to continuing to serve in the field of electronic training for industry and for all of the various Military Services.

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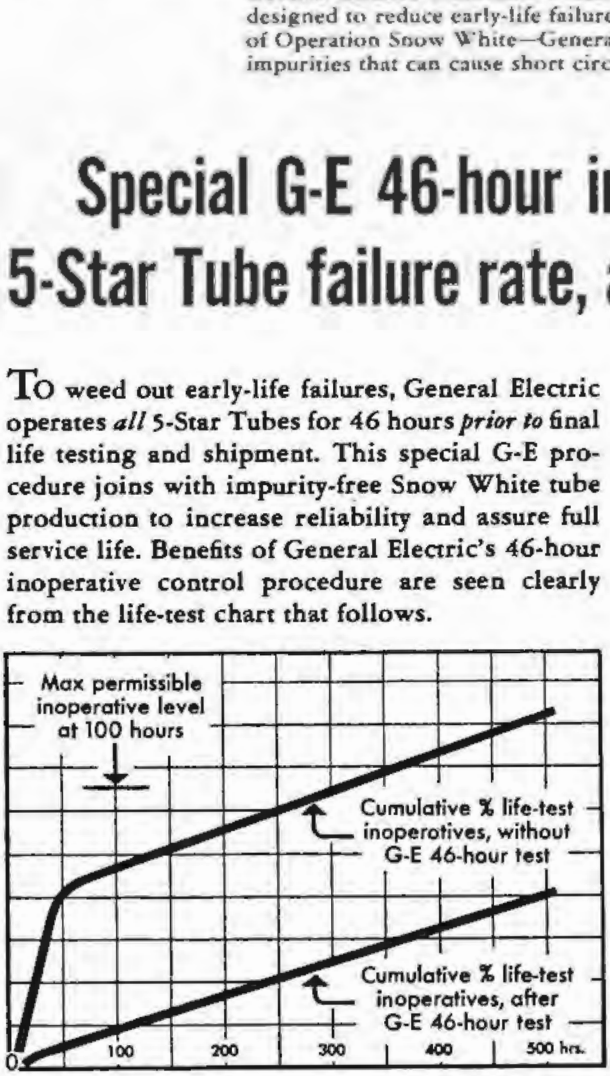
The 173 lessons in the complete CREI Home Study Course provide a complete reference library. More than 5,000 pages of text matter comprise the volumes. They are revised and modernized constantly.

General Electric technician checks 5-Star Tubes on special 46-hour inoperative control test, designed to reduce early-life failures. His lint-free, white Nylon garb marks this process as part of Operation Snow White—General Electric's all-out program to exclude from 5-Star Tubes any impurities that can cause short circuits or impair electrical efficiency.

# Special G-E 46-hour inoperative control cuts 5-Star Tube failure rate, assures top dependability!

To weed out early-life failures, General Electric operates *all* 5-Star Tubes for 46 hours *prior to* final life testing and shipment. This special G-E procedure joins with impurity-free Snow White tube production to increase reliability and assure full service life. Benefits of General Electric's 46-hour inoperative control procedure are seen clearly from the life-test chart that follows.



Note that the inoperatives in any lot of 5-Star Tubes on life test are only half as many, at 500 hours, as they would be without G-E inoperative control. Furthermore, at 500 hours, the percentage of inoperatives is still far below the permissible figure established for 100 hours.

46-hour inoperative control procedure helps make General Electric 5-Star Tubes the most reliable you can install. Added to special rugged design, Snow White cleanliness in manufacture, and rigid, extensive tests, this special G-E procedure further minimizes tube failure possibility and safeguards electrical performance.

Specify G-E high-reliability 5-Star Tubes when ordering new military electronic equipment! Use them as replacements! *Electronic Components Division, General Electric Company, Schenectady 5, N. Y.*

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

144-1A2

# SIGNAL·GRAM

## — GOVERNMENT —

**RESULTS OF GOVERNMENT RESEARCH AVAILABLE** Non-classified results of Government-financed scientific research are being turned over to American science and industry through the Office of Technical Services (OTS), Department of Commerce. Most Government research is devoted to strengthening the Nation's defense potential through developments in aeronautics, metals, chemicals, plastics, electronics, foods, fuels, instruments, leather, rubber, ceramics, textiles, atomic energy, and other industrial fields. Two monthly periodicals called "U. S. Government Research Reports" ($6) and "The Technical Reports Newsletter" ($1), advising of new material released, may be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

**ATOMIC HEAT FROM SOLAR FURNACE** The Army recently announced that a giant-size solar furnace capable of concentrating the sun's rays to produce temperatures comparable to those generated by an atomic explosion will be erected at the Quartermaster Research and Engineering Center, Natick, Mass. A solar furnace collects the sun's rays and concentrates them into a small target area in much the same manner as a "magnifying glass" may produce a very hot pinpoint focus. The furnace will have energy equivalent to 28 kilowatts. It will be utilized for laboratory testing of materials intended for the protection of military personnel against the thermal effects of nuclear and other weapons and is expected to reduce the time and cost of developing heat-resisting materials.

**CONTRACT AWARDS** The ARMY has awarded the following contracts: Roanwell Corp., microphone headset, $237,361; Cook Research Laboratories, recording system, $68,205; Stewart-Warner Corp., radio teletypewriter set, $2,415,948; General Cable Corp., telephone cable, $1,480,947. The NAVY announced recently contract awards to: Norris-Thermador Corp., three-inch .50 caliber ammunition, $1,389,321; Bethlehem Steel Co., overhauling and altering a Navy landing ship dock, $1,375,000; Ingalls Shipbuilding Corp. and General Dynamics Corp., nuclear-powered submarines, total of $41 million; Temco Aircraft Corp., development of a new guided-missile weapon system, $16,000,000. AIR FORCE grants include: Solar Aircraft Co., facilities for J-57 engine components, $1,300,000; Stewart-Warner Corp., communications equipment, $4,844,794; Boeing Airplane Co., facilities to produce B-52 bombers, $6,879,500; General Electric Co., radarscope camera systems, generator systems and parts, totaling $3,486,577; Recony Corp., air-conditioners, $2,476,362; Collins Radio Co., ultra-high frequency ground communication equipment, $9.9-million; Bendix Aviation Corp., wheel and brake assemblies for F-104 jet aircraft, $4,131,450; Lear, Inc., aircraft control and indicator parts, $2,556,750; Sundstrand Machine Tool Co., F-106 jet fighter spare parts and ground support equipment, $3,213,703; Cersci & Son, Inc., cargo trucks, $2,061,856; Temco Aircraft Corp., modification of RB-50 aircraft, $1,056,963; Standard Coils Kollsman Instrument Corp., Automatic Astro Compass, $26 million; Martin, Convair, and Douglas Aircraft Companies, for design fabrication and testing of three missiles, The Atlas by Convair, $145,000,000; The Titan by Martin, $358,000,000 and The Thor by Douglas, $67,500,000; Ford Instrument Co., Division of Sperry Rand Corp., ASN-7 navigation system, approximately $15 million.

## — INDUSTRY —

**INSTITUTE OF RADIO ENGINEERS NATIONAL CONVENTION** Time: 10 A. M. to 9 P.M., Monday through Thursday, March 18-21. Place: New York Coliseum, Columbus Circle, Manhattan. Events: 840 exhibits, 55 outstanding sessions, annual banquet, cocktail party, annual meeting, women's program.

**SATELLITE ROCKET PRIMED FOR DELIVERY** General Electric Co. officials have revealed that the "Vanguard" rocket engine "X-405," which will propel the proposed three stage earth satellite the first 36 miles into outer space in 2½ minutes, is ready for delivery. The engine will be delivered to the Martin Co. of Baltimore, which has been selected by the Navy as the prime contractor for the satellite.

PLANS OF AMERICAN ROCKETEERS Plans for 1957 will include a large aircraft-launched Rockaire and an auxiliary rocket engine for jet aircraft. Rockaire, developed by Douglas Aircraft Co., is an upper-air research vehicle to be fired vertically from an F-86D sabrejet. The rocket engine being developed for the Navy is to give conventional jet airplanes increased performance at high altitudes.

COMMERCIAL PILOTS TO TRAIN FOR JET AGE American Airlines, in preparation for the je age, has on order 35 Lockheed Electra prop-jets for short and medium range routes, and 30 Boeing 707 turbo-jets for transcontinental and other long-range operations. For early 1958 delivery, two flight simulators, one for each jet type, has been requested from Erco division, ACF Industries, Inc. The simulators will duplicate the cockpits of the two jet models in every detail and will be able to simulate every possible flight situation or any operational aspect of either airplane to the most minute degree. By the time the jets are delivered, these units will have enabled the airline to train its pilots thoroughly in the various flight characteristics of the two airplanes, thus smoothing the transition from piston airplanes to jets.

NEW RADIO INTERFERENCE BLANKER Hoover Electronics Co. has recently developed a radio interference blanker which will improve the ability of pilots of high-speed, high-performance aircraft to maintain communications with the ground. The blanker has been described as a rapid electronic switch which actually disconnects the antenna from the receiver when the amplitude of the signal out of the antenna oversteps a definite threshold. The associated receiver is not subjected to high-intensity bursts of static when the blanker is in operation.

"FAIR TRADE" LAWS UNENFORCEABLE Graflex Inc. and Bell & Howell Co., large makers of photographic products, recently joined Eastman Kodak and ended all "fair trade" agreements of cameras, films and other photographic products because of the difficulty of enforcing the law in the states where it exists and the continuing disintegration of individual state support.

COMMUNICATIONS ROLE IN FIRST NON STOP-JET FLIGHT Collins Radio Company played an important communications role in the historic first non-stop jet flight around the world Jan. 18. Voice communication was maintained at all times with the giant B-52's from ten ground stations using a transmission technique known as single sideband. The Collins company installed the ground equipment used during the flight and is currently developing for the Air Force a new inter-continental air-to-ground system using these principles.

## — GENERAL —

NOL CRYSTAL LABORATORY In the relatively new field of solid state physics, the crystal is being put to new uses in order to explore the complex structures of solids. The Naval Ordnance Laboratory is developing new types of crystals, principally for studies of their magnetic properties. The main interest to NOL is in their possible use in UHF electronics equipment as transformers and antennas or in the memory units of electronic computers.

YESTERDAY'S SCIENCE FICTION IS TODAY'S SCIENCE FACT General Electric experts believe that four satellite stations, travelling 4000 miles high over the equatorial section of the earth, can serve as relays to offer world-wide TV coverage. The satellites would be equally distant from each other and visible at any instant from the earth's equatorial region. TV signals could be transmitted from a ground location to the nearest satellite. Present-day technology indicates that the satellites would require only good quality receivers and transmitters to make the system function properly.

ARMED FORCES DAY, MAY 18 The tenth anniversary of military unification and the fiftieth anniversary of military aviation will be keynoted in the 1957 observance of Armed Forces Day, May 18, 1957. Both anniversaries to be observed this year are teamed under POWER FOR PEACE which has been the Armed Forces Day slogan since it was first used in 1953. The Post Office Department plans to issue a special stamp to commemorate the fiftieth anniversary of military aviation.

ULTRASONIC WAVES HELP BURSITIS Ultrasonic waves from a machine with a "sounding head" operating at a frequency of one million cycles per second are being used to combat the pains of bursitis, according to Dr. F. F. Schwartz, associate professor of clinical medicine at the Medical College of Alabama. Ultrasonic therapy produces better results than any other form of heat application. The waves give the patient a "micro-message" which is both physical and bio-chemical.

# IT&T now provides— *continuous* ELECTRONIC MILEPOSTS IN THE SKY

## VORTAC— *the new, automatic navigation system for all civil aircraft.*

From Federal Telecommunication Laboratories, a division of International Telephone and Telegraph Corporation, came TACAN (tactical air navigation) —to give our military aircraft the pin-point navigational accuracy and reliability, both in distance and direction from a known point, demanded for military operations at jet speeds.

Because the present nationwide navigation system for civil aircraft, called VOR, already provides the directional information, the government's Air Coordinating Committee decided to add the *distance measuring* feature of TACAN—creating a *new* integrated system called VORTAC. Soon all aircraft—private and commercial as well as military—will receive *complete* navigational information from either TACAN or VORTAC.

In the skies, over the seas, and in industry . . . the pioneering leadership in telecommunication research by IT&T speeds the pace of electronic progress.

VORTAC airborne equipment is now available. For detailed information write to Federal Telephone and Radio Company, a division of IT&T, Clifton, N. J.

IT&T

**INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, 67 Broad Street, New York 4, N. Y.**

# UNICATIONS GO ON A SAFARI

## with Arthur Godfrey

HAVE YOU EVER KNOWN ANYONE who was satisfied with what he did? If you have, pause and consider why he was satisfied. Was it because he already was well off and only needed to hold on to his accomplishments to be happy? Was it because he conquered the unusual and overcame obstacles, thereby, gaining a feeling of greatness and importance? Was it because a man of distinction in our times overcame the hardships of life and in so doing endeared himself to millions of people? If you are thinking in terms of greatness through accomplishments, charitable actions and love of people, then you may very well ask this question. In all the mighty outbursts of genius that mark the beginning of modern times, who was the greatest man? One person might say, Columbus, discoverer of America; another, Michelangelo, the original genius of the Renaissance; still another might say the Good Samaritan of Biblical days; a military strategist might say Napoleon; a communicator, Marconi or DeForest. Who is to judge?

Today, SIGNAL magazine evinces an interest in another man by the name of Godfrey. Mr. Arthur Godfrey, whose accomplishments in many fields can be recorded already as history. Be this as it may, Mr. Godfrey is about to fulfill another one of his lifelong dreams—a series of which have been nothing short of miraculous. Now he takes off on a "safari into the interior of darkest Africa." Being the man that he is, Mr. Godfrey wants each and every one of his friends to go along with him. This he has planned through the medium of communications. His prodigious efforts to utilize the wonders of the electronic age have been finalized and we, his television and radio audience, will be given the privilege to view and live the experience of this humble gentleman. All we need do is to tune in on Mr. Godfrey's scheduled broadcast time over CBS radio and television.

### *Via Air France*

Leaving via Air France, Mr. and Mrs. Godfrey will celebrate their 19th wedding anniversary in Paris. Mr. Godfrey's plane will be flown to Madrid by his co-pilot, Mr. Frank LaVigna and Captain John Armstrong.

From Madrid the party will fly to Majorca, in the Balearic Islands, for re-fueling and thence to Tripoli, in Libya, where the plane will be thoroughly checked prior to the long haul across the Sahara to Fort Archambault, French Equatorial Africa.

### *Shortwave from Africa*

Mr. Godfrey will broadcast from the jungles of Africa by means of an Eldico 1-KW shortwave transmitter. By changing the crystals of the transmitter, he will be able to transmit on any of four frequencies which have been loaned to him by Radio Corporation of America with the sanction of the Federal Communications Commission. Power for the transmitter is provided by a 2½-KW Onan generator driven by a gasoline engine, which will be hauled by jeep and which will, in addition, run ice machines, electric razors, electric lights, etc. The same equipment, less the Onan generator, will be carried on his "One Mike" enabling Mr. Godfrey to broadcast from his airplane. The broadcasts will be made on whichever of the four frequencies conditions will permit him to use. The shortwave transmissions will be picked up at Rocky Point, New York, by RCA and then relayed to CBS for

Mr. Godfrey is pictured here at the controls of his DC-3. This plane will be flown to Madrid by Frank LaVigna and Captain John Armstrong, his co-pilots. From there the Godfrey party will fly to Majorca, in the Balearic Islands, and thence to Tripoli in Libya, where the plane will be checked thoroughly prior to the long haul across the Sahara to Fort Archambault, French Equatorial Africa.

re-broadcast on Mr. Godfrey's regular radio and television programs.

It is understood that General Curtis E. Lemay, Commanding General of Strategic Air Command, is making plans which may allow him to accompany Mr. Godfrey. If this becomes an actuality, General Lemay will enjoy his first vacation in twenty-five years. If world conditions permit and the pressure of SAC duties eases sufficiently, Gen. Lemay may go on leave at one of the overseas bases. Under current planning, the Godfrey party would be granted permission to land the DC-3 at the base to pick up Gen. Lemay. At the end of the hunting trip, Gen. Lemay would be returned to the SAC base to resume his work.

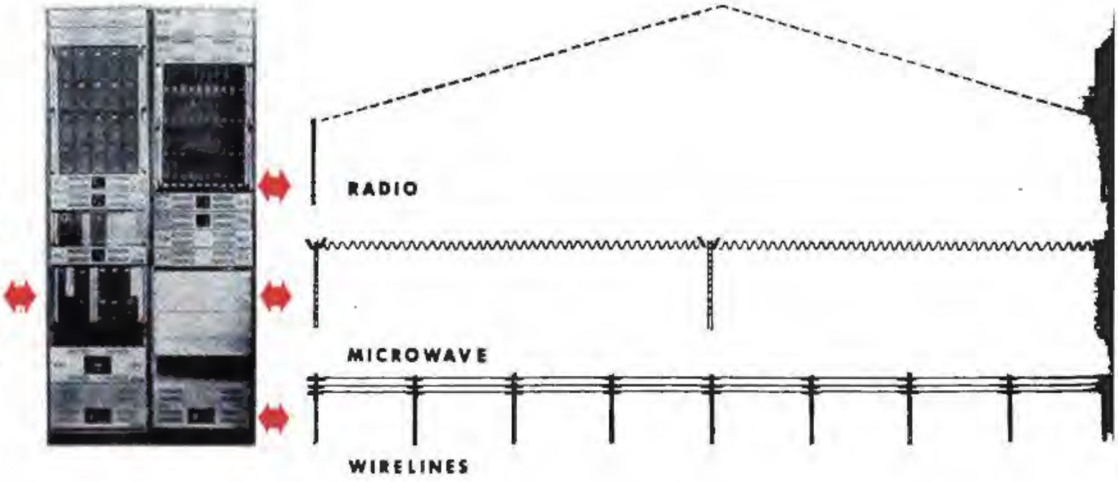
### *22 Years in Broadcasting*

Arthur Godfrey has spent more than twenty-two years in broadcasting and has become one of the best loved and most-listened-to and seen personalities in American history. His weekly audience is estimated at more than forty million people. He founded the GAPSALS (Give A Pint, Save A Life Society) in 1944 and through his appeals, aired locally in New York, more than 6,000 pints of blood were collected. As a Navy war correspondent he flew to Saipan to witness uses of blood plasma he was collecting. In 1951 he ran a 15-hour Blood Pledge Marathon on the CBS Radio Network. As a result of his appeals, more than 300,000 pints of blood were pledged.

Godfrey was promoted in 1950 to Commander, USNR, after having been a Lieutenant Commander since 1939. Winning the golden wings of a naval aviator was his biggest thrill. An exponent of safety in flying, he is also one of the aviation industry's best ambassadors of good will. He has provided scholarships at American University in Washington, D. C., to train students in flying and other aspects of aviation. The Air Force Association honored him with a plaque for "distinguished public service contributing to a greater understanding of air power . . . . and proving the efficiency of air travel."

Many people have noticed Mr. Godfrey limp at times. The story behind that is an inspiration to all who have physical handicaps to overcome. In 1931, he suffered 47 fractures in an automobile accident. It took him years to learn to walk again unaided. Today he flies planes, rides horses, ice skates, and now is off on a safari to Africa.

SIGNAL magazine wishes Mr. Godfrey good luck and a bon voyage. We look forward with interest to his broadcasts from Africa and wish to thank him for the opportunity which he has given us to bring you the above story relating to the fulfillment of his dreams.—The Editor.


RADIO
MICROWAVE
WIRELINES

er major stride forward in communication. the research and development laboratories llins Radio Company comes KINEPLEX — ctrum conserving, high-capacity, synchronous ystem which transmits and receives 3,000 f information per second on a 3 kc band, superior signal-to-noise performance.

table to wireline, cable, radio, or microwave ies, KINEPLEX provides twice as many nels on a 3 kc band as present day carrier pewriter systems. In teletypewriter applica- this means 40 channels on a 3 kc band , 75, or 100 words a minute operation.

EPLEX will take stored business machine in serial or parallel form and transmit it at the 3,000 bit per second rate. Material can be om magnetic tape, paper tape, punched , or other storage media.

EPLEX can also be used for telemetering, visory control, and facsimile. The total data mission capacity of the system can be ed between various services to fit specific cations. Write today for literature on s new TE-202 KINEPLEX Data System.

**DATA**

3,000 bits per second or 40 teletypewriter channels of 100 words per minute in a 3 kc bandwidth, or a combination of the two.

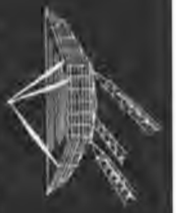
**For additional information:** call your nearest Collins sales office or write for technical brochure.

# Collins also leads development in the fields of

## AVIATION

Collins completely outfits airline, military and business aircraft with the most advanced communication, navigation, flight control and instrumentation systems in aviation. Many new lightweight, reduced-size versions are now being delivered. Collins designed the original Integrated Flight System, leads in combining comm/nav/ident units into a single compact "CNI" package for new military aircraft, and continues to pace the industry in developments in airborne radar, ADF, ILS, VOR, HF and VHF communication.

## GROUND COMMUNICATION



Collins engineers, designs and supplies the equipment, installs, and puts into operation integrated point-to-point communication systems of any scope. The Collins system engineering staff is backed by the finest equipment in the world, whether standard MF, HF or VHF, Transhorizon "scatter," microwave relay and multiplex or single sideband HF. Typical of Collins communication progress is "Kineplex" — a high speed data transmission system doubling communication capacity.

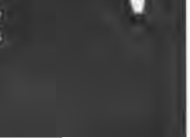
## AMATEUR RADIO

In the early 1930's Collins set the standard in Amateur radio and, through continuous design and development, has raised this standard to its present single sideband station — the most honored and prized in the Amateur fraternity. This station is the top performing rig on the air with its kilowatt KWS-1 transmitter and highly selective 75A-4 receiver. Many of the leaders in the electronics industry became acquainted with Collins through the Company's superior Amateur equipment.

## BROADCAST

Collins supplies a complete new AM station from mike to antenna or modernizes existing facilities. Besides the superior line of transmitters, Collins supplies the broadcaster's needs with such advanced additions as TV-STL microwave relay system, the lightest 4-channel remote amplifier on the market, phasing equipment and audio consoles. Collins field service organization has built an enviable reputation in assisting the broadcaster in installation or in times of emergency.

## COMPONENTS AND TEST EQUIPMENT



The degree of precision and reliability of Collins products requires development by Collins engineering of components such as Autotunes and Autopositioners, Mechanical Filters, oscillators, heat reducing tube shields and ferrites. These developments and other high quality components are sold by a Collins subsidiary, Communication Accessories Company of Hickman Mills, Missouri. The same principles of accuracy and reliability apply to Collins test equipment, built especially for Collins but adaptable to testing other equipment types.

# a TAX BILL OF INTEREST

**by Kennedy Watkins**

Tax Attorney
Washington, D. C.

In accord with past practices, the first few days of the first session of the 85th Congress witnessed a large number of revenue bills being introduced in both Houses of Congress. Many of these are introduced "for the record"—for home consumption; some may never see the light of day as they lie forgotten in committee; some may be the subject of open hearings and in due course might ultimately be enacted into law. To prognosticate at this stage which of the bills introduced thus far may be ultimately enacted is impossible. However, it is not too difficult to spot certain of these measures which, in the light of their objectives and current conditions, are not only of interest but might have some measure of success in being enacted. Such a bill is S. 352, a bill to amend the 1954 Internal Revenue Code, so as to impose a graduated tax on the taxable income of corporations. This bill was introduced on January 7, 1957, by Senator Sparkman. A bill similar to S. 352 (S. 4138) was previously introduced by Senator Sparkman in the closing days of the last session of the preceding Congress.

### *Extension Study by Committee*

To place this bill in its proper setting, it must be noted that its sponsor has long been Chairman of the Senate's Select Committee on Small Business. This Committee has labored extensively in developing and studying the ills, and possible means of their cure, of small business. One of the many problems in this area which can be relieved by legislation concerns the financial and tax situation of small business. It was doubtless with this in mind that the Senator introduced S. 352.

Pursuant to the terms of this bill, in the case of taxable years beginning after December 31, 1956, the taxable income of corporations would be taxed as follows:

| | |
|---|---|
| Not over $5,000 | 5 percent of the taxable income. |
| Over $5,000 but not over $10,000 | $250, plus 10 percent of excess over $5,000. |
| Over $10,000 but not over $15,000 | $750, plus 15 percent of excess over $10,000. |
| Over $15,000 but not over $20,000 | $1,500, plus 25 percent of excess over $15,000. |
| Over $20,000 but not over $25,000 | $2,750, plus 35 percent of excess over $20,000. |
| Over $25,000 but not over $100,000 | $4,500, plus 45 percent of excess over $25,000. |
| Over $100,000 | $38,250, plus 55 percent of excess over $100,000. |

In substituting graduated taxes at the rates indicated for the present normal tax and surtax on corporate taxable income, this bill would, according to Senator Sparkman, "mean a tax saving to nearly 98 percent of all corporations." He goes on to point out that with the maximum rate of 55%, there would be an increase in taxes on about 2% of the corporations in the country today. Based on the rates set forth in S. 352, the staff of the Joint Committee on Internal Revenue Taxation estimates that there would be no loss in Federal revenue. "In fact," the Senator says, "it would bring about an increase in revenue in the neighborhood of ninety to one hundred million dollars." [Cong. Rec., 1-7-57, p. 255.] In the present fiscal situation, such a prognosis as this has considerable appeal. This, coupled with an expressed desire on the part of the Administration to help small business and realizing the "grass root" pressure which small business is capable of exerting, would seem to indicate that S. 352 is a bill to watch.

### *Remarks of Congressman Mills*

While considering the beneficial aspects of this proposed legislation, both as to small business and the Federal revenues, it must be recognized that all small businesses are not small corporations and, further, that the introduction of graduated rates on corporate taxable income is a new concept not free of potential hazards. In a recent speech before the Federal Tax Forum, in New York City, on December 6, 1956, Congressman Wilbur D. Mills, a member of the House Ways and Means Committee and Chairman of its Subcommittee on Internal Revenue Taxation, was careful to point out that the vast majority of small business in the U. S. is conducted as sole proprietorships or as partnerships. His remarks on this aspect of the problem are of such pertinence as to warrant repetition. In this connection, he said:

> "In 1953 there were approximately 7,450,000 businesses in the United States, of which only 441,767 were organized as corporations. Among these corporations 344,518 earned less than $250,000 and of these companies, 64,228 earned more than $25,000. As a matter of fairness and in the interests of strengthening the small business foundation of our economy, I do not see how we can justifiably provide tax relief for small corporations and do nothing for the millions of entrepreneurs who because of sound business reasons or statutory proscription are unable to avail themselves of the corporate form of organization."

Consequently, any such legislation as within the ambit of S. 352 would be helpful only as to a small segment of small business. While it is perfectly true that the 1954 Code provides a means whereby certain proprietorships and partnerships may elect to

*(Continued on page 50)*

# Quotes in Review

a survey of major statements made during the past two months

"Signal progress on both the military and civil fronts marked the activities of the aircraft industry during its fiscal year ending October 31, 1956. The industry not only substantially maintained its military production schedules, it simultaneously brought into service many manned aircraft and guided missiles of highly advanced capabilities.

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"During the year, the Air Force accepted substantial quantities of 'century series' supersonic fighters and the Navy's air arm also took delivery of high-speed types. As a result, the three Marine air wings and the 17 Navy carrier air groups are now almost completely equipped with modern aircraft types. During the same period, the first heavy jet bomber wings were activated by the Air Force. The first of a series of fighters capable of flying twice the speed of sound took to the air. At the end of the fiscal year, America's first supersonic jet bomber was undergoing taxi tests preparatory to its maiden flight. And advanced production stages were attained on a fleet of jet tanker planes which will greatly improve the Air Force's long-range combat air capability.

* * * * *

"By July 1957, the minimum target strengths set for the air services several years ago will have been reached. These goals embrace 137 wings for the Air Force, 17 modern carrier air groups and proportionate strength for the Army and Marine Corps. They were devised on a timetable basis, as those military planners considered necessary, to assure the defensive and retaliatory capabilities required to discourage aggression against this country and her allies.

"To what extent these strength levels may be affected by changing degrees of world tension, or by the obvious progress of Soviet air power, is not known. As a result, it is currently impossible to determine what greater or lesser requirements may be made on the production capacity of the aircraft industry. Military planners will take periodic 'new looks' at the world situation and the aircraft industry will undertake whatever development and applied research and production activities the military services require as a result of these appraisals. It is certain, however, that there will be no compromise with quality in aeronautical products. The industry will be expected to develop and produce advanced weapons superior in all respects to those which can be developed and produced by potential enemies. It will be a continuing task to keep our military units supplied with such equipment."

***Admiral DeWitt C. Ramsey, USN (Ret)***
**The Board of Governors of the Aircraft Industries Association of America, Inc.**
**Washington, D. C.**

* * * * * * *

"I come tonight as a special pleader for military strength as a power for peace. Never was it so necessary to keep the peace. Never was it so vital to convince every other nation of the necessity to keep the peace. The world simply cannot yield to the temptation to war. War seems so attractive as the immediate solution for human wrongs. Preventive war appears to be an easy and direct course to rid the world of tyrannical dictators and to punish little pretenders. With all the tangential and centrifugal forces loose, we need a good, solid force that will hold the world constantly and unwaveringly on the beam toward peace.

* * * * *

"The fundamental aim of American military forces is to support our foreign policy, of which they are an inseparable instrumentality. Our Armed Forces are not only the reliable guardians of our freedom and national integrity—they are also the most dependable pillars of our diplomacy for peace. Foresight, imagination, and a bold and realistic approach to the problems of defense in the atomic age have characterized the development of our military program. It is wisely designed to provide the required strength without jeopardizing the basic freedoms of our people or the vigor of our economy.

"The team principle is fundamental to all our military efforts. Our interdependent Army, Navy, and Air Force work together to maintain the three-dimensional power necessary to deal with any enemy on land, at sea, or in the air. Each member has a unique and essential role. Each complements and supplements the others. Our military policy is not shackled to a single concept of war, nor is it based upon any one weapon or family of weapons. A resourceful enemy could be expected to strike at our weakest point. Hence we are not allowing ourselves to be weak or vulnerable in any particular. Our defense team is so constituted that it is ready for whatever emergency might develop during these critical times—whether it be a global war, a local or limited war, or any other form of aggression. It is capable of applying military power with proper discrimination to meet every situation with maximum effectiveness. Our Nation's powerful, balanced forces include every essential element of defensive and offensive strength. As a team, they have the ability to fight successfully against any enemy, any time, any place, and under any circumstances, which is the only effective deterrent to an aggressor."

***Wilber M. Brucker***
**Secretary of the Army**
**Illinois Manufacturers' Association**
**Chicago, Illinois**

* * * * * * *

"The electron may well be one of the keys that will help to unlock the door to Canada's future greatness. In many ways, it provides the answer to the problems raised by your geography, climate and population resources. Automation, for example, will come into increasing use as the means of assuring greater productivity in the face of a relatively limited working force. Together with industrial television, it will enable operations to be seen and controlled in places where climate, distance or the nature of the process limit human intervention.

"Mass production assembly, smelting, oil refining, equipment and product inspection—virtually any major industrial process—will employ these new electronic methods and machines for control, regulation and production. This in turn will create new industries and services—new forms of employment and higher standards of living.

* * * * * *

"We see electronics at work in almost every aspect of Canada's cultural life and national development. Electronic minds and hands are at work in factories. Microwave and other forms of communication link mining communities and logging camps. Electronic equipment sails with the fishing fleets off the Grand Banks, in the Pacific, on the Great Lakes and in Arctic waters. Radar and other electronic gear stand endless watch as northern sentinels of defense.

* * * * * *

"I would leave you the thought that electronics will provide both our countries with the means for enriching our common destinies. It will provide new fields of employment for our people and new dimensions in entertainment. The new wonders of communication will expand our horizons while electronics further strengthens our mutual ramparts of national defense and peace."

***Mr. Frank M. Folsom***
**Chairman of the Executive Committee**
**Radio Corporation of America**
**The Canadian Club of Toronto**

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"Along with other institutions of science and engineering, our salary problem is exceptionally acute. The shortage of scientists and engineers has pushed up the salaries offered by industry and Government, with the result that the gap between academic salaries in these fields and salaries in industry is widening. It is a shocking fact that young men receiving their doctor's degrees in science and engineering frequently now obtain jobs paying higher salaries than we can pay the teachers who directed their graduate training. Widening, too, is the gap between salaries paid by educational institutions and salaries paid by many non-educational but non-profit institutions and organizations. Certain of the foundations, research institutes, quasi- government organizations, and other institutions especially in the field of research have salary scales substantially higher than our academic salaries at M.I.T. It is not that their salaries are too high; ours are too low.

"As a result we are squarely up against the possibility that the best minds in our engineering colleges—and to some extent in our science schools—may be attracted away from teaching into industry or other fields. This possibility is further increased by the strenuous efforts now being made to recruit scientists and engineers for urgent defense projects requiring many hundreds of professional workers.

* * * * * *

"If we permit this kind of deterioration to continue, the baneful effects for industry, for national security, and for the public welfare can become profoundly dangerous. Already we are engaged in an all-out technological race with the Russians. Already the Russians are training more scientists and engineers than the United States. Already they are offering greater incentives, rewards, and status to their scientists and engineers in education than are we. Already we have before the Nation a desperate need to augment the quality and quantity of scientists and engineers."

***James R. Killian, Jr.***
**President, Massachusetts Institute of Technology**
**Report of the President**
**Cambridge, Massachusetts**

"In simplest terms, the weapons systems philosophy means that, when the Department of Defense buys a new weapon today, it makes a serious effort to buy a 'complete weapon.' In the strictest sense, it attempts to place with one manufacturer the responsibility for providing an entire aircraft, or missile system, ready for operational use. This whole package is supposed to become an integrated and compatible system made up of major components and sub-systems . . . airframe, engine, fire-control equipment, air and ground instrumentation, test and maintenance gear, and so on. The company which wins a weapon system contract today thereby manages a complete and often complex program and, therefore, bears an important part of the responsibility for its success or failure.

"It is only in recent years that this concept has been widely dramatized and, even more recently, more widely adopted. Despite its dramatization, its emergence as an important aspect of modern-day military procurement has been more evolutionary than revolutionary.

* * * * * *

"For example, in the development of bombing aircraft, there came a growing appreciation of the fact that there was an important relationship between the bombsight or bombing system and the navigation and steering system. In short, for most efficient bombing, there should be an integration or marriage of the bombing and the flight control equipment.

". . . you can still find instances where the procurement plan does not call for a real marriage in the design, development, and production of such major sub-systems as the bombing equipment and the automatic flight control equipment. Thus, despite the dramatization of the weapons systems philosophy, some of the weapons of the next decade will be assembled from bits and pieces, just as were the weapons of a decade ago."

***Dr. Carl A. Frische***
**Vice President for Operations**
**Sperry Gyroscope Company**
**Air Force Association**
**Garden City, New York**

* * * * * * *

"Industry naturally reacts unfavorably to being a special target, and the attitudes which special attacks reflect cannot help but retard progress, whether they are applied at local, state, or national levels. They will slow down the rate of expansion and growth and, in so doing, militate against the interests of the country and each of its subdivisions everywhere.

". . . I am afraid that we have developed a feeling in recent years that progress is somehow automatic—that success comes along as a matter of course. We have reached a stage in which nearly everyone can go to college, and each year we see frantic bidding for our new graduates. I sometimes think that many of them must have a distorted picture of the requirements for success in any undertaking.

"The fact is that the rules of pioneering haven't changed and the rules of success haven't changed. The rewards and the gains will go only to those who are willing to work hard for them."

***Henry B. du Pont***
**Vice President, E. I. du Pont de Nemours & Company**
**The Rotary Club**
**Louisville, Kentucky**

# The Civil War and he U.S. Military Telegraph Service

by Colonel H. V. Canan, USA (Ret.)

THE ADVENT OF THE CIVIL WAR FOUND THE TELEGRAPH new but rapidly expanding industry. The people of the United States had been quick to realize its commercial and social advantages, and by 1861 telegraph lines girded the Nation and extended even to the west coast. The telegraph had become a major factor in the rapid exchange of news, information, and ideas.

Although its potential in warfare and in the dissemination of intelligence had been generally realized by military students, the telegraph was not an active tool of the U. S. Army. Little thought had been given to its use in combat and no plans existed to utilize commercial lines in the event of an emergency.

At the outbreak of war, all the telegraph facilities of both the North and South were in the hands of private individuals. In April 1861, with full cooperation of the telegraph companies of the North, the Government assumed nominal control of all telegraph lines leading into the Capitol. Assistant Secretary of War, Thomas A. Scott, secured the cooperation of Edward S. Sanford, President of the American Telegraph Company, who was most helpful in organizing a small unit in the War Department to carry on the operation, control, and supervision of the lines. For the first several months of the war, the small organization formed hy Sanford was the only governmental effort to control the telegraph or to exploit its military possibilities.

## *Government Authority Limited Before Bull Run*

Until the Battle of Bull Run, the authority which had been imposed by the Government over private lines had been limited and of small consequence. It had been assumed that when need arose, private companies would extend their lines into the combat zones of the armies. It was a false premise and during the battle there was a lack of communication on the battle field.

Messages to Washington were just as bad, with half wire and half courier service forming the link between Maj. Gen. McDowell's army and the War Department. Even communication with nearby Harper's Ferry was broken. The independent force there under Maj. Gen. Patterson did not learn of the Union defeat for three days and then from a Philadelphia newspaper. This battle forced the Government to realize that its communication with the major portions of its army was deficient.

The little that had been accomplished toward the control and supervision of the telegraph in the early days of the war was achieved by the patriotic efforts of Sanford and the generosity of his company. The American Telegraph Company had made most of the expenditures in the early days of battle and had built, operated, and maintained telegraph lines which during a war should properly have been handled by a governmental agency.

Andrew Carnegie had been appointed by Scott as his assistant and soon he became the Secretary of War's right-hand man. When the Government finally realized the need for better military communications, Carnegie secured men of exceptional administrative ability for an expanded United States Military Telegraph Service. The initial appointment of only men from the telegraph industry soon led to its executives dominating the thought in the War Department.

## *U. S. Military Telegraph Service is Born*

Among those appointed in 1861 was Anson Stager, General Superintendent of the Western Union Telegraph Company. He was selected as chief of the newly conceived Military Telegraph Service. He submitted a plan for a unified service for the Army with lines going down to the headquarters of every major independent command. He recommended that a bureau which would purchase and distribute all materials needed for the construction and operation of the military telegraph lines be organized directly under the Secretary of War. Arrangements would be made with private companies for the use of their lines where needed. Stager's plan was approved and the Military Telegraph Service formally came into being as a civilian bureau, attached to the Quartermaster Corps. The civilian operators were given the status of Quartermaster civilian employees. Only a favored few were given commissions and considerable bad feeling developed among the majority of the men who remained civilians. Those in the field, many of whom received wounds in the war, repeatedly petitioned for military status. However, military status would have put them under the command of the military leaders, which Stanton and Stager wished to avoid.

## *Control and Growth of the Telegraph*

An act of Congress, passed January 31, 1862, gave the President authority to take over any or all telegraph and rail lines when the public safety so required and to operate them in the interests of national defense. The act allowed full development of the Military Telegraph Service. In February, Stanton as Secretary of War issued an order by which the Army took control of all telegraph lines. Censorship was provided.

Where leaks of information were suspected, the War Department did not hesitate to tap friendly wires. Specifications were placed on the use of codes and ciphers, leaving commanders entirely at the mercy of the civilian operators. This affected military operations, since the use of code rendered rapid communication in the field impossible. So that the Secretary of War would know what was going on, copies of all messages sent in cipher were sent to Washington. Many Northern commanders felt that their acts and even their thoughts were under constant surveillance, that reprisal would follow if the Secretary of War did not approve. Lest their actions or statements be misinterpreted, they dared not reveal too much in their messages.

In spite of bureaucratic meddling, extension of the service followed rapidly. Each military department soon had its military telegraph chief. By the end of fiscal year 1862, there was a total of 3571 miles in the system. In fiscal year 1863, the annual construction had reached 3240 miles with 8340 miles in operation.

In the West the Military Telegraph was indispensable. The telegraph was needed on the long lines of communication. Although the wire was frequently strung along the railroads, line repair was fraught with danger. One out of every twelve men engaged in the work was either killed or wounded, or died of exposure.

Since the operations were farther from headquarters, matters did not go as smoothly in the West, at first, as they had in the East. Early in 1862, dispatches were not reaching Grant. Although they were sent to the end of the advanced wire, the operator failed to forward them. The operator soon deserted his post and went into the Southern lines taking all of the dispatches with him.

The most efficient service was in the East. An average of 200 miles of field wire was put up and taken down each day during Grant's Virginia campaign. As Southern territory was occupied, the lines captured were operated by the Military Telegraph Service.

As time went on, the need for field telegraph became more apparent. After McClellan took command of the armies, he cooperated with Major Myer, the Chief Signal Officer, in establishing direct field telegraph service to the troops on the battlefield.

### *Telegraph Equipment in the Field*

The first field train for the telegraph was purchased and sent forward for the Peninsula campaign in May, 1862. In addition to carrying flags, night signals, and rockets, light wagons carried ten miles of telegraph wire.

Myer's Field Telegraph became a most useful tool for commanders. From the modest beginning in the Peninsula Campaign, a total of thirty trains were procured and issued to the various armies of the North.

At the front, the Military Telegraph carried communications to army headquarters and the field wire carried them from there to corps headquarters and at times to lower echelons. The normal distance covered by the field lines during a campaign was from five to eight miles, although distances as great as twenty miles were reported. The equipment was excellent and improvement was made as needed. Wagons in the trains carried reels of five to ten miles of insulated wire—insulated so that it would transmit in storm, on the ground, or under water, even when not properly laid. The installation and repair were frequently carried out under small arms fire or artillery fire.

As each army moved forward, its field wire was taken up, but communication with the War Department was maintained by the more permanent installation of the galvanized wire of the Military Telegraph Service. A French military observer, though he acknowledged that field wire was a great advantage to commanders, feared that it would keep them too close to their headquarters where messages could never replace personal observation.

The Northern soldiers knew little about the field telegraph. Until warned by orders, they thought that the field wire was a part of a Confederate infernal war machine and soldiers would cut it for souvenirs. To prevent intentional or accidental interruptions of the wire during the battle at Fredericksburg, a detail of cavalry patrolled the line. Many of the patrol were stragglers who had found a job they could do which was removed from immediate rifle or artillery fire.

Although the Army had been successful in obtaining, operating, and improving the Field Telegraph, its successful operation had long been a cause for controversy. Civilian companies did not approve of telegraph operation by the military. The civilians in the Military Telegraph Service also expressed some dissatisfaction, although they worked harmoniously with the military in the field. Stanton wanted to extend his control to include the field lines.

### *Military Telegraph Service Takes Over*

The Field Telegraph Service was kept constantly on the defensive. Protests against the cabal undermining it were unfruitful. In 1863, Myer issued an unpolitic circular denouncing the systematic attempts of the civilian organization to deprive the Signal Corps of its field lines. Consequently, Myer was relieved from his duties as Chief Signal Officer, and the field trains were ordered turned over to the Military Telegraph Service. The military operators were ordered assigned to other military duty with the army. This crippled the Signal Corps and it scarcely could continue to carry out its functions.

Slowly the Military Telegraph Service assumed its new duties. In Virginia, in 1864 and 1865, Major Eckert, assistant general manager of the Service, and his civilian forces made decided efforts to provide Meade with ample telegraph facilities. Grant became enthusiastic over the services being rendered, both by his Signal Corps with aerial signals and by the Military Telegraph with the telegram. He described in detail how men of the telegraph service laid their lines without orders to the various lower headquarters, almost before the troops were in position.

There was no effective censorship of the telegraph during the first year of the war. It was a delicate matter and full of political dynamite. Since no one wanted to supervise censorship, it was transferred from department to department. It first appears to have been administered by the Treasury Department. Then the War Department took it over. The first real attempt at censorship seems to have been made by Lieut. Gen. Winfield Scott prior to the First Battle of Bull Run when, after a bad security leak, he ordered the telegraph companies to transmit no messages concerning military operations unless approved or authorized by him.

Censorship was next transferred to the State Department. The censor was instructed to put stringent rules into effect. These prohibited Washington from dispatching over the wires anything intended for publication which related to the civil or military operations of the government unless they were dispatches of the regular agent of the associated press. Nothing damaging to the haracters of military officers, the administration, or the abinet could be sent over the wires from Washington.

These orders had little effect since no censorship of the ails had been attempted. There were no measures to revent transmission of the prohibited news from telegraph offices in Baltimore, Philadelphia, New York, or ther important cities. Many dispatches which were suppressed in Washington were mailed to other cities and ut on the wires.

After the United States Military Telegraph Service was rganized, the responsibility of telegraph censorship was eturned to the War Department as a military function. From then on all telegraph communications not specifically authorized were forbidden.

As the use of the telegraph for military purposes increased, information gained from tapping telegraph wires became an important source of military intelligence for the South. Tapping was most productive during that period of the war when messages were sent in the clear. Wire tapping brought attention to the need for sending important messages in cipher.

An example of an early cipher is shown in a message sent by President Lincoln in 1862 to Burnside at Fredericksburg a few weeks before the battle. Lincoln requested a conference in a message which read as follows:

> If I should be in boat off Aquia Creek at dark tomorrow (Wednesday) evening could you, without inconvenience, meet me and pass an hour or so with me. A. Lincoln.

Suspecting that the Confederates had tapped the line, the Union operator used a homemade code in sending the message, depending upon the operator at the other end to figure out what was meant. The message read:

> Can Inn Ale me with 2 oar our Ann pass Ann me flesh ends N. W. Corn Inn out with U cud Inn heavenly day nest Wed roe Moore Tom darky hat Greek why Hawk of Abbott Inn B chewed if.

Lincoln's signature "Can Inn Ale" was at the beginning of the message and was, along with the balance of the message, to be read in reverse. The message was deciphered and the meeting arranged in spite of the risks involved.

As the war progressed, cryptograpby was developed. Commanders in the field had no access to the ciphers or keys. The cipher books were issued only to the "telegraphic experts," as approved and appointed by the Secretary of War. Commanders in the field were specifically forbidden to interfere with them. Since local military leaders had no command or control over the operators, the accuracy of the service rested with the operators alone.

Although the type of control and command used by the Military Telegraph Service was entirely foreign to the American concept of command, it worked. If we judge the Service by the results obtained, then it must have a high rating. One of the great feats of the war was the transfer of two corps of 23,000 men with impedimenta from the East some 1,200 miles to Chattanooga in eleven and one-half days. It was a remarkable rail movement, and without the closely knit, closely controlled, centralized telegraph, it could not have been accomplished.

After Grant took command of all the Union armies, he received by daily telegram all intelligence coming into the War Department. The efficient functioning of the Military Telegraph permitted him to be the first great military leader to use the telegraph for tactical and strategic planning.

Pictured here is the film for the Micro-Master camera. It is exposed in long rolls that are automatically transported as each frame is made from one magazine to another

# PHOTOPROGRESS

by FRANK SMITH
Photo Editor, SIGNAL

### Kodak Sheet Film S. O. 1177

One of the most exciting bits of news which has been released recently is the announcement of the Eastman Kodak Co., Rochester, N. Y., regarding their new experimental super-speed pan sheet film designated as S. O. 1177 which is claimed by the manufacturer to be four times faster than Royal Pan.

The film has already been successfully pre-tested by a few metropolitan newspapers in recent weeks. Existing light photos heretofore regarded as impossible—night sports action photos, building interiors where shortest possible exposures are needed—have been handled successfully by press photographers using the new film.

S. O. 1177 is the result of recent discoveries made by Kodak scientists working in emulsion research. Because it has a very rich silver content, fixing time is longer than it is for other films. There is a slight, inherent fog in the emulsion but tests have shown that this does not interfere with good print quality. Grain is somewhat coarser than in Royal Pan, but it is finer than would be expected for such a large speed increase. Five to six times enlargements have proven very satisfactory for press work. Because the film is still in the experimental stage, it will only be manufactured in limited quantities so that improvements and modifications can be incorporated quickly.

The company recommends development in DK-60a for 6 to 10 minutes at 68 degrees F. or in DK-50 for 8 to 12 minutes at 68 degrees F. The longer development timer gives approximately 4 times the speed of Royal Pan. Further increases in developing time tend to increase contrast and fog without any appreciable further increase in speed.

Fresh developers should be used as partially exhausted developers may produce dichroic fog. This can usually be swabbed off while the film is still wet. Kodak rapid fixer should be used. Fixing time is slower than other films because of the richer silver content. Regular procedure may be used in washing.

The film is available only in three sizes (4"x5", 5"x7", and 8"x10") and only in 25 sheet packages. Prices are the same as those for Kodak Infrared Film. Orders will be accepted only for one case or multiples and can be placed with regular Kodak dealers.

### New Projector for Data-Reduction Features Variable Speeds, Remote Control

Remote control of prolonged single-frame projectio at full illumination is a feature of a new projector fo critical analysis of 16 mm. motion picture films. Bot forward and reverse projections in a range from 16 t 24 frames per second can also be controlled from a hand held remote control box.

Called the L-W Industrialist, the new projector is modification of an Eastman Kodak Kodascope 16 mm silent analyst projector, combining the reliability and advanced engineering of the Kodascope projector wit special adaptations required for data-reduction and methods analysis.

The L-W Industrialist can project a single still picture for prolonged study without the loss of illumination o the heat damage to film that has been a drawback i the past. The ability to advance or reverse by remote control one frame at a time or at speeds of from 6 to 2 frames per second permits slow speed frame-by-frame analysis of any portion of the film.

Advancing or reversing to a certain portion of the film is facilitated by the frame counter. A wide aperture plate will permit user to add identification marks onto the *sprocket* holes. A tilting design aids in proper alignment of the picture. The L-W Industrialist is completely portable; it operates in its case and only the cover need be removed. For daylight viewing in the analysts office, a Kodak Projection Viewer is built into the carrying case. This combines a special front surface mirror with a black day view screen. Film capacity is 400 ft., and cooling is provided by a constant speed motor for blower service. A fast power rewind is provided. The projector is manufactured by the L-W Photo Products Co., 81 South Flower St., Los Angeles 17, California.

### "Moonlet" Tracking Camera

One of the most interesting cameras to be announced recently is the "moonlet" (earth satellite) tracking camera which is being developed by the Perkin-Elmer Corp., Norwalk, Conn., for use in photographing the earth satellite which is scheduled to be launched during the coming International Geophysical Year, which starts July 1,

The L-W Industrialist 16mm motion picture projector. This features remote control and projection of a single still picture for prolonged study without the loss of illumination or heat damage to film. It has the ability to advance or reverse one frame at a time at speeds of from 6 to 24 frames per second permitting slow speed frame-by-frame analysis of any portion of the film.

1957 and runs through 1958. The camera, which will measure 10 feet high by 8 feet wide, has been designed and is being built under the auspices of the Smithsonian Institute.

According to Dr. Fred L. Whipple, Director of the Smithsonian Astrophysical Observatory which has been given the responsibility for the optical tracking of the satellite, scientists will require a precise determination of the satellite's orbit to achieve their planned experiments with the space ball.

Twelve of the special cameras, with one of the most difficult to produce optical systems ever attempted, will be produced and strategically placed about the globe to track the satellite.

They will be used for this purpose in conjunction with radio listening stations, astronomical observatories, and amateur observations (the latter called "operation moonwatch").

Two of the cameras are earmarked for use in the United States, one at White Sands Proving Grounds, New Mexico and the other at Patrick Air Force Base, Florida. The others will be placed at Arequipa, Peru; Cordoba, Argentina; Blomfontein, South Africa; Teheran, Iran; Cadiz, Spain; Hawaii; Japan; Australia; India; and an island in the Dutch West Indies.

Although the cameras are being built specifically for IGY studies, Dr. J. Allen Hynek of Ohio State University and Associate Director of the Satellite Tracking Program states that the telescopes are of highest optical quality and of sufficient versatility to be useful for a wide variety of future satellites.

The production of the optical systems for the cameras is being undertaken by the Perkin-Elmer Corp., builders of the Baker-Super-Schmidt Meteor Cameras and other optics for a number of astronomical observatories.

Dr. James G. Baker, President of Spica, Inc., and one of the foremost optical designers in the United States designed the 20 inch aperture, ultrafast f/10 apochromatic lens for the camera. The cameras have a 30 degree field of view.

The lens includes three aspheric corrector plates with a total of four aspheric surfaces, and a 32 inch mirror. The importance of aspheric surface to lens design is twofold. First, since an aspheric surface often replaces one or more classical surfaces, it means lighter weight and smaller lenses. Secondly, aspherics will sometimes correct aberrations not otherwise correctible, resulting in faster and more precise lens systems. The mechanical portion of the cameras was designed by Joseph Nunn and Associates of Los Angeles, Calif., and will be fabricated by Boller and Chivens of Pasadena, Calif. The lens system weighs 250 lbs. and will photograph the satellite on a strip of 55 mm. cinemascope film about one foot long.

## An Ultra-High Speed Lens for Use in Dim-light Photography and Television

Photographers and television cameramen requiring the utmost in light gathering power will be pleased with the announcement of the Farrand Optical Co., Inc., Bronx Blvd. and E. 238th St., New York 70, N. Y., who have announced availability of their new Super-Farron f/0.87 lens—an ultra-high speed photographic objective well-corrected over an unusually wide field. In contrast to other available lenses of similar aperture, the Super-Farron covers a much wider field (30 degrees) with a good correction that holds up over a broad spectrum.

In a 76 mm. focal length, the Super-Farron lens covers a 40 mm. diameter field, and is thus suitable as an objective for use with the Image Orthicon tube in television cameras and for 35 mm. photography.

In addition to the standard infinity correction for direct photography, the lens can be supplied corected for 16:1 magnification for fluoroscopic application and corrected for 4:1 magnification for photography of oscilloscopes for television, the lens can be supplied with correction for the envelope thickness of the pick-up tube.

Developed by an organization with an extensive record of achievement in optical design and manufacture as well as complete familiarity with end-use requirements, the design of this objective represents an important advance over previous developments in the field of ultra-high speed lenses.

## *L. J. M. Daguerre, The World's First Photographer*

This is the title of a beautiful and historically correct book on the history of photography by two well known historians of the subject, Helmut and Alison Gernsheim of England. Ordinarily books are reviewed in our book section, but this being such an exceptional volume and pertaining as it does to the history of photography, it might be well to call your attention to it here by giving a thumbnail review.

Published late in 1956, the volume consists of some 216 pages of authentic photographic history (in this case, the daguerreotype), and 117 illustrations, one of them being no less than the first picture ever made in the world (1826), by Daguerre's partner, Nicephore Niepce.

Daguerre, as is generally known, is the French inventor who gave the world the first practical photographic process (1839). The book is an absorbing and intriguing study of Daguerre and his process and covers his life from the time he was apprenticed to an architect, through his work as a scene designer, inventor of the diorama and inventor of the daguerreotype.

The book successfully portrays the fascinating developments leading to the invention of the daguerreotype as well as a number of other items indirectly related to the process. The price of the book is $7.50 and it may be obtained in the United States from the World Publishing Co., New York City.

Anyone interested at all in the history of photography, and particularly the daguerreotype, will do well to add this volume to his library, and schedule it for an early and complete reading.

### New Wide-Film Microfilm System

An entirely new reproduction system on film that can both improve most worn and smudged drawings and produce sharp, clear, and distortion-free second originals up to 36x54 inches in size or even longer, was introduced recently by Keuffel and Esser Co., Hoboken, N. J.

The system, called Micro-master, was developed to satisfy exacting professional and archival standards by Micro-master, Inc., Kansas City, Mo., in association with Keuffel and Esser. Based on a 105 mm. negative that is 16 times larger in area than conventional 35 mm. microfilm, Micro-master is being offered as a nation-wide reproduction service.

An entirely new concept in reproduction, the new process provides a series of advantages for precise engineering and architectural work that make it superior to any existing method.

To begin with, Micro-master was not adapted from any existing process. Microfilm, by contrast, depends on 35 mm. or, in a few instances, 70 mm. motion picture stack and conventional single-frame cameras. Where larger cut film sizes have been used, only standard cameras, projectors, and processing techniques have been employed.

The 105 mm. negative size of Micro-master represents the smallest area possible for handling, storage, and shipping that is consistent with the ability to achieve full-scale reproductions without distortion and loss of detail. The negatives of 105 mm. size are small enough to fit into standard 5" x 8" filing drawers and a series of them occupies only about 1/25th of the space required for an equal member of tracing.

Roll film is used for loading in the camera and for development. After developing, each negative is cut apart and is ready for filing and reproducing. Micro-master is a complete system. Economical 4" x 6" card prints are available for filing and reference.

The line of equipment includes fully-engineered screen projectors, table-top viewers with an 8" x 12" surface, and large-sized viewing tables for drafting room use.

### Mullard Image Dissector Tubes for Recording A Series of Photographic Frames in Sub-Microsecond Periods

Some interesting news has emanated from England r cently concerning the Image Dissector Tubes (availabl on special order only), of Mullard, Ltd., Mullard Hous Torrington Place, London, W.C.I.

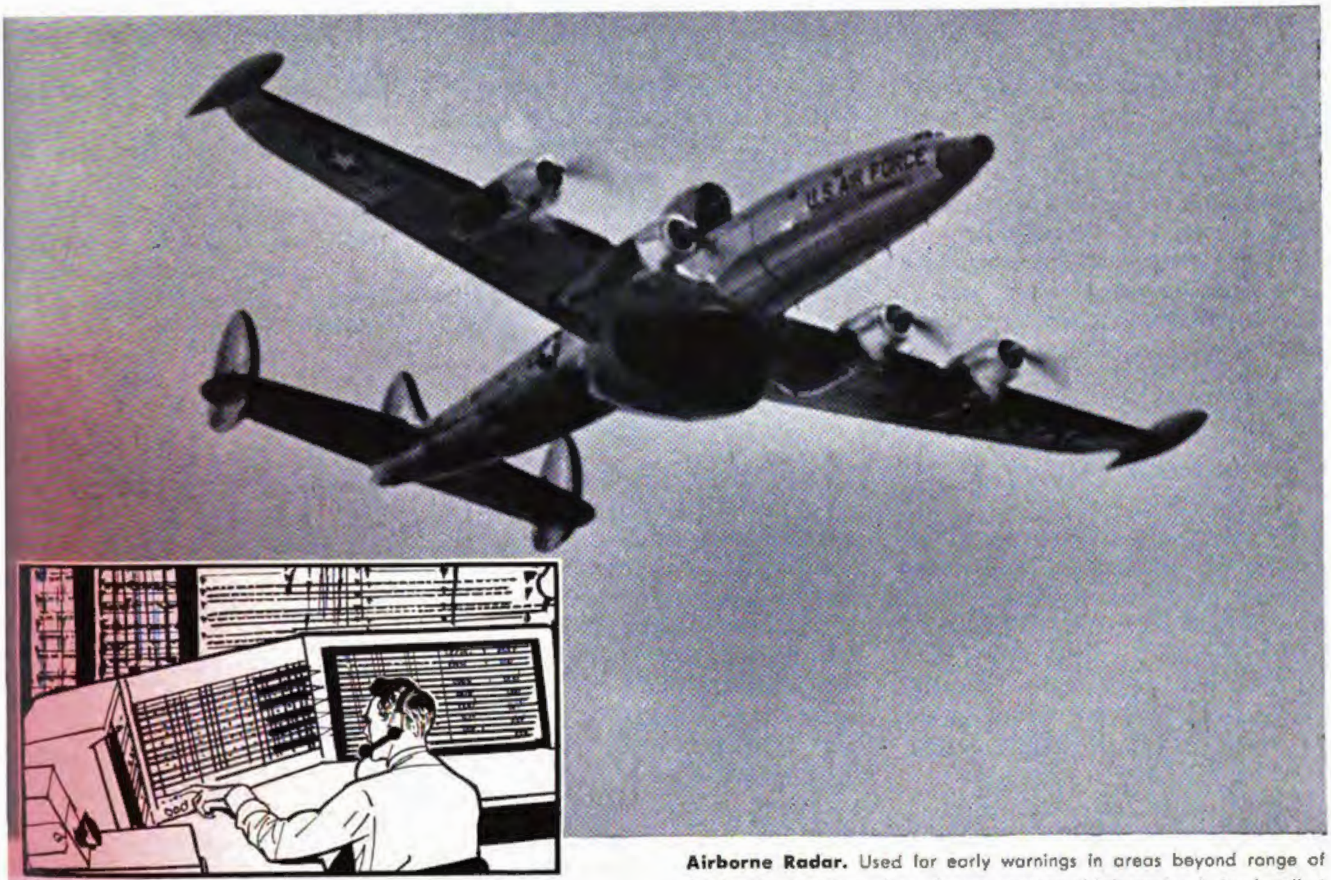
Although image converter tubes used as electron shutters have given satisfactory single exposures as sho as $10^{-9}$ second, the most efficient fluorescent screens hav an afterglow of 2 x $10^{-5}$ second, which limits the repet tion rate for multiple shots and causes blurring if hig speed film transport is used. To make possible the r cording of up to 100 frames on a single negative, ima dissector tubes have been developed. The photo-catho of an image dissector tube is active only in an array "mark" areas separted by non-emitting spaces, so th with uniform illumination on the cathode only th "mark" areas are reproduced on the fluorescent scree During an exposure, electromagnetic or electrostatic sca ning deflects the "marks" uniformly across the "spaces at the screen, the tube being switched off before overlapping occurs. The result is a composite negative which can be analyzed into a series of frames each representing a single time element. The analysis can be effected either by viewing through a suitable transparency or by "playing back" through a decoding tube. One type dissector tube is the "dot cathode" tube. The cathode is active in an array of dots 0.001 inch square and 0.009 inch apart.

[illegible]

Scanning is effected electromagnetically. A decoding tube for a different type of image dissector picture has also been developed. The cathode of the image tube is sensitive in a series of concentric rings separated by negative spaces. Scanning is effected electrostatically by varying the anode voltage. The decoding tube is similar in principle and by varying the applied voltages a particular frame can be picked out of the composite picture.

Full technical information concerning these tubes may be obtained by writing the manufacturer at the address shown above.

# Help test SAGE
## – the new Air Defense System



**Sage "Brain".** Giant electronic computers receive and store defense data . . . furnish correct picture to commanders at earliest possible moment.

**Airborne Radar.** Used for early warnings in areas beyond range of fixed radar locations. One of many sources of information being handled by Sage (semi-automatic ground environment).

The Defense Projects Division of Western Electric has opportunities for Engineers, Physicists, Mathematicians and Technicians for field work in testing Sage.

* * *

New digital computer techniques and their application to radar data processing and weapons control have opened a new and expanding field of automation. The extensive classroom and laboratory training which precedes job assignment at Western Electric affords an excellent opportunity to enter this new and challenging electronics field as part of the Bell System team.

MAIL RESUME TO:

Mr. W. M. Gesell, Room 902, Defense Projects Division, Western Electric Company, 220 Church Street, New York 13, New York or Telephone Collect to: WOrth 4-5400 Ext. 6628.

**Western Electric**

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

## A Tax Bill of Interest

(*Continued from page* 40)

be taxed as corporations, [Sec. 1361, 1954 Int. Rev. Code] it must be realized that this right does not apply to all sole proprietorships or partnerships as such. Further, an election to be so taxed when circumstances permit is, with one narrow exception, irrevocable and binding as to future years.

Aiding as it would some 98% of corporate taxpayers, the smaller ones, this bill would lay the foundation for drawing a line between big and small corporations with the result that there would be disparity in tax treatment between corporations based on size, as well as disparity between small businesses depending upon their form of doing business.

The introduction of this novel principle of the graduated tax in the corporate area is therefore not without concern. While the proposed rates equate fairly well with present procedures, it seems perfectly obvious that if this principle becomes law, the rates will be altered as to corporate taxpayers in much the same fashion as has been true with individual taxpayers. In accord with the theory that taxes should be imposed on the basis of the ability to pay, large corporations will find, particularly in times of emergency, that the rates will be on the ascending scale. The pattern has been set as to the taxation of individuals; it will not deviate if the taxpayer is a corporation. Since there is a tendency (if not a practice) where graduated taxes are used to impose the greatest burden on the "big" taxpayer, this may well become t pattern for the so-called "big" c poration. With this thought in min the plight of a corporate stockhold whose dividend comes after ta is awesome to contemplate. It is be hoped that if this new princi comes to pass there will be some p vision for the deductibility of di dends in the computation of corp ate taxes. Without such a provisi raising funds for capital impro ment by means of equity financi would be severely prejudiced, if terminated.

Despite the good intentions of 352, it would seem on balance t the inherent disadvantages which most likely to accrue from its ena ment outweigh the immediate a relatively short-run benefits to derived therefrom.

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## A Progress Report on SEAC

(*Continued from page* 25)

In the trial demonstrations, an average of two seconds was required for each patent search. However, the present tape units on SEAC are soon to be replaced by eight high-speed multichannel units which are expected to increase the search speed by a factor of 8 for further investigations by this project.

SEAC's latest feat, demonstrated for the first time on November 30, 1956, was accomplished by attaching a facsimile digitalizer as one of the selected input-output units. It then scanned a visual configuration (initially a black letter on a white background) and reproduced the pattern of black and white as ones and zeros in the memory. Then machine programs were fed into SEAC which analyzed the pattern in several ways: (1) to determine the relative proportion of black to white; (2) to identify the number of discrete black areas in the viewing field; (3) to obtain statistical data on areas in the field that are always covered or always not covered by a specified shape that is moved about rectilinearly; and (4) to test particular character recognition logic.

The present work of the data processing systems laboratory is, in many respects, an outgrowth of the pioneering efforts of the personnel of the electronic computers laboratory and the applied mathematics division, who were responsible for the design, development, expansion, maintenance and use of SEAC. During its lifetime, the basic circuitry has been improved and incorporated in a package design which provided the building blocks of the second computer constructed by the Bureau. The DYSEAC, while utilizing the same basic electronic circuit elements, was organized into a far more powerful system for controlling and responding to auxiliary external devices. Major emphasis was given to versatility of control facilities and latitude for expansion. The entire installation was eventually housed in two 40-foot trailer vans and transported to White Sands, New Mexico, for ultimate use by the Signal Corps.

### *Impetus to Research Programs*

Closely allied with, and basic to, the development of the systems specifications, are the research in and development of new components, techniques and improved circuitry. A continuing investigative program in semiconductor devices and their properties has led to the development of the diode capacitor memory, the diode amplifier, and gas diode indicator and display devices. For several years NBS actively participated in a program of cathode-ray tube improvement for computer storage (memory) application. Research in the utilization of magnetic ma rials as computer memory eleme is in progress, as well as the desi of experimental transistor circuit

The success of packaged circuit in the DYSEAC gave impetus to project to miniaturize the packa and thus, reduce its power requi ments and size while maintaining drive ability. This may make pos ble a computer of 100 times t arithmetic power of SEAC occupyi one-fourth the space. SEAC has bee and is continuing to be, used as t proving ground of model designs such developments as the diod capacitor memory, an improved W liams memory, diode amplifier a plications, packaged circuitry, a other work of the laboratories.

A natural corollary activity of t Bureau, in addition to the many co sulting and advisory services to t Government activities, has been t dissemination and exchange of inf mation with representatives of t scientific laboratories and industri concerns of the United States a abroad. Especially now with t popular emphasis on automation a its possible effects on the standa of living and economy, the numb of activities interested in keepi abreast of the progress of automat data processing and control h greatly increased the scope of co sulting and advisory services.

# Association Affairs

## Award Made to the AFCEA

An award of the "Lee De Forest Commemorative Plaque" was made to the Armed Forces Communications and Electronics Association by the Veteran Wireless Operators Association, (VWOA).

The presentation of the plaque was made on the occasion of the Thirty-Second Anniversary Dinner-Cruise of the VWOA. Former AFCEA National President George Bailey represented President Percy Black at the Sheraton-Astor Hotel in New York City on February 21st to accept the award.

Further coverage of this event will be featured in the April issue of SIGNAL.

## Honor Graduates Receive Awards

The Armed Forces Communications and Electronics Association Award for outstanding scholastic achievement was recently presented to honor graduates at the Signal School, Fort Monmouth, N. J.

Five of the officers were enrolled in the Signal Officers Basic Course which is designed to give a working knowledge of the duties and responsibilities which the officers may expect during their early service with the Signal Corps.

Highest percentiles in the basic course were held by the following:

Section 712 — Second Lieutenant James B. Calvert, 1210 N. 30th St., Billings, Mont. He attended Montana State College.

Section 713—Second Lieutenant Kenneth F. Gordon, 8 Park Place, Holley, N. Y., who graduated from Cornell University.

Section 714—Second Lieutenant George P. Lang, 2214 Hess Ave., Wheeling, West Va. He is a graduate of Carnegie Institute of Technology.

Section 715—Second Lieutenant Frank G. Selleck, 679 Ridge Road, Middletown, Conn., who studied at Rensselaer Polytechnic Institute.

Section 716—Second Lieutenant Richard L. Heckman, 9401 Manor Road, Kansas City, Mo. He is a graduate of Iowa State College.

In the Radar Maintenance and Repair Officer Course, high man was Second Lieutenant Paul D. Schoomaker of 4 Overlook Drive, Northboro, Mass. Lt. Schoomaker is a graduate of Worcester Polytechnic Institute.

Second Lieutenant Robert Miller took the number one spot in the Signal Materiel Maintenance Officer Course. Miller, a resident of Viborg, South Dakota, studied at South Dakota State College.

## General Larew Retires

Brigadier General Walter B. Larew, Chief of the Army Communications Service Division in the Chief Signal Office, retired recently after 31 years of Army service.

General Larew began his career in the Army Signal Corps in 1926. During World War II, he served in the China-Burma-India Theatre. Upon his return, he became Director of the Communications Department and Chief of the Communications Section at Orlando, Fla.

During the Korean Conflict, General Larew once more saw service as Signal Officer of the Ninth Corps and later Signal Officer of the Korean Communications Zone.

SIGNAL magazine has been honored by General Larew's many contributions and his continuing interest in the Armed Forces Communications and Electronics Association. Our best wishes go with him in retirement.

## Chapter of the Year Award

The 1956-57 "Chapter of the Year" will be named at the national convention at the Sheraton Park Hotel in Washington. The award, an engraved plaque, will be presented to the winning chapter during the annual banquet on May 21, 1957.

The award is based on chapter activity in the following categories during the fiscal year ending March 31, 1956: number of new members, percent of new members, percent of renewals, and number of monthly meetings. Points are awarded in each category as follows: first place—5 points; second place—4 points; third place—3 points; fourth place—2 points; and fifth place—1 point. The chapter earning the largest total of points in the four categories wins the award.

Chapters are reminded to forward to National Headquarters promptly any membership applications and renewals they have on hand, as well as reports of all meetings.

*(Continued on page 52)*

## Technical Papers Chosen

The chairman in charge of th committee for securing technica papers to be presented during th AFCEA National Convention, M Francis H. Engel, has informed Co vention chairman, Admiral Joseph Redman, of the following pape which have been selected for prese tation:

"Rapid Fault Elimination in Con plex Electronic Systems," Monr Calculating Machine Co.; "Sing Sideband Receivers," Radio Corpor tion of America; "Single Sideban Applied to Air-Ground Comunic tions," Collins Radio Co.; "A Sing Sideband Radio Central to Repla Military Wire Lines," Motorola, Inc "The Trend of Facsimile in Milita Communications," Times Facsimi Corp.; "Processing, Narrow-Ban Transmission, and Remote Display Radar Data," Lewyt Manufacturin Corp.; "Multiplexing Circuits in th National Air Defense Communic tions Networks," Lenkurt Electri Co.; "The Air Route Surveillanc Radar for U.S.A. Air Traffic Co trol," Raytheon Manufacturing Co. "The Vanguard Launching Vehicl Instrumentation System," The Mart Co.; "Results of a Simple Techniqu for Handling Complex Microwav Circuits," Sylvania Electric Product Inc.; "A Fully Automatic Teletyp writer Distribution System," Aut matic Electric Co.; "Some Aspect of Telegraphic Data Preparation an Transmission," Western Union Tel graph Co.

Time and space allocation alon directly affected the choice of addi tional papers. As this is the first tim technical papers will be presented a an AFCEA Convention, Nationa Headquarters wishes to express it profound thanks to the many con tributors who responded to the Asso ciation's request for material.

## Colonel Farnham Retires

Lt. Col. Nell E. J. Farnham, activ for many years in the launching o progress of Armed Forces Communi cations and Electronics Chapters. ha recently retired.

Colonel Farnham has had 14 year of active duty and has formerly bee attached to the Signal School at For Monmouth, N. J.

A charter member of AFCEA i 1946, she helped organize the Euro pean Chapter in Frankfort, German and the chapters at Fort Gordon Ga., and Paris, France. She has jus completed an active year as secretar of the Fort Monmouth chapter.

# AFCEA Group Members

## Communications—Electronics—Photography

*Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By thei membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several o its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the elec tronics and photographic fields, available for advice and assistance to the armed services on research, development, manufactur ing, procurement, and operation.*

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Admiral Corp.
Air Associates, Inc.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Argus Cameras, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Berkshire Transformer Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Clevite Transistor Products, Division of Clevite Corp.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Compagnie Francaise Thomson-Houston
Convair, Division of General Dynamics Corp.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
Dukane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co.
Haloid Co.
Hammarlund Manufacturing Co., The
Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
Hoover Electronics Co.
Hopkins Engineering Co.
Hughes Aircraft Co.
Hycon Eastern, Inc.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Business Machines
International Resistance Co.
International Telephone & Telegraph Corp.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
KayLab-Kintel
Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.
Koiled Kords, Inc.
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Iowa State College, Ames, Iowa
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Norwich University, Northfield, Vt.


PHILCO
SIDEWINDER

# Chapter News

Atlanta—Inspecting the high speed motion picture camera: from left to right, Mr. Ralph Grist, Mr. W. F. Johnson, Mr. B. S. Gilme President of Southern Bell Telephone Co., Mr. W. L. Porter, Mr. Arthur Reed, Colonel Don Adams, and Mr. C. M. Eberhart.

### *Atlanta*

The chapter's December meeting was highlighted by a program presented by representatives of the Eastman Kodak Company.

The guest speakers were Arthur J. Reed and W. L. Porter, Professional Technical Representatives, who demonstrated high speed motion picture photography and showed the film, "Magnifying Time," on the subject. They pointed out that there is a greatly expanded use of photography in industry, especially in public relations, advertising, sales, personnel, merchandising and safety.

In January, the chapter meeting was held at the Fort McPherson Officers' Club. An interesting program of entertainment was presented by the Special Services Section of the Third Army.

### *Augusta—Fort Gordon*

The chapter's December meeting was held in Augusta and featured an annual ladies night dinner-dance.

Installation of the new officers elected in November took place on this occasion.

### *Boston*

Mr. Thomas R. Hennessey, vice president, Public Relations of the New England Telephone and Telegraph Co., acted as host to the chapter at its January meeting in the telephone building at 185 Franklin Street in Boston.

Following dinner and a conducted tour of the building, the group assembled in the auditorium for a demonstration of Direct Distance Dialing by Mr. Francis J. Cronin. This was particularly timely as the service is coming to Boston and the adjacent areas in June of this year.

The final demonstration of the evening was made by Mr. Robert Maguire and consisted of a composite presentation of information collecting agencies which included picket planes, the DEW line system, and defense facilities such as intercepting planes and NIKE installations. This was the first public presentation of the demonstration which is known as the "Nation's Sentinel."

### *Fort Monmouth*

More than 200 members attended the January dinner-meeting of the chapter. The guest speaker was Mr. Jorge Jensen, an expert on rocketry from th Glenn L. Martin Company, Baltimore He chose as his subject, "Man-Mad Earth Satellites" and gave an extreme ly interesting lecture.

The chapter wishes to announce tha during 1957, meetings will be held th third Thursday of the month at Gibb Hall Officers' Club.

### *Lexington*

In December the chapter sponsorec an Industrial Mobilization Program. Chapter members and representative of the Department of Commerce attended a joint dinner-meeting held at the Phoenix Hotel in Lexington.

William R. Haines, Director of Industrial Defense for the Business and Defense Services Administration, of the Department of Commerce, delivered an address on the "Posture of Readiness," for industry in the age of the H-bomb. He stated that in the defense of American industry, it is the Government's job to reliably estimate stock requirements and maintain procedures for the ade-

Boston—From left to right, Thomas R. Hennessey, vice president public relations, New England Tel. and Tel. Co.; Francis J. Cronin, public relations representative, New England Tel. and Tel. Co.; Mr. Robert Maguire, supervisory ass't, New England Tel. and Tel. Co.; and Mr. Fred E. Moran, president, Boston Chapter, AFCEA.

*(One of a series of institutional messages)*

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**Sacramento**—January dinner meeting of the AFCEA, Mr. M. G. Mauer turning over the Sacramento Chapter to the new president, Lt. Col. C. M. Godfrey.

quate stock-piling and efficient, prompt distribution of scarce and critical materials in the event of attack.

To insure the continuity of essential production, he told the group, every company should prepare an overall plan for industrial defense which encompasses the activities and responsibilities of every department from the plant level to top management.

Haines' speech was of such significance that it has been reprinted in its entirety in the January, 1957 issue of SIGNAL.

After the speech, time was given for general discussion with members and guests on "Methods and Plans for Programming for Industrial Mobilization."

### New York

The initial 1957 meeting of the chapter was held at the Belmont-Plaza Hotel in New York City on January 30th.

The meeting was preceded by a social hour and dinner. Announcement was made of the following Standing Committee Chairmen, as approved by the Board of Directors: Public Relations—Edwin C. Carlson; Financial —William L. Hallahan; Liaison — George W. Bailey; Membership—Glenn D. Montgomery.

Guest speaker of the evening was Mr. Seymour N. Seigal, Director of Communications for the City of New York. He addressed the meeting on the subject of "Communications for Civil Defense." He was assisted by Mr. Charles J. Hartley, Chief Supervisor of Civilian Defense Communications and Mr. Robert Link, Supervisor of Radio Amateurs Civilian Emergency Services. Mr. Seigal illustrated the overall Civilian Defense Communications Organization established for the City of New York by a number of charts and photographs. He pointed out that the maintenance of the water supply was one of the first essential requirements in an emergency, and that communication systems utilizing wire lines and radio for both voice and telegraph operations have been established for this purpose.

He further stated that most of the Civilian Defense Communications System requirements have been planned. The essential elements have been set up on a standby basis in co-operation with the New York Telephone Co. and the Western Union Telegraph Co.

He explained that plans also have been made to limit non-essential telephone calls in case of a civil defense emergency in order to prevent interference to emergency communications. Mr. Hartley outlined the important part played by microwave radio, VHF and HF radio in Civil Defense plans. The major broadcasting stations in the New York area can be tied together and controlled from one location whenever required.

Mr. Robert Link discussed the important part which the radio amateur plays in the Civilian Defense Communication picture. Many of them have volunteered their services and have also loaned or furnished radio equipments for the various control centers.

Major General Robert E. Condon, Director of Civil Defense for New York and members of his staff were present at the meeting.

### Rocky Mountain

The chapter's December meeting was held at Ent Air Force Base.

At that time the program consisted of dinner, a business meeting and the showing of two special interest films of Yuma, Arizona Air Force Base's annual rocketry meet.

### Rome-Utica

"New Developments in Surface Communication" was the presentation of Mr. I. R. Saddler, manager of materials and modules planning at RCA. Camden, N. J., to the Utica chapter members in January at Griffiss AFB Officers' Club.

The talk was illustrated with a color-sound motion picture that described RCA activities in the field of military communications. This film explained the various divisions of the company's defense products areas and things in development and production.

**South Texas**—January meeting—left to right: Ben Givens, San Antonio division manager, Southwestern Bell Tel. Co.; Col. A. H. Snider, USAF, Chapter President; Mr. J. M. Black, guest speaker and operating vice president of the Southwestern Bell Tel. Co., and Mr. R. A. Goodson, Texas general manager, Southwestern Bell Tel. Co.

Following this, Saddler demonstrated n ultra-miniature radio transceiver, a levice about the size of two king-size acks of cigarettes which has a communications range of about a mile or wo. He also demonstrated a self-powered maintenance inter-phone for se by maintenance crews and an ear rotector that is worn by ground crews vhen operating in the vicinity of high mbient noises.

Prior to the technical meeting, a ocial hour was held.

### an Francisco

The following slate of officers was hosen at the chapter's last meeting: resident—Lt. Comdr. S. N. Barton, SNR, Mackay Radio; vice presidents —Maj. T. D. Razovich, USAR, Radio tation KFRC; R. A. Krause, Stanford Research Institute; K. W. Goossens, Pacific Tel. & Tel. Co.; secretary—Col. H. L. Schnoor, USAR, Pacific Tel. & Tel. Co.; treasurer—Lt. Col. W. G. Damerow, USAR, Pacific Gas and Electric Co.; directors — Col. S. S. Cerwin, USA. Sig. O. Hq. 6th Army; R. H. Cobb, Western Union Tel. Co.; W. B. Nielson, Lenkurt Electric Co.; F. V. Sloan, Federal Communications Commission; Col. L. C. Parsons, USA Ret.; W. R. Patton, Sylvaoia Electronic Defense Lab.

Following the election, Mr. C. L. Wickstrom, past president, expressed his feeling for the good work which had been done by the chapter and thanked everyone for the cooperation received during his past two year term. Lt. Comdr. Barton, the incoming president, thanked the group for the trust placed in him and promised his full support behind the aims and objectives of the Association.

Talks by Col. Cerwin, Capt. Patterson and Cmdr. Anthony on the subject of "Modern Communications in the Armed Services" ended a very successful evening.

### Scott-St. Louis

Col. Charles W. Gordon, commander of the 3310th Technical Training Group, was the speaker at the January meeting of the Scott-St. Louis area chapter in Belleville, Illinois.

In introducing a new USAF film which he presented after his talk, Col. Gordon related some interesting engineering problems which he had encountered in his past experiences in the communications and electronics field. He emphasized the importance of the support given by the engineers who construct the specialized buildings and structures necessary to accommodate electronics installations.

The film which Col. Gordon presented is a new 30 minute USAF color film entitled "Air Force Engineers." It depicts the various activities of Air Installations engineering in the operation of Air Force Bases and some of the unusual problems which have been met by Air Force engineers. A highlight was the description of Thule Air Force Base in Greenland which is constructed entirely on perma-frost. Buildings have to be insulated from beneath lest they melt themselves into a hole.

Other features were pictures of the world's largest airplane hangar, underground fuel storage systems, the climatic test hangar in Florida, and how Air Force bases are planned and kept up to date.

### South Carolina

The chapter held a two day session for its last meeting. A dinner was given at the Charleston Officers' Club on January 11th. Distinguished guests included Rear Admiral H. C. Bruton, Director of Naval Communications, Washington, D. C.; Captain C. C. Burlingame, Commanding Officer, U.S. Naval Minecraft Base; Mr. Ralph S. Grist, Southern Bell retired and Regional Vice President AFCEA, Atlanta, Ga.; and Mr. J. C. Baughman, Southern Bell General Coordinator of Military Services, Atlanta, Ga.

Following dinner, Mr. Grist gave a brief talk on AFCEA aims and purposes. Admiral Bruton, the principal speaker of the evening, was introduced and gave a very interesting talk on "Recent Developments in Naval Communications - Electronics" which has been printed in this issue on page 7. This topic was supplemented by the

**Northeastern University**—AFCEA cameramen shout commands on the parade grounds during the filming of the Northeastern University Fall Awards Parade at Boston, Mass.

**San Francisco Chapter**—Annual meeting for the election of officers was held on January 17, 1957. Pictured above from left to right are: first row, J. F. Parachini, director; S. N. Barton, president; Major T. D. Razovich, a vice president; Lt. Colonel W. G. Damerow, historian; second row, H. L. Schnoor, treasurer; H. W. Austin, director; C. L. Wickstrom, past president; W. R. Patton, a director; K. W. Goossens, secretary.

color film, "Naval Warfare—North Atlantic, 1957."

After the dinner the Executive Committee held a business meeting at which W. T. Edwards (USA, Ret.) of Southern Bell Tel. & Tel. Co., Columbia, S. C., was elected to succeed Colonel Oscar S. Tigner (USA, Ret.) as third vice president of the chapter. Col. Tigner has been transferred to Atlanta by Southern Bell.

On Saturday, the 12th of January, an interesting and informative tour of the Charleston Naval Yard was made by many of the members. This included inspection of a radar picket ship, and of the Charleston Minecraft Base where they saw an electronic repair shop and a minesweeper.

### South Texas

The January meeting of the chapter was held at the Randolph Field Officers' Club and was a joint meeting composed of representatives of the American Institute of Electrical Engineers, the Institute of Radio Engineers and the Research Society of America, in addition to the AFCEA.

A dinner and social hour preceded the highlight of the evening which was a talk given by the guest speaker, Mr. John M. Black, vice president of Southwestern Bell Telephone Co. of St. Louis, Mo. The subject of his address was "Future Developments in the Telephone Field."

### Southern California

Major General Alvin L. Pachynski, Director of Communications-Electronics USAF, was the principal speaker at the November meeting which was held at the Town House in Los Angeles.

Speaking on the trends in Air Force communications-electronics, General Pachynski stressed the factors responsible for rising costs in terms of resources required, and discussed the challenge imposed by the future.

**South Carolina** Chapter Meeting—left to right: W. T. Edwards; Admiral H. C. Bruto Director of Naval Communications and guest speaker; S. C. Baughman; and R. S. Gris

### Southern Connecticut

"The Operation and Mission of the Signal Equipment Support Agency" was the presentation made by Colonel R. B. Tomlinson, Commanding Officer, Signal Equipment Support Agency, Fort Monmouth, to the chapter's December dinner meeting.

Colonel Tomlinson covered the close relationship of his agency to industry, its interest in production and the "in-plant testing program" which is now part of Signal Corps production contracts.

The following slate of officers were chosen for 1957: president—Edwin P. Hurley, Southern New England Tel. & Tel. Co.; vice presidents—Charles Ecklund, Dictaphone Corp.; Spencer Montgomery, Jr., the Montgomery Co.; Rodney E. Nelson, Machlett Laboratories Inc.; secretary—I. T. Shapiro, Signal Corps Supply Agency; treasurer—Sidney Rosenberg, Signal Corps Supply Agency.

In January, Mr. F. W. Roberts, vice president—Engineering and Research Dictaphone Corp., was the chapter's guest speaker. He described and demonstrated some of the company's products. These ranged from a portable, pocket-size magnetic tape recording machine to a large, rack-mounted, magnetic tape logging-type recording machine.

**Southern California** Chapter meeting—from left to right are: Lt. Gen. Pete Quesada, director; Charles A. LaHar, president; Maj. Gen. Alvin L. Pachynski, Director of Communications-Electronics, USAF, principal speaker; Mr. Dave Callahan, director.

### Switzerland

The chapter held its January meeting at the American Community House Geneva. Among the distinguished visitors present were Mr. Franklin C Gowen, United States Resident Delegate and Consul-General, as well as a number of senior officials of the International Telecommunication Union.

Installation of the new officers elected in December took place.

The main attraction of the meeting was the film, "Voices under the Sea." prepared by The American Telephone & Telegraph Co., on the new trans-Atlantic telephone cables. In addition two filmed United States TV programs were shown.

### Tinker-Oklahoma

The chapter held a joint dinner meeting in January with the local organizations of the Institute of Radio Engineers and the American Institute of Electrical Engineers.

Dr. Marshall Middleton, Jr., of the Westinghouse Electric Corp., was the principal speaker. He chose as his subject, "Product Design by Digital Computers." He discussed the application of an EDPM Computer (IBM 704) to the design of such products as induction motor, luminaires, and turbine generators.

Dr. Middleton also described the IBM 602A Electromechanical Computers, the Card Programmed Electronic Computers, the 650 Magnetic Drum Computers, and the 704 Electronic Data Processing Machine. He illustrated his talk with some very fine film slides.

### Northeastern University

The following report has been received on the activities of this chapter:

The students recently were invited by Western Union Telegraph Co. to dinner at its Boston Office, during the occasion of a Boston chapter meeting. The subject of the evening, automatic teletypewriter switching controls, proved to be of the highest interest quality.

The photographic section of the chapter is now busy on its newest motion picture project. The electronics group has decided to build all of the experimental stations suggested in the ARRL Course in Radio Fundamentals.

U. S. Army Photo

Firing of 280 mm Atomic Shell at Las Vegas Proving Ground in May, 1953. This shell was designed jointly by Picatinny Arsenal and Los Alamos engineers and scientists.

# ARMY ATOMIC MUNITIONS ARE BORN AT PICATINNY ARSENAL

Picatinny Arsenal at Dover, N. J., is composed of a group of Ammunition Development Laboratories responsible for Army ammunition technical development. Its responsibilities include research and development of ammunition for artillery, mortars, and recoilless rifles, mines, grenades, warheads for bombs and guided missiles, and rocket propellants.

One of Picatinny's principal laboratories is the Atomic Applications Laboratory, which is responsible for Army research and development of atomic munitions. This Atomic Applications group operates as the nerve center for all activities in atomic development for the Department of the Army.

To execute its mission responsibility, the Atomic Applications Laboratory draws not only on its "in-house" capabilities, but on the facilities of other Army arsenals, proving grounds, and on industry. Its "in-house" capabilities include an engineering technical organization that uses the full facilities and capabilities of the arsenal.

As well equipped as it is to solve the multitude of complex technical problems which confront it, Picatinny Arsenal has no greater asset than the long years of accumulated experience and unfailing loyalty of its career government employees. A recent example of its effectiveness is the crash program which resulted in the 280 mm Atomic Shell.

Picatinny's technical capabilities are utilized basically in expanding the frontier of mechanical, electrical and explosive development. The scientific personnel in organizations such as the Atomic Applications Laboratory will determine America's ability to meet potential aggressors with the most effective Atomic Weapons possible.

This is one of a series of ads on the technical activities of the Department of Defense.

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**FORD INSTRUMENT COMPANY**

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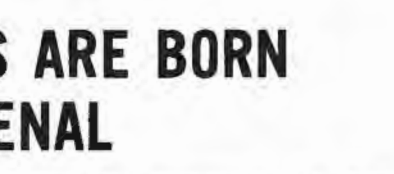

In Ford Instrument Company shops, equipment being made under contract with the Army Ordnance Corps is precision machined.

**ENGINEERS**
**of unusual abilities can find a future at FORD INSTRUMENT COMPANY. Write for Information.**

# ITEMS OF INTEREST
## From Government, Industry and the Services

### 1957 Reunion of SHAEF Signal Division

The editor of SIGNAL is very pleased to publish the following notice which was received from Major W.J.G. Barnett, M.B.E.R. Signals, of Sanderstead, Surrey, England.

It is particularly gratifying to note that Brigadier Harris is most keen to keep alive the splendid comradeship fostered during the war years.

"World War II American members of the SHAEF Signal Division will be interested to know that a number of their British colleagues met in London at the Waldorf Hotel on 22nd September 1956 at a SHAEF Signal Division Reunion Dinner. These reunions have been an annual event since 1948. General Vulliamy usually presides and Brigadier Harris has been a regular attender. There is always a great deal of reminiscing and the names of General Duke Lanahan, Colonel Henry, Colonel Young, Bim Behn, McCann, Murphy, Haight, Mitchell and many others crop up regularly when the 'battles are fought over again.'

"All too infrequently there has been American representation, but General Duke Lanahan, Colonel Ralph and Lt. Col. Rosso have attended past reunions.

"The 1957 reunion will be held at the Waldorf Hotel, Aldwych, London on 28th September at 7 p.m. and a most cordial welcome is extended to any of our American colleagues who may be in London at this time.

"Brigadier Harris, who is now Engineer-in-Chief of the British Post Office, says he will be very surprised if some of you cannot make it.

"The reunion secretary, Major W. J. G. Barnett, would be very glad to have news from any of you who happen to read this. His address is 'Braemarian,' Courtlands Close, Sanderstead, Surrey, England."

### Punched Card Transcriber For Use On SEAC

A punched card transcriber recently developed by the National Bureau of Standards (NBS) makes possible more rapid feeding of data into an automatic computer.

The device is designed to convert numbers and instructions recorded on punched cards into a binary serial code. In this form information is suitable for direct rapid input into the computer or temporary storage as a magnetic recording.

The system is about 150 times faster than the present paper tape inscriber and can handle up to 600 cards per minute. The transcriber is intended primarily for use with the NBS high speed electronic computer, SEAC. For a further report on SEAC, see our feature article on page 18.

Pictured above is North American Aviation's new X-10, an unmanned test vehicle for t Air Force SM-64 NAVAHO inter-continental strategic guided missile program, which h been recently tested in flight at the USAF Missile Test Center, Florida. Called "an invaluab source of important data," the X-10 is powered by two turbo-jet engines and is provid with a landing gear so that it can be recovered for repeated use. Design and manufactur of the NAVAHO guidance and control systems is the responsibility of North American' Autonetics Division, and a third division, Rocketdyne, is building rocket engines for th missile, which will be rocket-boosted to flying speed and then powered by ram-jet engine The NAVAHO will travel at supersonic speeds and very high altitudes, with great accurac of delivery.

### New Combat Surveillance Agency

The Department of the Army has announced the establishment of a new agency, the Army Combat Surveillance Agency (ACSA), which will be located in Washington, D. C.

The functions of the ACSA will be to coordinate and expedite the production of a combat surveillance system to be used by troop commanders. This system will use improved electronic equipment and techniques which will aid commanders in gaining battlefield information about the enemy.

The new agency will concern itself with research, development an test of techniques and equipment, production of equipment and systems, development of doctrine and procedures for its employment, and training of necessary technical personnel.

At the head of the new establishment will be Brigadier General Francis F. Uhrhane. General Uhrhan was formerly Chief of Research and Development for the Army Signal Corps.

### Edison Award

The first woman radio amateur to win General Electric's Edison Radio Amateur Award for public service has been presented with the Edison trophy at a banquet in Washington, D. C.

The 1956 winner is Mrs. Mar (Mae) Burke, W3CUL, a housewife, who is known throughout the world for voluntarily handling an average of 3000 messages a month in Morse code, many from far-flung military outposts. A licensed radio amateur since 1932, Mrs. Burke has handled 312,000 messages in the past seven years. Her longest stretch of operating without missing a schedule

(*Continued on page 64*)

# You can't shrink the pilot
# ...so *Admiral* shrinks the controls

## *New transceiver control box reduced to one-fifth former size*

The cockpit of a modern fighter plane is packed as tight as a filling in a hollow tooth. As more and more electronic equipment is added to the plane's complement, each new device must fight for space on and behind the instrument panel or console. Now Admiral, maker of the famed AN/ARC27 transceiver, has designed a control box that "moves over" to make room for other needed equipment.

Heart of the new control is an ingenious "mechanical memory" drum that selects any one of 20 preset frequencies with a single knob. Another knob controls three coaxial switches designed by Admiral so the pilot can manually select any of the transceiver's 1750 frequencies. This single compact unit will be universally employed to replace any one of 15 currently used control box combinations. It occupies as little as one-fifth the space and also reduces weight up to 80%.

Here is another instance where Admiral initiated and perfected an important advance in the science of military electronics. Inquiries are invited regarding Admiral's capabilities and production capacity for electronic or electro-mechanical equipment.

**Admiral**®
**CORPORATION**
**Government Laboratories Division, Chicago 47**

RESEARCH • DEVELOPMENT • PRODUCTION
IN THE FIELDS OF:
COMMUNICATIONS UHF AND VHF • MILITARY TELEVISION • RADAR
RADAR BEACONS AND IFF • RADIAC • TELEMETERING
DISTANCE MEASURING • MISSILE GUIDANCE
CODERS AND DECODERS • CONSTANT DELAY LINES
TEST EQUIPMENT • ELECTRONIC COUNTERMEASURES

**ENGINEERS:** The wide scope of work in progress at Admiral creates challenging opportunities in the field of your choice. Write Director of Engineering and Research, Admiral Corporation, Chicago 47, Illinois.

was 1825 days, five years without taking a vacation or a single day off from her service.

"Mae" also operates at her home, 265 Waverly Road, Morton, Pa., a key station in the civil defense emergency communications network. This equipment features a gasoline generator power supply for use in the event commercial power lines fail.

The principal speaker at the banquet was Rear Admiral H. C. Bruton, Chief of Naval Communications. Dr. W. R. G. Baker, G-E vice-president, served as toastmaster, and the award was made by L. Berkley Davis, general manager of the G-E Electronic Components Division which sponsors the annual award.

## Electronics At Bendix

The Bendix Aviation Corporation, in its recent annual report by President Malcolm P. Ferguson, discussed for the first time the extent of its activities in the electronics field.

In his letter to stockholders, President Ferguson wrote that "Although outside the electronics field, the fact is not adequately appreciated that in terms of finished products utilizing electronic circuitries or controls, it constitutes, at least 40% of Bendix products' output." His report cited particularly the activities of Bendix Radio Division in supplying long-range search radar sets for the Air Force and in connection with the SAGE system as well as small, one manned "gap-filler" radars for the SAGE system. The report further pointed out that Bendix Radio Division was one of the leaders in developing and producing aviation, marine, and two-way radio communication equipment.

Bendix marine radar, in addition to serving on Coast Guard ships, is now being used in the hurricane study along the Atlantic Seaboard sponsored by the Oceanographic Institution of Woods Hole, Mass.

## New Intercommunication System

The first of a series of intercommunication systems for guided missile launching stations has recently been completed and delivered to the U.S. Air Force by Connecticut Telephone and Electric Corp.

Consisting of hundreds of telephone receiver units interconnected through specially integrated central amplifier stations, the system enables operators to reach any station instantly and to coordinate information essential for the proper launching of the missile.

Two New Radar Mortar Locators With Electronic Brain.

## New Radar Mortar Locator

A new radar mortar locator, with an electronic brain that pinpoints the location of an enemy position in seconds, has been perfected by the Army Signal Corps and the General Electric Company.

Signal Corps scientists reveal that the locator has a longer range than any known motor built today.

Its greatest advantage is speed. The AN/MPQ-4 locater, using a new beam technique, rapidly pinpoints the enemy mortar position. With this beam technique, the projectile appears as blips on the screen. The operator centers hairlines on the blips and the computer gives him a direct map coordinate reading of the enemy position. Relayed to an artillery battery, this information triggers immediate counter fire.

Compact and mobile, it can be operated either on the trailer or with the' console in a foxhole 150 yards away for remote control and safety of the operator if the set itself should come under fire.

## Ptolemy Helps Modern Missiles

Scientists must keep in touch with missiles in flight to learn how they perform and how they can be improved. Recently, the mathematicians at the Lockheed Missile Systems Division became concerned with the fact that the magnetic tape system, used in recording the radio signals from a missile in flight, was not perfect for the job.

The sound recorded on the tape is subject to what engineers call "flutter" and "wow" or distortion as it is
played back. The distortion is in
herent in the data conversion uni
which receives the information fron
different tones on the tape, but sci
entists can compensate for the dis
tortion if they know what is happen
ing in the system.

For this reason they began lookin
for a mathematical formula whic
could be used to chart a series o
variations from the mean, or th
average. The distortions they wer
trying to beat are essentially suc
variations themselves. They decide
to employ a formula stemming from
technique that Ptolemy had onc
used to try to explain the puzzlin
variations of certain planets in rela
tion to the stars.

The Lockheed experts tried this
formula on their problem and i
worked. As a result, the missile division expects to be able to process data much more swiftly and at the same time retain accuracy.

## British Research Into Scatter

Intensive research into tropospheric scatter is now being carried out in Great Britain.

Marconi Wireless Telegraph Co. Ltd. has established an experimental 200 mile tropospheric scatter link between the north and south of England, and hopes shortly to extend the link a further 200 miles into Scotland.

Plans are now in hand to set up high power transmitters and associated receivers at Newcastle, on the northeast coast of England. The object of these will be to operate up to 36 simultaneous telephone channels between these two points.

## New Pocket-Size Television Camera

A pocket-size live television camera has been developed by the Radio Corporation of America for Military airborne, mobile, and field closed-circuit TV applications.

It was made possible by a new design approach which combines transistors, specially developed transistor circuitry, and a new RCA half-inch vidicon camera tube.

The pocket-size TV camera (JTV-1) weighs less than a pound and measures only 1-⅞ by 2-⅜ by 4-½ inches; yet surpasses standard vidicon-type industrial TV cameras in sensitivity. Used with an F-1.9 lens, it requires only 10 foot candles of scene illumination for clear pictures.

The camera promises to open new fields of application for closed-circuit television, permitting direct observation and reconnaissance in places and locations heretofore inaccessible to existing TV camera equipment.

## Panelescent Lighting

Three new military naval applications, all using Panelescent lamps by Sylvania, have been introduced recently. They include a control panel, identification signs, and a tachometer.

The control panel, using the lamp, operates at 600 volts, 400 cycles, but can also be operated at lower voltages. The lamps can be utilized for single instrument dials, for instrument clusters, or for an entire instrument panel. Lamps are particularly adaptable to naval and marine usage for instrument dials, radar, binnacle lights, status boards, and other navigational or pilot-house areas.

The identification signs, such as aircraft "Fasten Safety Belts," use a Panelscent lamp behind a plastic cover on which the sign lettering is engraved.

The airplane tachometer indicator, manufactured by General Electric Co., is presently being tested with a Panelescent lamp.

The Panclescent lamp is a device which produces light by the principle of electroluminescence which is the creation of light by the excitation of certain phosphors placed in an electric field. Only 25 one-thousandths of an inch thick, the lamp produces a uniform light without the use of bulbs, tubes, filaments, or cathodes. In its present construction, it consists of porcelainized steel with a ceramic-phosphor coating.

It has a number of major advantages for military-naval applications. They include its thinness, or flatness of light source; its ruggedness; its long life; its economy of operation; its low operating temperature; and its ability to withstand severe temperature changes.

## New Reactor Center

A Nuclear Reactor Center has been established in West Caldwell, N. J., by Daystrom, Inc.

The "Argonaut" reactor is to be installed in a 36,000 square foot laboratory. In this lab, college and university faculty members throughout the country can be trained in the peacetime use of nuclear reactors. In this Nation's newest nuclear center, Daystrom Nuclear will also go into quantity production on a 10 kilowatt "Argonaut" research reactor that will be available for the first time to colleges and universities, as well as to industry.

The purpose of this new Daystrom Reactor Training is to implement the vast peacetime atomic training program which is to be sponsored by the Atomic Energy Commission.

## Annual Conference On Electronics In Industry

The Professional Group on Industrial Electronics of the Institute of Radio Engineers and the Armour Research Foundation will jointly sponsor an Annual Conference on Electronics in Industry.

This conference will be held April 9th and 10th in Chicago, Illinois.

The following papers will be read:

Session I—"Basic Instrumentation" by Dr. W. A. Wildhack, National Bureau of Standards; "Communication Problems between Instruments, Controls and Man" by H. B. Ziebolz, Askania Regulator Co.; "Economic and Technical Aspects of Industrial Electronics" by Dr. Ellsworth D. Cook, General Electric Co.

Session II—"Application of Magnetic Amplifiers in Industrial Instrumentation and Control" by Dr. William A. Geyger, Naval Ordnance Laboratory; "Principles and Techniques for Direct Reading Digital Transducers" by Dr. Waldo H. Kliever, Consultant; "Solid State Devices in Industrial Electronics" by Dr. Lloyd DeVore, Stewart-Warner Corporation.

Session III—"Electronics in a Chemical Company" by R. C. McMillan, E. I. duPont de Nemours & Co., Inc.; "Some New Aspects of Nuclear Instrumentation in Industrial Electronics" by Nicholas C. Anton, Anton Electronic Laboratories, Inc.; "Process Monitoring by Dielectric Constant" by Wilfred H. Howe.

Session IV—"Automatic Card Programmed Control of Reversing Rolling Mills" by E. H. Browning, Westinghouse Electric Corp.; "Some Application of Analog Computer Techniques to Control System Design" by Ernest Goggio, Tammen and Denison, Inc.; "Selection of Reliability Levels in Equipment Design" by Dr. Harold Garbarino, Armour Research Foundation.

## Raytheon Forms New Laboratory

A new electronics laboratory at Maynard, Mass., whose responsibility it will be to design and develop airborne equipment, has been formed by Raytheon Manufacturing Company of Waltham, Mass.

The laboratory will work on such devices as Doppler navigation instruments, aircraft intercept radars, altimeters, surface radars, and other classified items for the Defense Department.

Serving as a nucleus for the laboratory will be engineers and technical employees transferred from the firm's former aircraft systems department. The laboratory will be self-sufficient, housing all its own supporting services as an integral part of the organization.

## Two New Air Force Test Missiles

Two new research missiles, especially designed by Lockheed Missiles of California to combine highest performance with low cost, are saving U.S. taxpayers millions of dollars as the Nation's missile program moves forward.

The test "birds," called the X-7 and the X-17, go through the paces of regular operational missiles. However, the X-7 ramjet vehicle is recovered from supersonic flight by parachute to fly again. The X-17, only a fraction as expensive as the long-range ballistic missiles it simulates, is used to provide information on the problems which arise when the warhead of a ballistic missile reenters the earth's atmosphere at high speed. In order to do this, the test missile hurtles out through the earth's atmosphere at speeds far in excess of the velocity of sound. Within seconds after it is fired the missile blasts through the sonic barrier and pierces the ionosphere. It then plunges at tremendous speeds from the ionosphere back into the earth's heavy blanket of air.

## NEC Conference

The Nation's leading forum on electronic research, development and application, the National Electronics Conference, has selected the following dates for its future meetings:

1957—October 7, 8 and 9 at the Hotel Sherman, Chicago, Ill.

1958—October 13, 14 and 15.

## Navy-AEC Skyhook Balloon

The first of a series of SKYHOOK balloon flights has been launched from Guam and has reached an altitude of 108,000 feet. The plastic SKYHOOK balloon, manufactured by Winzen Research Inc., Minneapolis, Minn., was launched for the Office of Naval Research and the Atomic Energy Commission.

Guam was selected as the launching site because of its proximity to the Geomagnetic equator. In this region the earth's magnetic field filters out of the cosmic ray flux all but the very high energy particles. The consequent reduction in low energy background permits easier and more accurate interpretation of experimental results.

Data obtained from these flights should provide scientists with a better understanding of these particles and may eventually lead to applications in such practical fields as communications and electronics. Magnetic storms that disrupt communications are associated with sun spots which affect the energy distribution and total flux of cosmic rays. More precise measurements of the fluctuations in cosmic ray activity may permit a correlation of these two phenomena which may ultimately lead to the ability to predict periods of poor communications due to solar storms, much as weather is predicted today.

## New Radar Moving Target Simulator System

A new Radar Moving Target Simulator System which will generate the display of up to six individual moving targets on any standard radar indicator, has been developed by the Electronics Division of Fairchild Controls Corp.

The system is one of the new, specialized devices being engineered and manufactured for all branches of the Armed Services and prime military contractors.

Two models are currently avail-

(*Continued on page 69*)

**Component Specification: ARNOLD**

- ✓ SILECTRON CORES
  Types C, E and O
- ✓ TOROIDAL CORES
  Nylon and Aluminum cased
- ✓ BOBBIN CORES

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We'll welcome your inquiries on your Tape Wound Core requirements for Pulse and Power Transformers, 3-Phase Transformers, Magnetic Amplifiers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Reactors, Coincident Current Matrix Systems, Static Magnetic Memory Elements, Harmonic Generators, etc.

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For data on the various types of Arnold Tape Cores, write for these Bulletins:

**SC-107**—*Silectron Cores, Types C, E and O*
**TC-101A**—*Toroidal Cores, nylon and aluminum cased*
**TC-108**—*Bobbin Cores*

**ADDRESS DEPT. S-73**

How to be *sure* of tape core performance and uniformity? Just specify and use *Arnold* Cores in your transformer, magnetic amplifier, reactor and computer assemblies, etc.

*Here's why!*

To begin with, Arnold is a fully integrated company, controlling every manufacturing step from the raw material to the finished core. Then, modern testing equipment permits 100% inspection of cores before shipment. Finally, you're matching your requirements against the most experienced and complete line of tape cores in the industry. Arnold produces Types C, E and O Silectron cores, nylon and aluminum cased toroidal cores, and bobbin cores to meet whatever your designs may require in tape thickness, material, core size or weight. Wide selections of cores are carried in stock as standard items for quick delivery: both for engineering prototypes to reduce the need for special designs, and for production-quantity shipments to meet your immediate requirements.

*Let us help you solve your tape core problems.* Check Arnold, too, for your needs in Mo-Permalloy or iron powder cores, and for cast or sintered permanent magnets made from Alnico or other materials.

WSW6447

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# PERSONNEL CLEARING HOUSE

## *AFCEA Members Available to Industry*

**The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ......., SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.**

SALES ENGINEER: ADVERTISING—SALES PROMOTION MANAGER. Recent sales experience plus 10 years' experience in advertising and sales promotion of electronic products. Radio amateur for over 20 years. Age 37. Engineering education of 3 years and B.S. in Marketing. Prefer West or East coasts. Box 121.

COMMUNICATIONS SPECIALIST—COMMUNICATIONS SYSTEM MANAGER with leased long-line interphone experience plus 10 years military and civilian air traffic control. Broad background in electronics, air operations, and flight movement. AB and LLB degrees. Will consider any location. Box 122.

FIELD ENGINEER: ELECTRONIC, COMMUNICATION, MARINE EQUP'T. Data processing and automation. DOD project coordination. Branch Management, sales promotion, customer relations. Surveys and reports, subcontract and material expediting, program planning, production control, priorities. Box 123.

REPRESENTATIVE, with all clients performing R & D or supply work for Wright Field and other agencies, needs more lines to develop with both military and commercial potential. Preferred are electronics or photographic equipments and ANP (have AEC Access) or packaging material. Box 124.

MANUFACTURERS REPRESENTATIVE WASHINGTON, D. C. Long established and contacting all government procurement points in Washington, D. C., has opening for an additional account. Prefer a company manufacturing an end-use item and who is already doing some business with the military. Can also cover Philadelphia and Fort Monmouth. Replies confidential. Box 125

## *Government and Military Positions Available*

**Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.**

ORDNANCE ENGINEER ($7,000 a year). Assistant Inspector of Naval Material, Germantown, Pa., has opening in development and production of ordnance equipment. Requirements: Bachelor's degree in engineering (or four years' equivalent experience) and 2½ years' engineering experience, one in ordnance engineering. Master's degree can be substituted for one year's experience; Doctor's degree in ordnance engineering can be substituted for all experience. For further information, write: Supervising Inspector of Naval Material, 17 Brief Ave., Upper Darby, Penna.

ELECTRONIC ENGINEERS, ELECTRONIC SCIENTISTS, MECHANICAL ENGINEERS, starting salaries $5,335-$6,390. ENGINEERING DRAFTSMEN, $3,415-$4,080. Vacancies now exist at the U. S. Navy Electronics Laboratory, a major West Coast scientific organization engaged in research and development of electronic equipment and systems. For further information address: U. S. Navy Electronics Laboratory, Civilian Personnel Division, San Diego 52, California.

ELECTRONIC ENGINEERS: One Electronic Engineer (telephone) and one Electronic Engineer (radio), starting salary $6,390. Requirements are: degree in electrical engineering and 2½ years professional experience, one year of which must have been in the specialized field, or 6½ years professional electronic engineering experience. Applications should be forwarded to: Hqs., 5001 SU Station Complement, 5th Army, 1660 E. Hyde Park Blvd., Chicago 15, Illinois.

THE SPECIAL DEVICES CENTER, an activity of the Office of Naval Research, located at Sands Point, Port Washington, Long Island, has several vacancies for electronic engineers at $7035 a year and for Engineering Draftsmen at $4080 a year.
Inquiries should be directed to the Industrial Relations Officer. Telephones: Flushing 7-8300 and Port Washington 7-3800.
RADIO OPERATOR TECHNICIANS. Veterans $3400-$4200 to start. Overseas opportunities. Amateur or commercial licenses helpful. Full pay during advance training. Good advancement opportuni-

ties. Submit resume with name, age, address, phone number—if any, military experience, private training, work experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Teletype Operators and Cryptographic Technicians. Veterans $3200-$3700 to start. Overseas opportunities. Full pay during training period. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Electronic Technician ($7570 to $8645 plus 25% (non-taxable) cost of living allowance). Major duties are to plan, direct and supervise the operation and maintenance of carrier, repeater, terminals, telegraph and associated equipment installed in the toll test rooms. Includes inspections of facilities to determine required training, the organizing of the training and when necessary the actual conducting of the training. Three years general experience required and three years specialized experience. Inquiries should be directed to Civilian Personnel Officer, Alaska Communication System, 550 Federal Office Building, Seattle 4, Wash.

Electronic Engineers GS-5 through GS-12. These positions have a salary range of $4480 through $8645 per annum. Employees in these positions serve as advisors and consultants to Signal Corps Contracting Officers on technical phases of procurement of Signal Corps equipment during the period of solicitation and during the life of the contract. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Supervisory General Engineer ($6950 a year). To serve as an assistant to the military post engineer. Function of the Depot Facilities Division is related to maintenance, care and preservation of all buildings, structures, and rights-of-way and other real estate of the depot; responsible for fire protection and prevention for the depot; and management of depot facilities. Inquiries may be directed to the Civilian Personnel Office, Decatur Signal Depot, Decatur, Illinois.

East Coast Pictorial Center has an opening for a studio electrician at $2.51 an hour. Duties include operating most electrical equipment, required for motion picture production. Knowledge of lighting effects and switchboard wiring required. A position is also available for an architectural draftsman at $4,525 a year. Situation requires ability to execute designs and plans for motion picture settings, and to paint and dress sets, dioramas and other pictorial representations. Clerical duties include filing, developing and printing of blue prints, and a minimum amount of typing. For further information, write to Civilian Personnel Office, Army Pictorial Center, Long Island City 1, N.Y.

Physicist—GS-9. Qualified expert on radiology responsible for the operation of the film badge service unit and for the monitoring of personnel, material, equipment and radioactive sources. Accountant—GS-9. Responsible for receiving and analyzing all reports generated by the Finance and Accounting Branch; practical application of accounting theories. Cost Accountant—GS-9. Serves as Staff Accountant for the Maintenance Division responsible for performing professional accounting work in connection with cost accounting and Army Industrial Fund activities. Electronic Engineer—GS-7. Responsible for independent accomplishment of professional engineering work as related to research, development, design, evaluation, standardization, modification, etc., of prototype production and fabrication models of electronic equipment. Inquiries should be directed to the Civilian Personnel Director, Lexington Signal Depot, Lexington, Kentucky.

Medical Officer GS-12. This position pays $8645 per annum. The employee will be responsible for the operation of a Federal Civilian Health Service type of dispensary containing examination and treatment rooms and equipment. Examines military personnel having initial responsibility for diagnosis and disposition of cases for treatment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

### FORT MONMOUTH VACANCIES

Supv. Physicist (General), GS-14; Electronic Engineer (General), GS-14.

*Duty Station:* Pasadena, California.

Electronic Engineer (Radio), GS-13.

*Duty Station:* Christ Church, Hampshire, England.

Electronic Engineer (General), GS-13; *Duty Station:* Fort Monroe, Va., Fort Knox, Ky., Fort Bliss, Texas, and Fort Rucker, Ala. Electronic Engineer (Radio, Instrumentation), GS-12; Chemical Engineer, GS-11; Electronic Engineer (Radio, General & Wire Communications), GS-11; Mechanical Engineer (S&S, Signal Equipment), GS-11; Training Officer (General Fields), GS-11; Mechanical Engineer and Mechanical Engineer (Signal Equipment), GS-9; Employee Utilization Representative, GS-9; Instructor (Radar, Radio-Microwave, Wire Sound Recording), GS-9; Radio & Electronic Equipment Installer and Repairer, WB-15.

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## ITEMS OF INTEREST

(*Continued from page 66*)

able—one for laboratory installations and one for mobile field use.

The Model TSS-50 system for laboratory installations consists of six Target Simulator Units and one Sync/Power Unit enclosed in a steel cabinet. It provides for the immediate viewing of up to six separate moving targets on standard radar indicators. Aircraft and missile speeds up to 10,000 nautical miles per hour are easily generated.

The smaller field-type Target Simulator System, Model TSS-52, is similar to the laboratory installation in its functions. It is able to trace up to six simulated targets but contains only one set of meters, capable of monitoring one target at a time.

### IEE Meeting

The Institute of Environmental Engineers is a newly incorporated engineering society devoted exclusively to environmental science, simulation and testing.

This year, the IEE will sponsor its first annual technical meeting. It has been set for April 25 and 26 and will be held at the LaSalle Hotel, Chicago, Ill.

### RCA Elects Two Top Executives

Frank M. Folsom has recently been elected Chairman of the Executive Committee of the Board of Radio Corporation of America. Mr. John L. Burns has been chosen to succeed him as President and Director of the company.

The new president had been a senior partner and vice chairman of the Executive Committee of the management consultant firm of Booz, Allen and Hamilton.

In speaking of the new positions, David Sarnoff, Chairman of the Board of Directors, said: "Mr. Burns is no newcomer to RCA, for he has been intimately associated with our activities for the past ten years. He has worked closely with us in our periodic reviews of the company's objectives, policies, organization planning and our business programs and operations.

"This action was taken at the request of Mr. Folsom, who informed me of his intention of retiring from active service upon reaching retirement age in two years. He asked that his successor as president be selected at this time to permit an orderly transition in management."

### Holschuh Named President Of Sperry Gyroscope

The appointment of Carl G. Holschuh of Huntington, Long Island, as president and general manager of Sperry Gyroscope, has been announced.

Mr. Holschuh joined the company in 1933, devoting his early efforts to Sperry's extensive program in gunfire controls. During the war years, he advanced to assistant research director and was responsible for Sperry gunsight and turret developments for the B-17 Flying Fortress.

Previous to his present appointment, he was concerned with the organization of Sperry Gyroscope into several specialized divisions devoted to product family activity in such fields as aeronautical and marine equipment, electron devices, and air and ground weapons systems.

# "An infinite capacity for taking pains"

The above familiar phrase is usually given as a definition of genius. We borrow it as a job description.

The lengths to which our Quality Control people go, to insure the reliability of our complex products, are truly painstaking, and are applied equally to components we make ourselves and those we purchase from outside suppliers.

For example, consider vacuum tubes, the heart of hundreds of projects in our Electronics Division. No spot check satisfies here (even if that's all our customer specifies)—but a whole series of critical tests, including such precise evaluations as these:

*Inspection of tube characteristics* to rigid Stromberg-Carlson specifications—performed on special equipment which can do in a half-hour what would take days on conventional testing devices.

*Inspection by X-ray,* looking for deeply hidden potential faults which could cause malfunction at any time after first use.

*Inspection by microscope,* seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

You can't put a price on "taking infinite pains." You *can* place your confidence in a company where this is everyday procedure.

S-C STROMBERG-CARLSON

**STROMBERG-CARLSON COMPANY**

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

GD GENERAL DYNAMICS

# NEW PRODUCTS FROM INDUSTRY

Cover: Courtesy of American Machine & Foundry Corp.

## Missile with Radar Beacon

SIGNAL's cover picture, an artist's conception of a guided missile shows the radar beacon in the cutout. The improved radar beacon, produced by American Machine & Foundry Co., 261 Madison Ave., New York 16, N. Y., tracks rockets and guided missiles. A similar radar beacon is being manufactured also for the Armed Forces and has been tested successfully with all types of missile and drone equipment.

The complex sub-miniature components and circuitry of the radar beacon include a receiver transmitter, power supply unit, and antenna. They are pictured at the right.

The life expectancy of the beacon is over 50 hours when an external power supply is used, and the self-contained battery operates for about 15 minutes. The extremely compact beacon weighs only four pounds.

Sub-miniature components and circuitry

## Highway Hazard Flasher

Development of a wholly transistorized electronic highway hazard flasher was disclosed by the R. E. Dietz Co., of Syracuse, N. Y.

The application of an electronic circuit to a highway hazard light is practical now only because of the invention and development of transistors. Use of transistors in the electronic circuit assures long battery life up to 18,000 working hours at full power. This is the equivalent of six years at eight hours a day. Ruggedness tests show that transistors can withstand the shock of being fired from a mortar and still operate.

The new electronic highway flashers are expected to be a boon to construction concerns, municipal highway maintenance departments, and other organizations that need reliable and rugged hazard flashers.

## New Transistor Clip

Atlas E-E Corp., 47 Prospect St., Woburn, Mass., has announced a new design in transistor clips. A silver-plated beryllium copper clip will hold all Transistors .235" x .375" including the GE 2N167 and 2N78, and Texas Instrument Silicon types.

Split to insure a tight four point grip, the clip has a stop tab that prevents the transistor from moving longitudinally. An integral tab reinforces the single mounting hole to prevent twisting out of place.

## Radome Testing System

The CTI Radome Boresight-Error Measuring System, Model 150, is important to the manufacturer of plastic radomes as well as to aircraft and engineering firms installing and testing radar equipment.

The California Technical Industries (formerly Color Television, Inc.), 1512 Old County Road, Belmont, Cal., has announced that this system is available not only in a complete system, but for transmission efficiency measurements, for antenna pattern plotting. To augment existing antenna ranges, combinations and modifications of the basic components are available separately.

The Radome Testing System records the beam deflection in a radar tracking system. This automatically continuous function of the radome requires far less time and is far more accurate than manual, point-by-point measurements.

The transmitting parabola on the end of a Null-Seeking Boom directs a pencil beam at the radome and receiving antenna located at the other end of a 1500-inch range. The received signal, by means of a servo system, positions the Boom to the apparent axis of the receiving antenna as seen through the deflecting radome. While the motor-driven Radome Holding Fixture rotates, three recorders, synchronized with the position of the radome, plot the magnitude and the horizontal and vertical components of the beam deflection angle as represented by the position of the Null Seeking Boom.

## New Cathode Material Designed for Electronic Tubes

A passive cathode material with nearly doubled strength has been developed by Superior Tube Co., Norristown, Pa., manufacturers of small diameter tubing and precision electronic products.

Designated as Cathaloy P-51, the new alloy is similar to Superior's Cathaloy P-50 in chemical composition and electrical characteristics but contains four percent tungsten to increase its strength. Hot yield strength is about 5,000 pounds per square inch at 800 degrees Centrigrade.

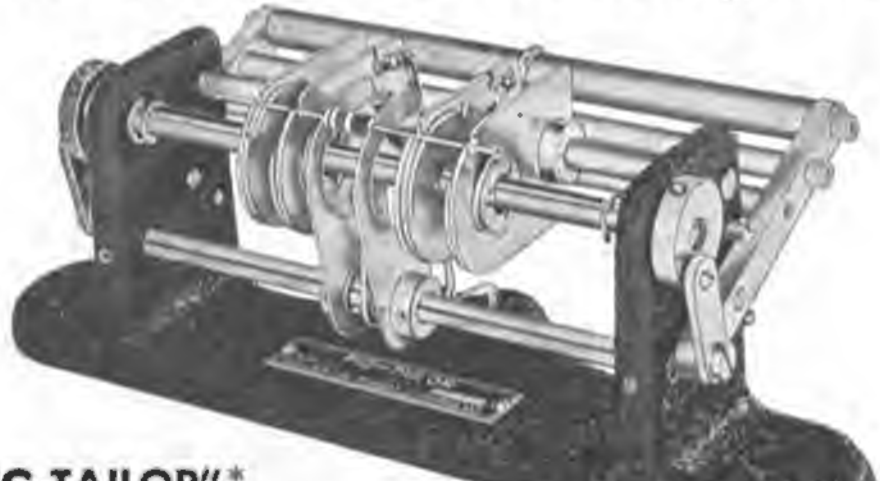
Cathaloy P-51 is designed for electronic tubes which require the low rate of barium evolution, with minimum sublimation and freedom from interference impedance characteristic of passive cathodes, but which operate under conditions of shock and vibration. It is especially useful in ruggedized tubes.

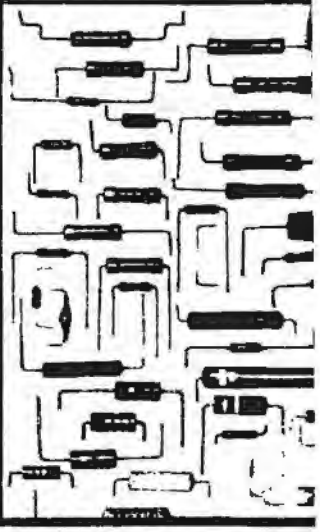
Customers' exact dimensional specifications are supplied in seamless, Weldrawn (welded and cold drawn), and Lockseam forms. Cathaloys P-50 and P-51 also are furnished as emission caps and shanks in disc cathodes.

(Continued on page 73)

# PROVEN-on the assembly line!

PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"





**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*

# "PIG-TAILORING"

***. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.***

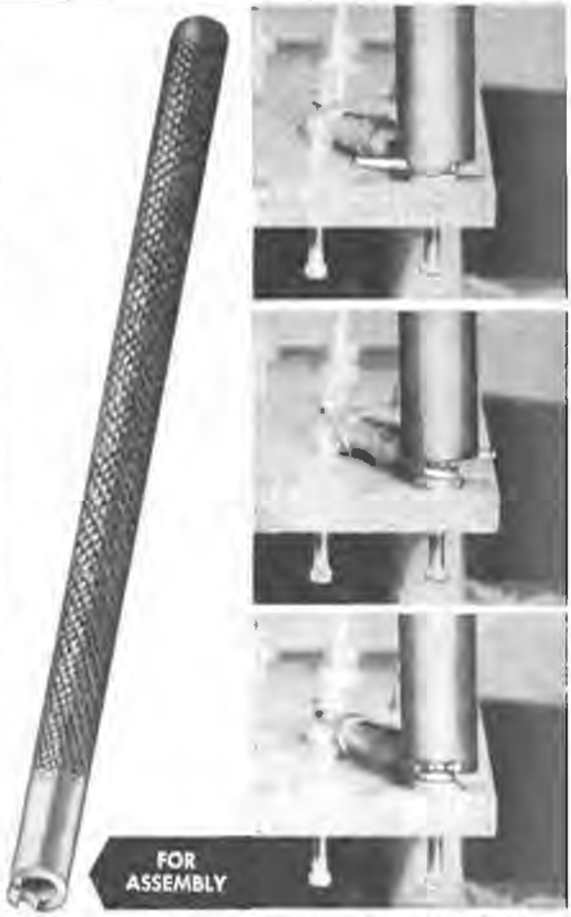
The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!



**"SPIN-PIN"*** T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

*Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-3P*

**BRUNO-NEW YORK INDUSTRIES CORPORATION**
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

# NEW PRODUCTS

## Lawrence Color Tube

A recent agreement between Litton Industries, Beverly Hills, Cal., and Paramount Pictures Corp. will enable a part of Litton, the Emeryville organization, to devote its facilities and scientific manpower to the application of the Lawrence tube to military and industrial uses. The unique tube was developed by Chromatic, a subsidiary of Paramount.

In air traffic control the tube presents landing planes in one color, planes taking off in a second color, and planes within a given distance in a third color on the display panel.

The Lawrence color tube makes it possible to select color displays in radar presentation. Thus, enemy planes can be identified and distinguished from friendly aircraft on a radar screen by their color image.

Paramount Pictures Corp. President Mr. Barney Balaban said, "In both military-industrial and home television cases, the vastly increased image brightness of the Lawrence tube, the simplified circuitry it has made possible, and the resultant lower cost of manufacture will make possible superior performance at lower cost."

## "Maintz" Protective Coating

A new coating which provides excellent protection against severe chemical and weather exposure has been introduced by the West Chester Chemical Co., West Chester, Pa.

"Maintz" is based on DuPont's chlorosulfonated polyethylene which, combined with silicone and other resins, produces an exceptionally tough and long lasting coating that resists abrasion, weathering, and chemical corrosion. It is elastic enough to withstand extremes of expansion or contraction without cracking and retains this property at temperatures as low as –40 F. Repeated rapid and severe changes in temperature can be tolerated without damage over a range of from –50 Centigrade to 150 Centigrade.

A chemically inert substance, "Maintz" resists oxidation, ozone, acids including nitric and chromic, chlorine solutions, alcohols, refrigerants, ethers, etc. Tests of exposure to salt spray and tropical weather for over two years have shown no measurable degradation.

Recommended applications of "Maintz" include refineries, chemical plants, marine service, or any other locations where severe conditions present problems in maintaining a protective coating.

Vacuum-Tube Voltmeter is assured greater accuracy by its design and construction.

## Vacuum-Tube Voltmeter

The accuracy of a laboratory instrument is combined with the durability necessary for everyday laboratory and production use in the Type 1800-B Vacuum-Tube Voltmeter offered by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Massachusetts.

High accuracy of the new voltmeter is assured by its design and construction. It is greater than ±2% accurate on all A-C and D-C voltage ranges. This has been achieved through advanced circuit design, power-supply regulation, and the use of long-term stable precision components.

The completely shielded diode probe is designed for use into the UHF range. Other features include a high input impedance, D-C polarity switch, illuminated meter scale with mirror and knife-edge pointer, and input terminals that are insulated from the panel so that the panel is grounded at all times. Priced at $415 net F.O.B., complete with probe.

## New Amplifier Klystron

A new klystron tube, the VA-806, has been introduced by Varian Associates, Palo Alto, Cal., for use as the final amplifier of a high power microwave transmitter.

The VA-806 has performance characteristics that permit amplification of frequency, amplitude, or phase modulated signals at power gains on the order of 50 db. It features a unique all-ceramic and metal construction.

VA-806 provides 2,000 watts of continuous power in the 7125 to 8500 megacycle frequency range. It is a water cooled, four cavity cascade amplifier, tunable ±25 megacycles from the specified center frequency.

## Missing Pulse

An instrument to check the performance of pulse-modulated tubes like magnetrons and klystrons is a recent addition to the specialized tube testing equipment of Manson Laboratories, 207 Greenwich Ave., Stamford, Conn.

Called the "Missing Pulse Detector," Model PD11A incorporates two input connectors, one for the negative detected RF pulse, the other for a negative reference trigger. A positive pulse registers on the counter if a pulse is missing. Under normal operation, no output pulses appear.

The set can check pulses from 0.2 to 6.0 microseconds in width at repetition rates up to 5000 pps. It requires 115 volts, 60 cps., 20 watts.

### *Slotted Line for Wave Guide*

Developed to fill a need in the ever expanding field of lower frequency radars and scatter communications systems, the Slotted Line is offered by I-T-E Circuit Breaker Co., 19th & Hamilton St., Philadelphia 30, Pa.

The Slotted Line for waveguide features bolted and dowled aluminum construction with probes tunable over the entire frequency band.

The inherent VSWR is less than 1.02 over the entire applicable band; the slope is under 1.005 VSWR.

The Slotted Line for Wave Guides, manufactured by I-T-E Circuit Breaker Co., Philadelphia, Pa., fills a need in the fields of radar and scatter communications. Instruments similar to the one pictured above currently are being supplied for both military and commercial installations.

Military and commercial installations currently are being supplied with instruments that range in size from WR-770 through WR-2300. They are designed to withstand severe field service under various adverse conditions.

### *Multi-Channel Programmer*

To satisfy the need for a small programming device, the exceptionally accurate MPR-13 Multi-Channel Programmer offers many advantages never before accumulated in one package. It is small, light, and provides up to 13 channels for any type of electrical programming. The unit is produced by Photographic Products Inc., 1000 No. Olive St., Anaheim, Cal.

The accuracy is of the order of one part in approximately fifty thousand. The general operating principle provides for an insulating tape similar to 35mm photographic film to be advanced at a precise rate of speed between 13 contractors. The tape is marked lengthwise in time and divided into 13 channels. Up to 13 types of signals, both repeat cycling or random nature, may be generated to control accurately a group of electrically operated equipment.

The unit was designed to withstand the rigors of missile and aircraft useage. For utmost ruggedness, the Programmer is manufactured to extremely close tolerances and housed in a magnesium casting which gives strength and resistance to shock and vibration.

### *Major Breakthrough in Connector Reliability*

Integral Connector Insulation molded directly onto contacts and leads provides fool-proof, tamperproof connector cables for trouble-free field operation.

Unique design and special production processes called the Alden "IMI" (integral molded insulation) Connector Technique will be unveiled at the New York I.R.E. Show by Alden Products Company of Brockton, Massachusetts.

This technique now makes it possible to supply molded unit cables in which the contacts and leads are molded with one hot shot of connector insulation into connector bodies integral with their cables. The designs eliminate tedious and critical assembly operations, reduce the population of parts in connector designs to a basic minimum, provide positive moisture seal and protect leads and contacts from shock and vibration.

### *Low Cost Telephone Carrier System*

Budelman Radio Corp., 375 Fairfield Ave., Stamford, Conn., announces immediate availability of a new, low-cost private line telephone carrier system.

Designed specifically to provide high-quality private line service on existing multi-party lines, the new Type PLC equipment can be installed in a matter of hours without running additional physical lines and without impairing or interfering with existing services.

The compact, highly adaptable PLC carrier equipment can be used in practically any type of system including manual, automatic, bridged or divided ringing, and magneto. Four channels are available on central office terminals to provide service to up to four private subscribers on any existing party line, at a moment's notice and without mutual interference from any party.

Because the equipment is completely recoverable it is ideal for meeting emergencies or for temporary or seasonal private line service.

### *8-ounce "Floated" Gyro*

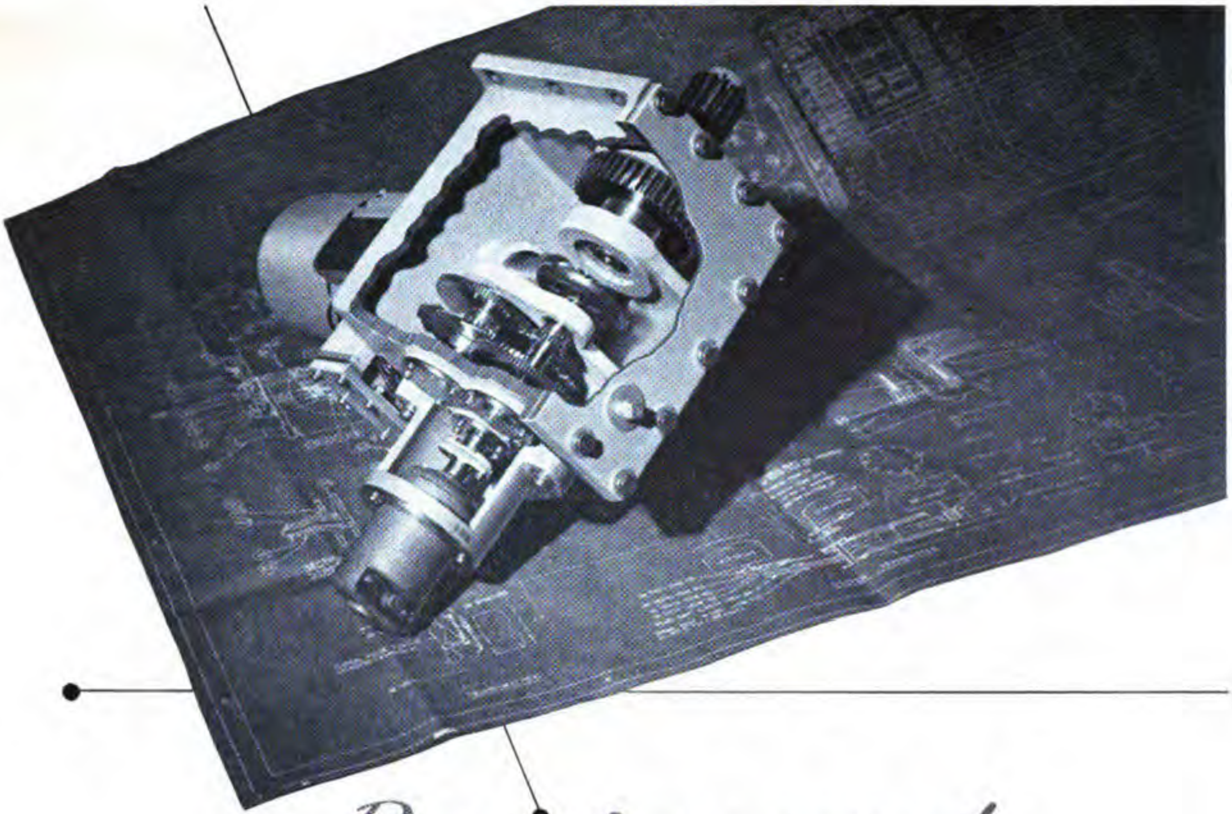
A miniaturized "floated" gyroscope that weighs only eight ounces, yet will meet the low-drift-rate requirements of short-time or "aided" automatic guidance systems, is being mass-produced by Minneapolis-Honeywell Regulator Co., Aeronautical Division.

Company gyroscope engineers describe the new MIG (miniature integrating gyro) as having the angular momentum of a HIG-5 ($10^5$gm-cm$^2$ sec), the Honeywell integrating gyro. Performance comparable to that of the larger HIG's under unfavorable environments is enclosed in a package weighing less than a half-pound.

Broader potential for the MIG was achieved by a new "systemized" design approach and by developing several new design concepts. These include combining the signal and torque generators into a single dual-microsyn designated as the Dualsyn and placing it at one end of the case with the gimbal at the other.

Other design features include reduction of the gimbal suspension pivot to .016-inch, a new method of fluid fill that virtually eliminates balance-shifting air bubbles, a new isoelastic spinmotor and mounting structure that greatly improves performance under vibration, and an improved end bellows that allows flotation fluid changes over a wide range of internal temperatures.

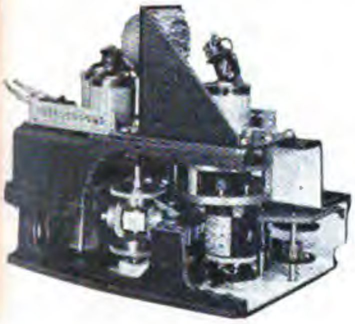
*(Continued on page 76)*

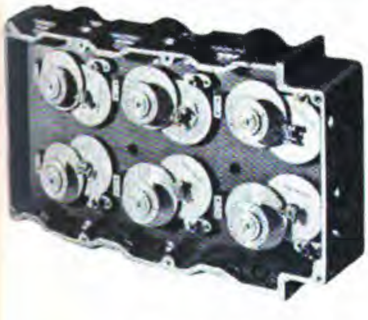


# *Precision-eered*

## ELECTRO-MECHANICAL ASSEMBLIES

### FROM PILOT STAGE TO PRODUCTION EFFICIENCY

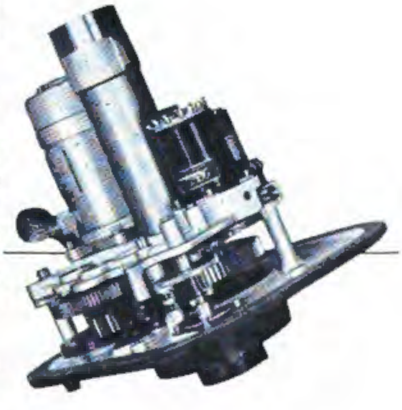




HAVE you a new product on the design boards? Do you have a new contract for radar, missiles, computers or other electro-mechanical devices? Then let Atlas help you from pilot stage to production efficiency.

Atlas experienced production and methods engineers layout the job using new cost-cutting methods, and improved processing techniques. Atlas toolmakers build dies and fixtures to implement these plans. Atlas skilled mechanics and assemblers **produce prototypes to your exact specifications *on a job basis,* and can follow** thru with production. As many men, machines and hours of work as your electro-mechanical unit requires and no more.

Atlas furnishes the practical engineering step between idea and production line. We've been "precision-eering" on a contract basis for more than a quarter of a century. May we work with you? Write for booklet "Precision-eering Electro Mechanical Equipment." ATLAS Precision Products Co., Philadelphia 24, Pa. (Division of Prudential Industries).



*"From Drawing Board . . . to Production Line"*

**ATLAS**

*Precision Products*

SERVICE ATLAS DEPENDABILITY QUALITY

# NEW PRODUCTS

## Pygmy Connectors

The Scintilla Division of the Bendix Aviation Corp. together with Avnet Eastern Sales, 36 N. Moore St., New York 13, N. Y. and Avnet Western Sales, 8966 National Blvd., Los Angeles 34, Cal., announce the availability of the new Bendix Pygmy Connectors.

In certain shell styles the new miniature aluminum connectors are only 1/4 the size and weight of standard AN Connectors. Aircraft gains a distinct advantage from the weight and space saved.

The wide variety of shell styles and insert arrangements offers anywhere from 1 to 55 contacts. All contacts are size 20, heavily gold plated, with machine closed entry sockets.

## Variable Autoformers Designed for Aircraft

The Pacific Division of the United Transformer Corp., 4008 W. Jefferson Blvd., Los Angeles 16, Cal., has announced its new "Vari-Lite" variable autoformers, which have been designed for aircraft.

These UTC aircraft variable autoformers are designed to replace resistive-type light control units with high-efficiency controls of exceptional reliability.

The input is 115 volts, 400 cycles; output is 0 to 28 volts. Typical of the "Vari-Lite" unit is the PA-1028, which has a 4-amp. capacity, measures 2⅜" x 2¾", and weighs 19 oz. It meets MIL-T-9219 and MIL-E-5272 specifications.

## Wheel & Gimbal Gyros

A new rate gyro, accurate under severe shock and vibration requirements, has been introduced by Humphrey, Inc., 2805 Canon St., San Diego, Cal., for missiles.

The model, Series RG03-0100, has a conventional spin axis orientation that allows it to be interchanged with other gyros.

Pivots, bearings, and loose springs have been eliminated by a wheel and gimbal system which permits a standard miniature motor and keeps the static mass of the motor from loading the gimbal.

Among the features of these gyros are high natural frequency, potentiometer pickoffs, pressure-sealed cases, and trouble-free, floating piston, dry air dampers.

Pygmy Connectors, available from Bendix Aviation, have from 1 to 55 contacts.

# New Literature

## Aviation Aspects of 1958 Budget

Excerpts and tables dealing with aviation aspects of the fiscal year 1958 Federal Budget and the accompanying budget message presented to Congress are highlighted in a bulletin release.

Included are discussions of the National Defense policy, the effect of the budget on various military air activities, military Research and Development obligations, and procurement.

Limited copies of the 15-page memorandum are available on request. Ask for "Aviation Aspects of the 1958 Federal Budget," from the Aircraft Industries Association of America, Inc., 610 Shoreham Bldg., Washington 5, D. C.

## Digimatic Automation

From Stromberg Carlson comes word of a new 12-page booklet describing the Digimatic tape control system for machine tools. Digimatic provides automation in a low-cost, fast, economical system that permits one man to handle several magnetic tape controlled machines, each making a different part, if desired. Rapid changeover from one part to another is accomplished in minutes by simply making a new tape.

Tapes are rapidly prepared by using the Digimatic planning desk and a small high-speed special purpose computer.

Small companies can obtain magnetic tapes from a computing center and save the expense of owning and operating their own computer until economies justify the expenditure.

The pamphlet will be sent upon request to the Manager, Applications Engineering, Electronic Control Systems, Inc., 2136 Westwood Blvd., Los Angeles 25, Cal.

## New DuMont Publication

A new quarterly technical journal has replaced the former "Oscillographer," published by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.

The replacement for the distinguished technical organ is the "Du Mont Instrument Journal." All electronic equipment, including pulse generators, vacuum tube voltmeters, and pulse transformers, as well as oscilloscopes will be covered.

Editorial content will feature articles written by authors all over the globe who are experts in the electronic instrument industry.

## Nickel Cadmium Batteries

To help engineers evaluate the practicability of miniature nickel cadmium storage batteries for electronic, aircraft, and communications equipment, an eight-page technical report describes high output sintered plate batteries. The batteries described are products of the Nickel Cadmium Battery Corp., 66 Pleasant St., Easthampton, Mass.

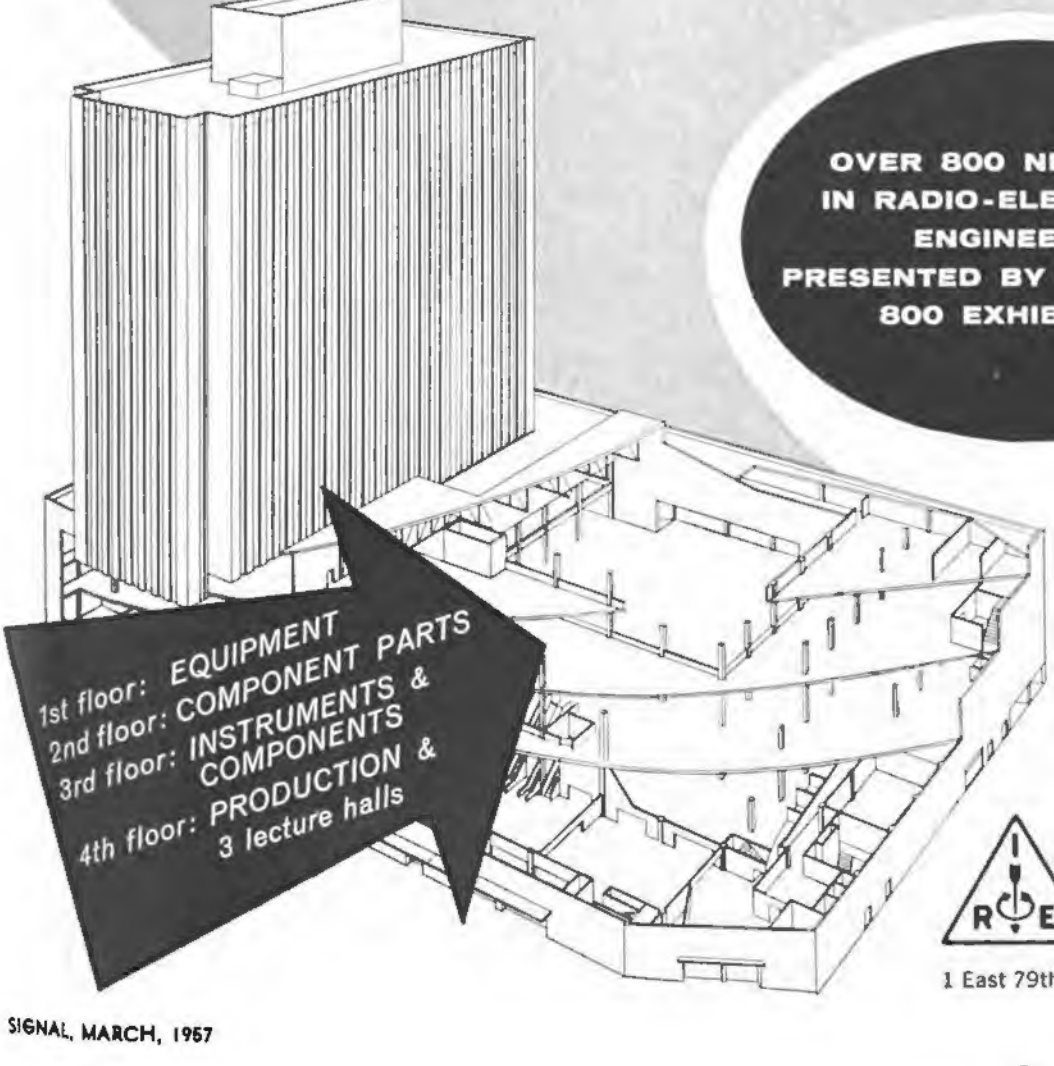
Copies of the booklet may be obtained by writing to the Company and requesting Bulletin No. 501.

## Civil Defense for Industry

A new Federal Civil Defense Administration publication outlines the steps which industry should take so that, in the event of an enemy attack on the United States, it will be able to resume full scale production as soon as possible.

The technical bulletin provides guidance in planning for emergency leadership, establishing alternate company headquarters, setting up emergency financial arrangements, and providing for alternate suppliers and production methods and an adequate supply of labor.

"Planning for Continuity of Industrial Management Following Disaster" may be obtained from the Federal Civil Defense Administration. Battle Creek, Mich.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2nd floor: COMPONENT PARTS
3rd floor: INSTRUMENTS & COMPONENTS
4th floor: PRODUCTION & 3 lecture halls

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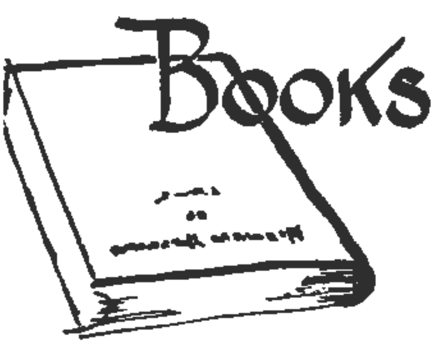

# Books

***ON HUMAN COMMUNICATION: A REVIEW, A SURVEY, AND A CRITICISM, by Colin Cherry. John Wiley & Sons, New York, N. Y. $6.75, 333 pages.***

*On Human Communication* is the introductory volume in a forthcoming series, Studies in Communication. This series, conducted under the auspices of the Massachusetts Institute of Technology, will survey the general field of communication from various points of view including those of the anthropologist, the linguist, the logician, the telecommunications engineer, and the social psychologist.

This volume consists of a series of simple essays. It gives the relations between the diverse studies of communication, of the causes and the growth of this modern interest, together with some idea of the unification which exists.

As the first of the series, this book is a challenge to the intelligent reader. The rest of the volumes, scheduled to appear within the next few years, should be equally provocative and stimulating.

***THE CATHODE RAY OSCILLOSCOPE, CIRCUITRY AND PRACTICAL APPLICATIONS, by J. Czech. Interscience Publishers, Inc., New York, N. Y. $8.50, 340 pages.***

The theory, design, and use of the cathode ray oscilloscope, one of the most versatile instruments in the electronic field, are discussed and explained in this up-to-date text.

Parts I and II of this book are mainly concerned with the structural sections and the mode of operation of the oscilloscope. The circuit descriptions contained in the text are supported by numerous original oscillograms. Part II also deals with the principles which apply when using the oscilloscope in measuring-techniques.

Part III discusses examples of measurements taken from actual practice and methods used for evaluating the results.

A chapter on measurements of television receivers shows how the use of a time base expansion unit allows far greater insight than a normal oscillogram into the details of a signal under investigation.

Directions for building a simplified oscilloscope and a simple time-base expansion unit are contained in Part IV. The circuits described provide an opportunity for considering further details of importance for working with oscilloscopes and for assessing their suitability to perform certain tasks.

As an introduction to the technique of oscillography, this book contributes not only to the advancement of the cathode ray oscilloscope in the field of applied engineering, but also helps promote the application of oscilloscopes in other fields where problems of measurement still await a solution.

***RANDOM PROCESSES IN AUTOMATIC CONTROL, by J. Halcombe Laning, Jr. and Richard H. Battin. McGraw-Hill Book Co., Inc., New York, N. Y. $10.00, 434 pages.***

This text book covers the basic background in the theory of random signals and noise and the practical techniques to be used in the analysis and synthesis of linear control systems which are subjected to random inputs.

The material presented is an outgrowth of a set of lecture notes given by the authors in the Aeronautical Engineering Department at M.I.T., in connection with studies in the M.I.T. Instrument Laboratory. The topics discussed, therefore, have been chosen because of the authors' experiences and interests in the design and analysis of systems in the fields of fire control and navigation.

The first half of the book treats the basic concepts of probability and random time functions. From fundamental ideas, analysis and design techniques are developed for linear control systems made up of both constant and time-varying components. Following most chapters, problems of varying degrees of difficulty are included to test the reader's knowledge of the more important concepts developed in the text.

***TRANSISTOR ENGINEERING REFERENCE HANDBOOK, by H. E. Marrows. John F. Rider Publisher, Inc., New York, N. Y. 288 pages, $9.95.***

This volume is a valuable source book for technical information on transistors and components designed for use with transistors, their operating capabilities, performance characteristics, and sources of supply. Information is assembled and coordinated on the commercial aspects of the transistor industry.

The book is divided into five major sections. The first section deals with the discussion of transistor materials, structures, and fabrication techniques. Coverage is given on point contact, field effect, analog, anti-analog, and other pertinent data.

Section II presents full unabridged information, including characteristic curves and performance data on some two hundred types of commercial transistors in the form of technical specification sheets.

Section III is devoted to components designed for use with transistors. The physical and electrical specifications are listed for many different types of transformers, capacitors, cells and batteries, and a variety of miscellaneous components.

Section IV covers the specifications and, in many cases, the schematics of over a hundred commercial applications of transistorized devices. A directory of transistors and component manufacturers is given in the last section.

***PRINCIPLES OF INSURANCE AND GOVERNMENT BENEFITS; For Service Personnel, by Capt. James M. Garrett, III. Military Service Publishing Co., Harrisburg, Pa. $2.00, 312 pages.***

Every man in uniform will recognize the value of this book as a source of information on all matters relating to family security.

It outlines general programs for officers and men showing the interrelation of the new dependency and indemnity compensation, social security, government insurance, and other government benefits with commercial insurance. Specific programs are illustrated with charts.

The text has been revised extensively to explain the many changes brought about by the recent Survivor's Benefits legislation. This new legislation affects all servicemen of every grade.

The service man who desires to plan adequately for the future security of his family will find this book an indispensable tool.

***L-C OSCILLATORS, by Alexander Schure. John F. Rider Publisher, Inc., New York, N. Y. $1.25, 72 pages.***

Volume 13 of the Electronic Technology Series deals with L-C oscillators. The series offers paper-bound volumes that fall into six groups: electrical bases for electronics, amplification, oscillators and propagation, communication electronics, and electronic engineering fundamentals.

This book includes pertinent items of general information relating L-C oscillators to energy conversion, frequency range, power considerations, series and parallel resonance, and the like. Other chapters study circuit analysis, essential features of oscillator circuits, and low, medium, and high frequency oscillators.

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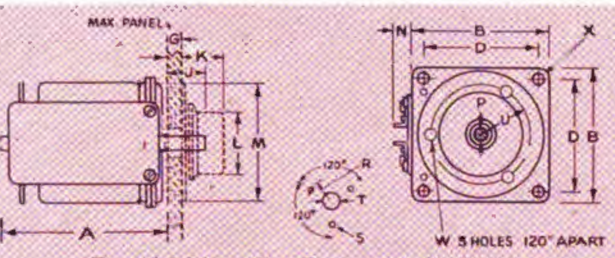

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Communications—Electronics—Photography

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Washington, D. C.

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# SIGNAL

**Communications-Electronics-Photography**

Journal of the Armed Forces Communications and Electronics Association

**VOLUME XI** **APRIL 1957** **NUMBER 8**

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### Aerial photo — Washington, D. C.

This aerial view, taken by Fairchild Aerial Survey, Inc., highlights many of the points of interest of the 1957 AFCEA Convention City.

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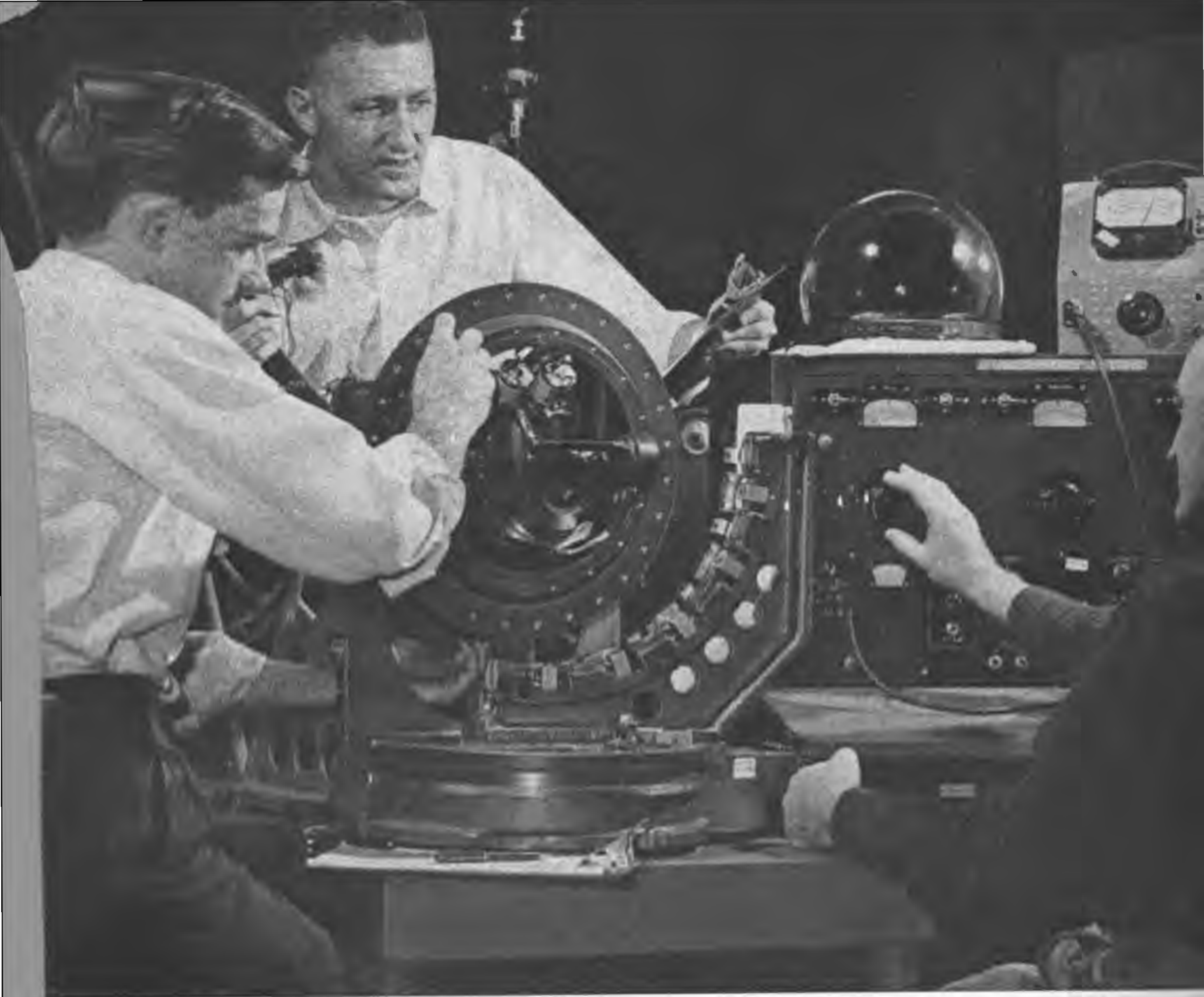
## More News About the AFCEA Convention

***Tour of Naval Research Laboratory*** — On Tuesday, May 21, members and their guests are invited to the Naval Research Laboratory for lunch, followed by a tour of the Laboratory's new nuclear research reactor facility and demonstrations of some current work in the general field of electronics. The reactor is the first in the Nation's Capitol and the first research reactor to be designed, built, and operated by a Department of Defense laboratory.

You have read about some of NRL's accomplishments in SIGNAL; this is your chance to see the laboratory in operation.

***Watch for complete convention coverage in the May issue of SIGNAL***



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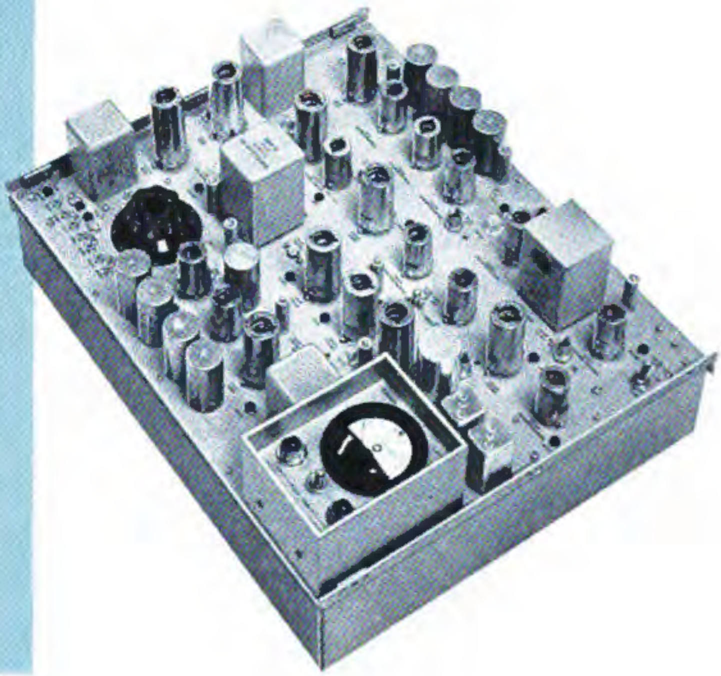

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# Radio Interference

**The Editor discusses a problem of vital interest to all communicators—that of radio interference. National Headquarters, AFCEA, gives full support to the establishment of a Cooperative Interference Committee to control preventable interference.**

SINCE WORLD WAR II, the demands ced on the departments, agencies l committees of Government to l with the problems affecting our ional welfare have been terrific. e ability of Government to make re rapid decisions has become a tter of concern. No longer is it sible for many understaffed gov- mental agencies to produce an- rs in the same time and space fac- to which we were accustomed or to World War II.

Whether Government likes it or t, too often it finds itself getting olved in the investigation of prob- s which could be handled by non- ernmental organizations. This is ticularly true in the field of com- nications and electronics as it re- es to radio interference. The deral Communications Commis- n (FCC), while performing an cient function, cannot possibly p up with the increasing number complaints from geographical as throughout the United States. C accepts the responsibility, it is e, but their staff would need to be ltiplied tenfold if they were to in- stigate and solve each interference e expeditiously. Given time FCC n and does solve this type of prob- n but in the interim, interference ntinues to the discomfort of many.

### *Assistance to FCC*

There's an old cliché that "Govern- nt governs best which governs st." With this thought in mind, the med Forces Communications and ctronics Association has the firm nviction that it can be of substan- l assistance to the FCC in the dio interference field by recom- ending the establishment of Co- erative Interference Committees. ch committees, sponsored by our hapters and working in cooperation th local and state officials, could rform a useful function.

The objective of any communica- ons system is service. The task of gineering a system capable of pro- iding acceptable service is usually not too difficult. In the field of radio communications, admittedly, there are many factors which must be taken into account by the engineer. These include frequency allocations, systems, propagation and site factors. However, there is one very important factor which the design engineer, to a large extent, is unable to control completely and that is spurious interference.

### *Control of Preventable Interference*

Certainly if a communications system is to be effective, it is not only necessary to provide preventive measures but also to take steps to accomplish the rapid detection and elimination of interference. The formulation of treaties and the enactment of laws and regulations are not alone sufficient to insure interference-free communications. This is no small undertaking and in fact has already extended beyond the capabilities of a federally authorized staff.

*The answer is to join hands in a mutual endeavor to control preventable interference. The Cooperative Interference Committee (CIC) idea is a natural development of this concept.* The first such committee was formed in 1954 in the Southern California area. National Headquarters, AFCEA, is proud that the idea was developed initially by two Southern California Chapter members, Ray Meyers and Al Parker. Its purpose was to assist the Federal Communications Commission in the huge task of investigating sources of interference from devices emitting radio frequency energy and assisting in its reduction or elimination whenever practicable or possible. The excellent work begun by this California group is gaining nation-wide recognition.

The Cooperative Interference Committee idea is to create industry-wide cooperative groups in a particular locality or area, and to join together existing user groups to advance the industry-wide concept. In operation, the CIC idea is simple. *Through self-made rules of procedure, interference problems affecting a user are channeled to a solution through the committee or through individual members.*

### *Entire Industry Benefits*

The CIC idea is not limited to mutual interference solutions. A committee can attack a general interference problem. Committee organizations achieve their own flexibility of operation within their own prescribed limitations.

Enthusiastic CIC groups have been established in *nineteen geographical areas* with initial membership up to 185. Many others are in the process of organization at the present time, using the Southern California Committee as a model. The ultimate goal is to establish a committee wherever there is such a concentration of radio users that problems of mutual interference develop.

Experience has demonstrated that interference problems can best be resolved by the concerted effort of those most vitally concerned with obtaining the greatest possible use of the limited channels available for communications. A typical group, having self-interest in the elimination of preventable interference, would consist of the radio users themselves, equipment manufacturers, service organizations, and engineers concerned with radio communications systems. *If such a group solves an interference problem or is able to recommend a course of action that will bring about a solution, the entire industry benefits. It is a case where everyone wins: the radio user, the public, and the Government.*

### *CIC Organization*

Following is a more detailed explanation of the terms of reference for the organization of a Cooperative Interference Committee.

Cooperative Interference Committee is a general term used to describe a group of radio users, manufacturers, and service companies that have joined together for the purpose of resolving radio interference problems with which members are mutually concerned.

Its purpose is to assist industry in the resolution of interference problems. It is an advantage to industry to have an organization through which interference problems can be cleared before the complaint is brought to the attention of the FCC. Individual members of such a group may represent communications systems such as police, forestry, gas or petroleum pipelines, aviation, common carrier operations, industrial, broadcast, government agencies, etc. In addition, representatives of transmitting and receiving equipment manufacturers, service companies, and radio engineers concerned with communications facilities all have a common interest in resolving interference problems through the medium of the Committee. In fact, the membership of one committee may very considerably from another due to the diverse nature of radio operations and interests which exist in different parts of the country. The area of operation may also be dependent upon local conditions. For example, due to concentration of radio facilities, one committee may be confined to a single large metropolitan area such as New York, Chicago, Baltimore, or San Francisco. On the other hand, in less populous areas a single CIC may be organized for a much larger geographical area. The point is, in either case, that the CIC organizational structure must be flexible so as to provide the type of service required in a particular region.

### *Members Make Policy*

It is desired to emphasize that the CIC is an autonomous organization whose sphere of operation is determined entirely by the wishes of the participating members. The FCC is strongly supporting the formation of CIC's wherever they are needed, and their FCC field representatives will assist established committees when called upon. The Commission does not participate in the direction or operation of these committees. The membership of the CIC nominates and elects officers and writes the rules under which the committee will function. There is no limitation on the number of members. It is thus possible for the committee, on its own initiative, to broaden its field of operation beyond the resolution of interference problems so as to include recommendations to the Commission on changes in the rules or suggestions to industry on equipment needs.

### *New Area CIC's*

In addition to the nineteen committees mentioned previously, organizational meetings were scheduled during February for a Portland, Oregon CIC; Orlando, Florida CIC, and an Elmira-Ithaca, New York CIC. Committees at Dallas, Texas; Pittsburgh, Pennsylvania; Syracuse, New York, and for the Twin-Cities area of St. Paul and Minneapolis, Minnesota, are also scheduled for organizational meetings during the early part of 1957.

Mr. Ewell K. Jett, AFCEA member, former FCC Commissioner, and currently a broadcast executive, has been elected chairman of the Baltimore area CIC to serve for one year.

A very successful committee has been in operation at San Juan, Puerto Rico, since April, 1956. During this time the Committee has resolved 20 major cases of interference without the necessity of FCC participation. This Committee is a typical example of the work that is being done or can be accomplished by committees now in being or in process of organization throughout the United States.

### *CIC At Work*

Some typical examples of interference problems which have been successfully resolved by committees are of interest.

Several mobile services operat
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varied from a few seconds to seve
hours. This case was referred to
local CIC by the FCC District Of
and after an investigation, the sou
was found. The interference
traced to a defect in the amplifier
a communications transmitter
censed by the Commission. The
fect was promptly corrected and
case closed.

An airline reported directly to
San Juan CIC that interference
Ponce, Puerto Rico, was compl
ly blocking their radio commu
tions. Interference was found t
sult from current leakage on p
lines due to a growth of trop
moss. The interference was el
nated by the power company by cle
ing power lines near Ponce Airp

A military fighter squadron be
use of a certain ultra high freque
for communications purposes,
aware that this frequency was in
for special flight test transmissi
under a license issued by the F
The co-channel interference was
such severity as to render the ch
useless for flight test pur
Prompt action by a CIC elimin
the interfering signal within appr
mately ten minutes from the time
complaint was received.

In conclusion, National H
quarters of AFCEA would be ple
to receive any comment from
national directors and the ch
presidents, regarding the estab
ment of a Cooperative Interfe
Committee. We believe that the
mation of a committee would
step in the right direction. Also
recommend contacting Ray Me
of the Southern California Cha
AFCEA, for additional inform
and a copy of his Chapter's 1957
brochure. It's worth reading.

* * *

## 1957 CONVENTION SPEAKERS

TUESDAY, MAY 21ST: The banquet speaker, Mr. Donald Clinton Power, will cover items of general and specific interest relating t communications and electronics. Mr. Power is President of the General Telephone Corporation. He is a former educator, a disti guished lawyer and holds a directorship in 22 corporations including six on foreign soil.

WEDNESDAY, MAY 22ND: Industrial luncheon. The Honorable Frank D. Newbury and Mr. James M. Bridges will have some imp tant things to say on research and engineering. Their presentations will be followed by a question and answer period.

THE HONORABLE FRANK D. NEWBURY, Assistant Secretary of Defense for Research and Engineering, will explain the operati of his new office and the relationship of this organization to industry and national defense.

MR. JAMES M. BRIDGES, Director of Electronics in Mr. Newbury's office, will discuss the ever increasing complexity of electronic equipment and systems in military applications. Major emphasis will be given to the critical problems developing in our national defense effort. Among these are included sky rocketing costs for weapon system electronic development and production, unrealizable demands upon scientific and engineering manpower, continually more difficult problems of attaining acceptable reliability, and the extension of weapon system development time cycles. Another important aspect of Mr. Bridges' talk will relate to some of the causes for expensive research and development costs for engineering efforts.

# FICo COMPUTER AND CONTROL SYSTEMS

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- For Processing of Data
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**FICo is one of the foremost organizations** in the United States working in the field of automatic control. Hundreds of engineers and extended precision mass production facilities enable FICo to handle complete systems contracts from start to finish.

FICo engineers and produces the guidance for the Redstone Missile.
*U.S. Army Photo*

FICo navigational equipment goes into a wide range of aircraft.
*U.S. Air Force Photo*

FICo controls are used in the atomic submarine program. FICo is also working toward development of the closed-cycle gas-cooled reactor.
*U.S. Navy Photo*

FICo research and design led to improved safety and arming device for Army atomic cannon.
*U.S. Army Photo*

FICo analog and digital computers can be readily developed and produced—using modular techniques—for special purpose applications.

FICo launching and control order computers are used for Navy A-A missiles.—*U.S. Navy Photo*

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# VISIT THE AFCEA NATIONAL CONVENTIO

**May 20, 21, 22, 1957.**
Monday, Tuesday, Wednesday.

**Washington, D.**
Sheraton-Park Hotel—All under one r

- 103 Exhibitors
- 155 Exhibit Units
- Daily Technical Sessions

- Trip to Naval Research L
- 6 Important Social Eve
- Special Program for Lad

## *This Program means business:*

### Monday, May 20th

8:30 AM—Sheraton Hall
**Opening Breakfast**
9:30 AM— **Official Opening of Exhibits**
10:00 AM—Caribar Room
**Chapter Presidents Conference**
10:00 AM-12:00—Continental Room
**Engineering Papers on Research and Application**
12:30 PM—Sheraton Hall
**Keynote Luncheon**
2:00 PM-5:00 PM—Adams Hamilton Room
**Industrial Movies**
2:30 PM-4:30 PM—Sheraton Hall
**Monitored Panel on Scatter Propagation**
7:00 PM—Continental Room
**Reception**
8:00 PM—Sheraton Hall
**Buffet Supper**

**Exhibits: 9:30 AM—9:00 PM**

### Tuesday, May 21st

9:00 AM—Caribar Room
**Council & Directors Meeting**
10:00 AM-12:00—Continental Room
**Engineering Papers on Research and Application**
12:00 AM—Busses to Naval Research Laboratory
**Embark at hotel, clearance at NRL, lunch, tour, return at 3:30 PM**
2:00 PM-5:00 PM—Adams Hamilton Room
**Industrial Movies**
7:00 PM—Continental Room
**Reception**
8:00 PM—Sheraton Hall—**Banquet**
Speaker: **Donald C. Power,** Pres. Gen. Tel. Corp.

**Exhibits: 9:00 AM—9:00 PM**

### Wednesday, May 22nd

8:00 AM—Caribar Room
**Officers & Directors Breakfast**
10:00 AM-12:00—Continental Room
**Engineering Papers on Research and Applicatio**
12:30 PM—Sheraton Hall
**Industrial Luncheon**
Speakers: **The Hon. Frank** **Newbury,** Asst. Sec'y. De Research & Engineering, a **Mr. James M. Bridges,** rector of Electronics, Office Asst. Sec'y. Def., R. & E.
Question and Answer Peri
2:00 PM-5:00 PM—Adams Hamilton Roo
**Industrial Movies**

**Exhibits: 9:00 AM—5:00 PM**

## *These Technical Papers:*

1. "Rapid Fault Elimination in Complex Electronic Systems," by John F. Scully of Monroe Calculating Machine Company
2. "Single Sideband Receivers," by H. F. Comfort of Radio Corporation of America
3. "Single Sideband Applied to Air-Ground Communications," by E. W. Pappenfus of Collins Radio Company
4. "A Single-Sideband Radio Central to Replace Military Wire Lines," by A. M. Creighton and D. B. Reeves of Motorola, Inc.
5. "The Trend of Facsimile in Military Communications," by A. G. Cooley of Times Facsimile Corporation
6. "Processing, Narrow-Band Transmission, and Remote Display of Radar Data," by Sheldon P. Detwiler of Lewyt Manufacturing Corporation
7. "Multiplexing Circuits in the National Air Defense Communi tions Networks," by J. B. Naugle of Lenkurt Electric Comp
8. "The Air Route Surveillance Radar for U.S.A. Air Traffic Contr by Bruce I. McCaffrey of Raytheon Manufacturing Comp
9. "The Vanguard Launching Vehicle Instrumentation System," Vernon J. Crouse, Jr., of The Martin Company
10. "Results of a Simple Technique for Handling Complex Micro Circuits," by Alexander Horvath of Sylvania Electric Prod Company
11. "A Fully Automatic Teletypewriter Distribution System," by R. Stiles and L. Johnston of Automatic Electric Company
12. "Some Aspects of Telegraphic Data Preparation and Trans sion," by W. B. Blanton of Western Union Telegraph Comp

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AFCEA at Boston 1956

Mrs. Mary D. Burke, winner of the 1956 General Electric Edison Award, is pictured here receiving a trophy from Mr. L. B. Davis, General Manager, Electronic Components Div., General Electric Co. Looking on are, right, RAdm. H. C. Bruton, USN, Director of Naval Communications and, left, Mr. Conan W. B. Barger, Mgr., Trans-Continental Relay Network, nominator of Mrs. Burke.

# Edison Award 1956

THE 1956 GENERAL ELECTRIC dison Radio Amateur Award for ublic service was presented to Mrs. Mary (Mae) Burke, W3CUL, on February 28, 1957.

Mrs. Burke, a 45-year-old housewife from Morton, Pa., the first woman radio amateur to win, handles 000 radio messages a month for ervicemen overseas. Her husband, Alfred, who accompanied her to Washington, D. C. for the award, aught her amateur radio and now maintains her radio equipment, which runs almost continuously. Mrs. Burke was chosen from a total of 50 amateurs nominated for this "Ham of the Year" award.

## *Industry and Military Attend*

Approximately one-hundred people attended the banquet, held in the East Room of the Mayflower Hotel in Washington, D. C. Rear Admiral H. C. Bruton, USN, Chief of Naval Communications and Vice President of AFCEA, gave the principal address. Dr. W. R. G. Baker, General Electric Vice-President and a National Director of AFCEA, served as toastmaster. The trophy and a check for $500 were presented to Mrs. Burke by L. Berkley Davis, General Manager of the G-E Electronic Components Division, which sponsors the annual award. Also attending the banquet were George Bailey, past National President of AFCEA, and Thomas B. Jacocks, General Electric's Washington representative and former President of the Washington Chapter of AFCEA. Members of the press were present as well as industrial and military representatives.

Admiral Bruton, during his address, spoke of Mrs. Burke as ". . . a highly dependable, able, and effective communicator. She has faced the finest kind of competition and has been declared the amateur radio operator who performed the most outstanding public service in the Nation during 1956. I extend to her my warm, personal congratulations."

## *Contributions of Radio Amateurs*

Admiral Bruton went on to say: "The accomplishments of radio amateurs in many fields of public service are well known. These include emergency communications in time of floods, hurricanes and other disasters, provided by such amateur organizations as the American Radio Relay League Emergency Corps, the Radio Amateur Civil Emergency Service, as well as by many individual amateurs. The fine service provided by many radio amateurs in connecting phone patches and in handling messages for members of all our Armed Forces and their families, represents a contribution to morale so great it is difficult to measure. It is, of course, in this important field of public service that we of the Armed Forces are so grateful to Mrs. Burke for her splendid performance.

"But I would like to speak briefly of another vital contribution by the radio amateur to public service, i.e., that of active service in our Armed Forces. The record here is impressive. Of the 6000 radio amateurs in the United States in 1917, approximately two-thirds served in our Armed Forces during World War I. More than 25,000 radio amateurs saw active military service in World War II. Large numbers serve today on active military duty; thousands more are affiliated with our inactive reserve forces.

". . . Because of the importance the Armed Forces place upon amateur radio, the military services are steadfast in their encouragement and support of its operation. There are hundreds of U.S. military-sponsored radio amateur stations throughout the world. . . . The U. S. military services also lend strong support to amateur radio in obtaining and retaining radio frequencies, the life blood of amateur operation. As many of you know, at all of the international radio conferences held during the past 30 years, the United States delegation has played consistently a leading role in the protection and acquisition of spectrum space for amateur service . . . firm action must continue to be exercised in the preservation and provision of spectrum space for the radio amateur. I might add that the Joint Communication-Electronics Committee of the Joint Chiefs of Staff organization is well aware of this important consideration.

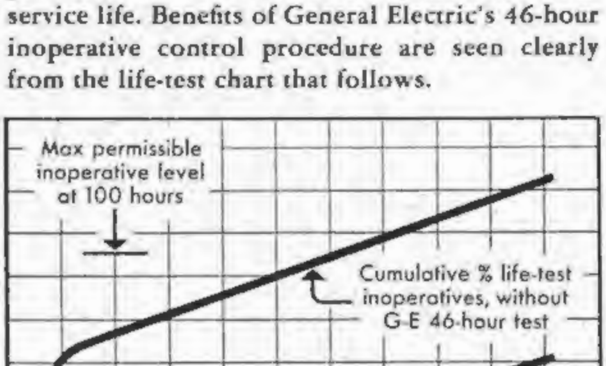
## *Ideals of the ARRL*

"No discussion of amateur radio is complete without mention of the American Radio Relay League, or ARRL, which is virtually synonymous with amateur radio itself in this country. It stands for the maintenance of fraternalism and high standards of conduct, a cooperative loyalty to the traditions of amateur radio, a dedication to its ideals and principles, so that the institution of amateur radio may continue to operate in the best public interest."

General Electric technician checks 5-Star Tubes on special 46-hour inoperative control test designed to reduce early-life failures. His lint-free, white Nylon garb marks this process as part of Operation Snow White—General Electric's all-out program to exclude from 5-Star Tubes any impurities that can cause short circuits or impair electrical efficiency.

# Special G-E 46-hour inoperative control cuts 5-Star Tube failure rate, assures top dependability!

To weed out early-life failures, General Electric operates *all* 5-Star Tubes for 46 hours *prior to* final life testing and shipment. This special G-E procedure joins with impurity-free Snow White tube production to increase reliability and assure full service life. Benefits of General Electric's 46-hour inoperative control procedure are seen clearly from the life-test chart that follows.



Note that the inoperatives in any lot of 5-Star Tubes on life test are only half as many, at 500 hours, as they would be without G-E inoperative control. Furthermore, at 500 hours, the percentage of inoperatives is still far below the permissible figure established for 100 hours.

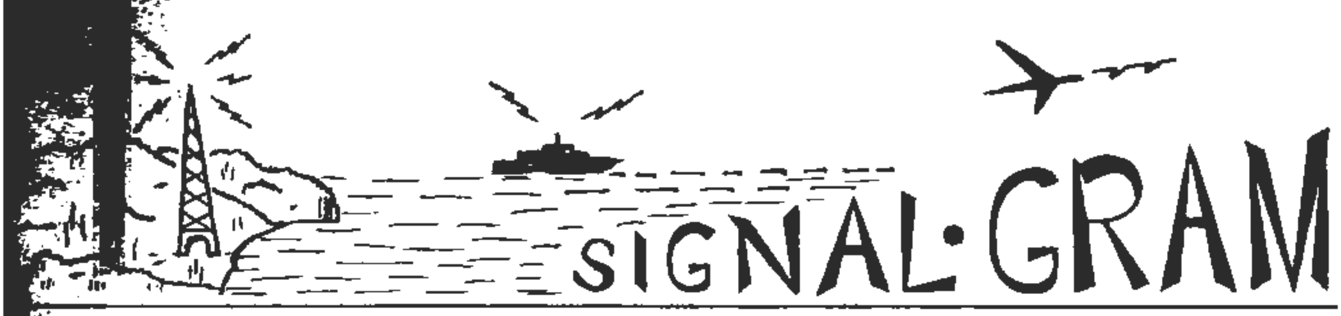
46-hour inoperative control procedure helps make General Electric 5-Star Tubes the most reliable you can install. Added to special rugged design, Snow White cleanliness in manufacture, and rigid, extensive tests, this special G-E procedure further minimizes tube failure possibility and safeguards electrical performance.

Specify G-E high-reliability 5-Star Tubes when ordering new military electronic equipment! Use them as replacements! *Electronic Components Division, General Electric Company, Schenectady 5, N. Y.*

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

194-142



# SIGNAL·GRAM

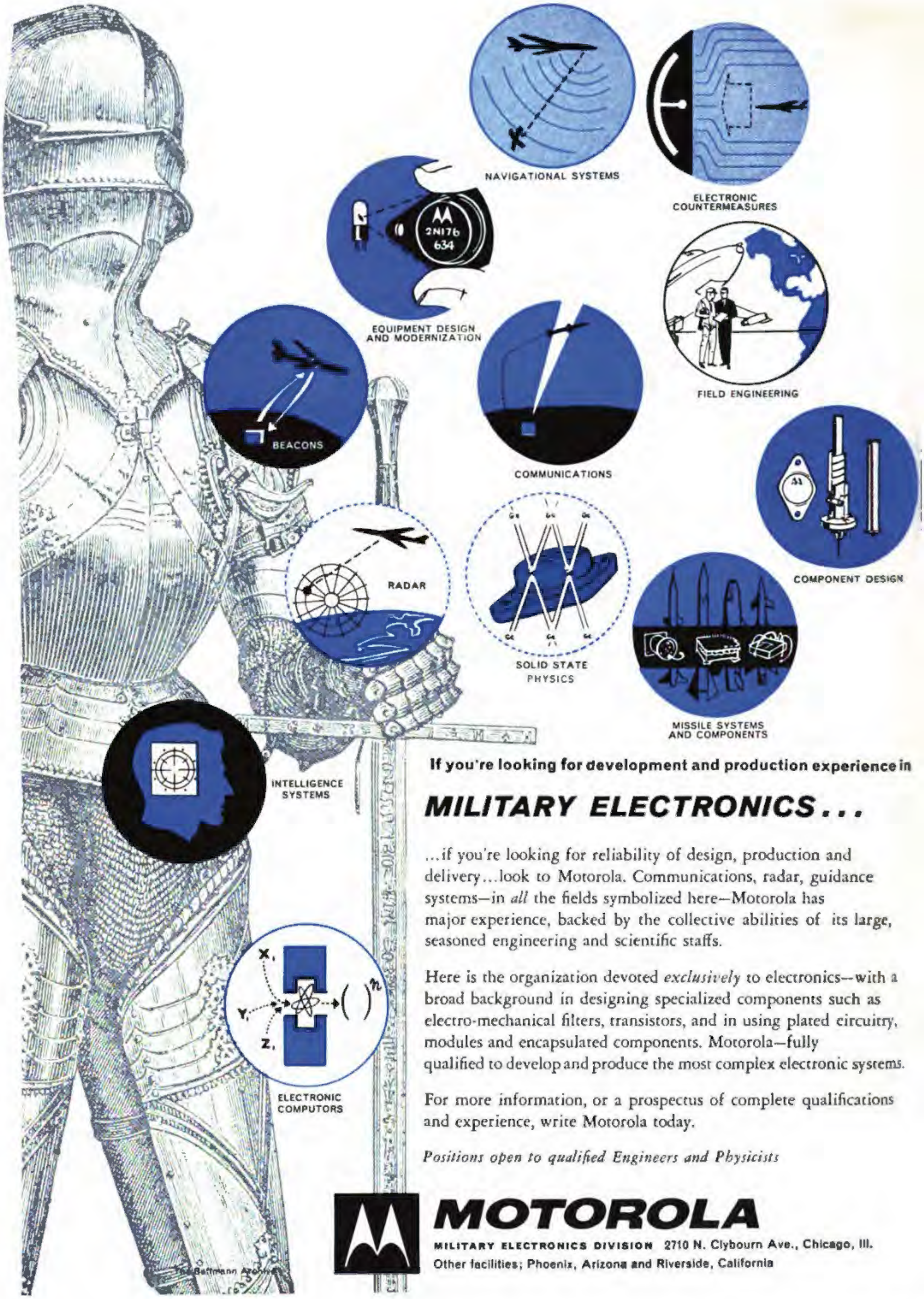
## — GOVERNMENT —

ELECTRONIC DATA PROCESSING NETWORK Keeping close control of over a million of Army equipment, from tanks to transistors, is one of the problems facing ay's modern United States Army. To relieve this problem, the Army Signal Corps d the Long Lines Department of the American Telephone and Telegraph Co. are now perating a new electronic data processing network, designed to speed up the flow of pplies and keep stockpiling to a minimum. The system, named Continental United ates—Data Transceiver Switching Network (CONUS-DTSN), works in the following way. lephone lines connect switching centers in five key cities. Interconnected to ese centers are 33 military installations. Data transceivers of the International siness Machines Corp. are used to exchange information on punched cards between all twork points. Cards punched at one end of a circuit can be duplicated rapidly at other end using communications lines. An estimated million such transactions can handled daily. Overall efficiency and reduction of the time required to process transmit information will bring about great savings for the Army. Studies are er way to determine how CONUS-DTSN can be utilized to ease the transition from ace to war in an emergency.

ACTOR VESSEL PLACED IN ARMY PACKAGE POWER PLANT A 15-ton cylindrical pressure vessel, which will contain the nuclear fuel in the Army Package Power Reactor, was set in the plant recently by construction workers at the Corps of Engineer's Research and Development Laboratories, Fort Belvoir, Virginia. The reactor core, containing highly enriched uranium (which contains a greater concentration of fissionable uranium-235 than natural uranium), is now being fabricated at the Atomic Energy Commission's National Laboratory, Tennessee. The plant is a prototype of "package" power reactors being developed for use at remote bases to eliminate the need of transporting bulky conventional fuels. It will produce 2000 kws of electricity.

NUCLEAR-POWERED GUIDED-MISSILE CRUISER NAMED LONG BEACH A new cruiser, scheduled for completion in late 1960, will bear the name LONG BEACH, the Navy announced recently. She will be the first surface ship to be armed with a "main battery" of guided missiles and powered with a nuclear power plant. Her nuclear reactors will be constructed by the Westinghouse Electric Corp., and her main propulsion machinery by the West Lynn, Mass., plant of G. E. The LONG BEACH will be a twin-screw ship capable of carrying, servicing, and firing the most advanced and effective guided missiles.

CONTRACT AWARDS The following contracts have been awarded by the AIR FORCE: Glenn L. Martin Co., $13,995,100, for TM-61B Matador missile; Bendix Products division of Bendix Aviation Corp., $1,016,468, for brake assemblies, spare parts and data to be produced at South Bend, Ind.; Cessna Aircraft Co., $4,500,000, for Boeing B-52; Grumman Aircraft Engineer Corp., $9,743,522, for inspection and repairs to rescue plane, Albatross; Lear, Inc., $3,961,850, for automatic flight control systems, spare parts for Boeing KC-135 jet tanker-transport; Sperry Gyroscope Co., $2,727,517, for APN-59 radar sets; General Electric's Light Military Electronic Equipment Department, $20 million, for production of airborne electronic countermeasures equipment; General Electric Co.'s Evendale, Ohio plant, $53,141,557, for production of J-79 jet engines; General Precision Laboratory Inc., 2 contracts totaling $4 million, for manufacture of electronic control amplifiers and research and development work on advanced airborne navigation systems. NAVY contracts awarded include: Westinghouse Electric Corp., $8,170,060, to manufacture main steam propulsion machinery for a planned nuclear-powered aircraft carrier; Mack Electronics Devices, Inc., $2,335, 328, receiver-transmitter electronic equipment; Bendix Aviation Corp., $1,985,802, to modify the brakes on F-100 Sabre aircraft; $1,810,144 for brake parts for B-25 and B-26 aircraft; General Electric Co., $1,837,962 for electronic test equipment; Northern Ordnance, Inc., 2 contracts totaling $9,500,000, for armament for guided missile ships; General Electric Co., $4,000,000, nuclear cruiser machinery. *(continued)*



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**MILITARY ELECTRONICS DIVISION** 2710 N. Clybourn Ave., Chicago, Ill.
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NAVY SHIPS HAVE LEFT ANTARCTIC FOR HOME BASES Deep Freeze II units in the antarctic recently teemed with activity as the ships and men of TF-43 prepared for departure on their homeward journey from the south polar region. A 100-percent effective air-drop of 10 tons of supplies and equipment was made Feb. 15, 1957, to the IGY party stationed at the South Pole by C-124's. Four dozen fresh eggs landed without a crack. The wintering-over parties, well quartered, provisioned and possessing the latest in modern scientific equipment, have turned to the tasks of living and conducting research for the International Geophysical Year. All are volunteers and cut off from the outside world by everything but radio.

CREVASSE DETECTOR Army Engineers have developed a device that locates crevasses —the constant fear of expeditionary forces in Arctic and Antarctic regions. The unit creates a low frequency electromagnetic field which is distorted by the presence of a crevasse. Basically, the device consists of 4 "electrodes" placed at 20-foot intervals on disc-shaped sleds and towed by an over-snow vehicle called the Weasel. When the search-head reaches a crevasse, the dielectric difference in the air in the crevasse and the surrounding area causes a noticeable change in the meter recording.

NEWBURY MADE HEAD OF NEW OFFICE Announcement has been made of the combination of the Offices of Assistant Secretary of Defense for Research and Development and Assistant Secretary of Defense for Engineering. The Honorable Frank D. Newbury, principal speaker at the Industrial Luncheon of the AFCEA May Convention, has been named to fill the new position designated as Assistant Secretary of Defense for Research and Engineering. This combination of the two units is designed to strengthen the U. S. defense technical effort.

## — INDUSTRY —

SUPERSONIC MISSILES FOR SUBMARINES The Firestone Tire & Rubber Co. has undertaken a program to design, build, test and install a guided missile launching system for U. S. Navy submarines. The launching system is for the Regulus, the 30-foot long, seven-ton, surface-to-surface, jet-powered missile which is capable of carrying an atomic warhead. Company experts believe that this new launching system will extend the Navy's submarine capabilities into the realm of supersonic missiles of tremendous strategic importance.

AN EYE THAT HEARS An "eye" that "hears" quick as a wink is now being used to detect and eliminate interference in the radar, communication and navigation systems of newly-built jet fighter-bombers. The new device, a "radio frequency spectroscope," was developed at Republic Aviation Corporation, and it reduces to half a day the three or more days it has taken to check aircraft electronic equipment on the production line. This check is to make certain that a pilot will be able to hear his radio clearly or that there is no electrical interference with the operation of his radar equipment. Basically, it is a hypersensitive radio set that is plugged into an aircraft's antenna. When an unwanted sound is detected, the set immediately changes it into a wavering line that can be seen on the glass "eye" of the listening device. Company electronic experts are then able to determine the source of the interference and eliminate it before the ship is released to the Air Force.

CHANNEL GUARD In the mobile radio field, General Electric Co. has announced a new tone squelch system designed to relieve two way radio users of the necessity of listening to transmissions of other operators sharing the same channel. It embodies a double-barrelled approach which combines the advantages of both tone squelch and conventional noise squelch. Channel Guard imposes continuous tone on normal squelch to assure a greater degree of privacy in communications than has been previously possible. The system makes it possible for mobile radio users to turn a "deaf" ear to on-channel interference by locking out all signals except those from their own transmitters, which are tone-coded for positive recognition by receivers equipped with the new device.

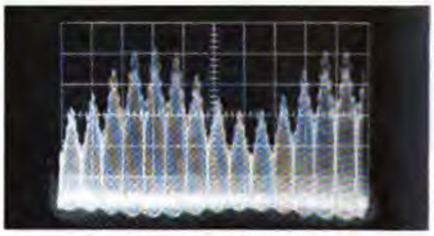
CLOSED-CIRCUIT TV SAVES TIME IN INDUSTRY A closed-circuit television camera, twice the size of a cigar box, is helping to relieve the critical shortage of skilled technicians and to reduce development time of jet engine control systems at the General Electric Company's Flight Propulsion Laboratory Department, Syracuse, N. Y. The TV camera, strategically placed in a controls laboratory, picks up hydraulic-control test data emanating from a computer and immediately pipes it via coaxial cable to an equipment testing engineer some 200 feet distant in another laboratory. The information is received on a monitor similar in appearance to a home TV receiver. G-E test engineers say the new method eliminates the need for two-way phone communications formerly required.

(continued)

## Hoffman Beacon Simulator bench tests TACAN-VORTAC for all-weather flying safety

The Hoffman-developed HLI-103 Beacon Simulator provides a sure, safe way to ground test airborne TACAN—and the TACAN portion of VORTAC. It duplicates the functions of a TACAN Land Beacon (AN/URN-3) and tests airborne units (AN/ARN-21) for azimuth from 0 to 360° with a ±0.2° accuracy or better, and range from 0 to 200 nautical miles with a ±0.1 mile accuracy or better. The Hoffman Beacon Simulator also tests the AN/ARN-21 at instrument airspeed from 0 to 1500 knots, land beacon identity tone and decoding functions—even simulates adverse weather conditions to assure complete operational reliability.

Hoffman TACAN-VORTAC test instruments, now used by the military services, are also available to aircraft manufacturers, commercial airlines and service operators to provide a vital, extra measure of flying safety for air navigation equipment *from the ground up.* Additional information will be promptly sent upon request.



Hoffman HLI-103 simulates the functions of TACAN Land Beacons. Photo shows 135 cps and 15 cps pulse burst detail. Phase relationships indicate surface beacon is due east of aircraft. Comparison of input settings with TACAN dial readings determines operational accuracy.

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Significant developments at Hoffman in the fields of TACAN, VORTAC, advanced navigation techniques, VLF, HF, VHF, UHF, forward scatter and tropospheric communications and advanced ECM have created important positions for physicists and engineers of high calibre. Please address inquiries to Vice-President of Engineering.

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***GNALGRAM------***

EW 'RADIOMARINE' RADAR FOR PASSENGER LINERS A high-definition "Radiomarine" radar ystem, recently developed by RCA, has been purchased and installed aboard passenger iners SS Independence and SS Constitution, to complement RCA "Radiomarine" radar quipment already on the two ships. The new radar provides six ranges, from one ile to 40 miles, and produces sharp clear pictures of ocean activity on a 16-inch iameter, cathode-ray indicator scope. The new type 12-foot, low-wind-resistance lotted antenna makes possible a narrow beam width of only .65 degrees, providing xtremely sharp bearing resolution for navigation in congested waters.

ESTERN UNION INSTALLS TICKETFAX The first Ticketfax system in New York has been nstalled for the Pennsylvania Railroad at Pennsylvania Station, serving New York, renton, Newark and Philadelphia. Ticketfax flashes Pullman and reserved-seat coach ickets in facsimile "picture" form in seconds, from the ticket bureau to customers t the counters of railroad stations. Now it is possible also for railroad cus-omers in the New York area to obtain tickets and reservations by direct facsimile ransmission from Pennsylvania Station without leaving their offices. Questions bout train departure and arrival times, connections and other travel problems also low over the facsimile system between the railroad and its customers.

AYTHEON SUPER-SLEUTH Guided missiles, radars and other defense weapons will be ore reliable in action because of a super-sleuth with x-ray vision now used by aytheon Manufacturing Co. to check special electron tubes going into these devices. he sleuth photographs up to 18,000 subminiature tubes per day and ferrets out flaws idden from the human eye which some day may cause that tube and the weapon using it o fail. It probes each midget tube from three different angles, revealing its innermost structural secrets. The x-rays peer through the tube's 30 or more delicate parts cramped into a space only one inch long and a quarter-inch round.

LECTRONIC SYSTEMS IN TELEPHONES Laboratoire Central de Telecommunications, the French research associate of International Telephone and Telegraph Corp., has recently developed and made practical fully-electronic automatic switching equipment, and a 20-line exchange for the French Navy. In the equipment, the automatic interconnection among 20 subscribers, and the supply of tones and ringing equipment, are carried out by static electronic components; all mechanical movements and metallic contacts are eliminated, and are replaced by magnetic cores that can assume two different conditions, which allow or impede the flow of electrons through semiconductor elements.

'AMPLITRON" TUBE BEEFS UP RADARS Military secrecy has been lifted from a new electron tube called an "amplitron." Developed by the Raytheon Mfg. Co., Waltham, Mass., the new tube effectively "beefs up" the radar's performance by amplifying or boosting the energy output of the basic signal as much as 8 to 14 times. When added to the air traffic control radars now being built by Raytheon for the Civil Aeronautics Administration, the effective range of these sets will be increased from 200 miles to about 350. The tube is extremely valuable for use against enemy electronic jamming and as a navigational aid for military and commercial aviation.

SPERRY TO PRODUCE DEVICES FOR OUTER-SPACE High-precision missile devices, instrumental in harnessing the tremendous energy released by the new "exotic" fuels, will be developed and produced by Sperry Gyroscope Company's Air Armament Division. Currently used as guided missile propellants, such solid and liquid fuels hold great promise for tiny, self-driven, precision instruments. Solid propellants are nonradioective and basically stable when used in such instruments and may be safely machined, drilled and handled. If ignited with a match under room conditions, they will burn like a cigarette; when fired in a suitably enclosed container, enormous amounts of energy can be obtained instantly.

NEW RCA RADAR DEVELOPMENT A new instrumentation radar system which for the first time makes possible direct calibration and immediate evaluation of the performance and behavior pattern of guided missiles has been developed by Radio Corporation of America. It is capable of tracking with accuracy over extended ranges, in darkness, through clouds, and under any atmospheric conditions, to yield data that can be reduced almost instantly to final form.

INDUSTRY ADVISORY CONFERENCE The Mayflower Hotel, Washington, D. C., was recently the scene of the Industry Advisory Conference on Electronic Information. Lynn J. Bartlett, Jr., president of Information for Industry and sponsor of the Conference, summarized its action and decisions. Other major subjects discussed included the format and content of IFI's 1956 Uniterm Service to U.S. Electronics Patents, the possible expansion of the new edition to cover proceedings and activities of professional electronics and related societies, and the desirability of back-indexing U.S. Electronics Patents issued during 1950-1954.

(*continued*)

**EARLY TELETYPEWRITER**

**TELETYPE MODEL 28 PRINTER**

# 50 years that changed the picture

The need for a reliable printing telegraph instrument that would provide a typed record of the message for both sender and receiver brought the company now known as the Teletype Corporation into the picture in 1907. From the halting performance of the original page printer to the smooth 100 words per minute of today's precision equipment has been a major step in communications.

But today Teletype equipment is often far more than a communication instrument. It is a basic element in production control systems . . . its ability to transmit and reproduce text and punched tape is harnessed to office automation . . . it provides a "conveyor system" for channeling complex raw data to a computing center thousands of miles away — and getting the answers back in a twinkling.

Indeed, Teletype machines have made many of the dreams of 1907 a daily part of today's business world. And the horizons widen daily as new dreams occupy our engineers and keep our laboratories humming.

If you would like a copy of our booklet, "The ABC's of Teletype Equipment," write to Teletype Corporation, Dept. S-4, 4100 Fullerton Ave., Chicago 39, Illinois.

*1957 Golden Anniversary Year*

TELETYPE

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NEL DONKIN JOINS PAGE Page Communications Engineers, Inc. has announced the intment of Colonel Forrest W. Donkin, USAF, formerly Deputy Commander of the Airways Communications System (AACS), as Vice President and Director of Operas, Western Division. The firm's Operations Department has been expanded into ern and Western Divisions. The Western Division covers all PCE projects in the fic and Asian areas. Colonel Donkin is an AFCEA member.

POST FOR FREEMAN James M. Freeman, News Service Manager for American Telephone Telegraph Co. in Washington, has been appointed Assistant Vice-President, Public tions, of the Michigan Bell Telephone Co. in Detroit. Mr. Freeman took up his assignment in March. He is succeeded by Philip D. Taylor, formerly Assistant -President, Public Relations at Indiana Bell.

POSITION FOR GENERAL COLLINS Appointment of General Samuel Pickens (Pick) lins as Manager, Operations of Army and Non-Military Services, Government Service rtment, RCA Service Co., Inc., was announced recently. General Collins, who red in 1956, has an extensive background in communications. He received his t amateur radio "ham" license in 1920, and much of his Army service was spent in ious Signal Corps activities. At the time of his retirement, he was serving as ef of the Army Security Agency. He is a graduate of the United States Military demy, Class of 1926, and a member of the AFCEA.

APPOINTMENT FOR EWING Dr. Douglas H. Ewing, Vice-President, RCA Laboratories, been named Vice-President, Research and Engineering, of the Radio Corporation of rica. Dr. Ewing will be responsible in his new position for RCA's laboratories engineering services and will have his headquarters at the David Sarnoff Rerch Center, Princeton, New Jersey. Dr. Ewing joined RCA in 1945 as manager of Teleran Engineering Section of the RCA Victor Division. From 1949 to 1951, he granted a leave of absence from the company to serve on the Air Navigation elopment Board in Washington. Returning in 1951, he became Director of Research vices of the RCA Laboratories. Subsequently he served as Director of the Physi and Chemical Research Laboratory and as Administrative Director, RCA Laboraies, until his appointment as Vice-President of those labortories in 1955. He is ember of the AFCEA.

## — GENERAL —

FFIC CONTROL Effective use of closed-circuit television in traffic control may the answer to choking traffic problems now faced by most American cities. This the way such a system could be coordinated from a centralized traffic-control eau as described recently by a G-E electronics expert: Closed circuit TV cameras ld be strategically located along busy cross-city intersections and each camera ld be focused on a system of mirrors at the intersection. The mirrors, in turn, ld afford a view of traffic flow from all four directions of the intersection. a system of measured stadia or graduated marks on each mirror, the distance of affic from the mirror could be calculated. A traffic coordinator, seated in front a bank of television monitors at a central traffic bureau, could thus view affic conditions at any number of intersections.

GH SPEED PHENOMENA DEVICES What would happen if a meteor struck a guided missile an airplane traveling in the upper atmosphere? A device that will enable the Air rce to study this and other high-speed phenomena is being investigated by scitists at Armour Research Foundation of Illinois Institute of Technology. The Air rce Office of Scientific Research has contracted the Foundation to investigate the plication of electromagnetic principles to the design of a high velocity linear celerator.

LL TO AID EDUCATION Aimed at easing the shortage of technical and scientific rsonnel in the U. S., Senator Warren Magnuson (D., Wash.) has introduced a measure ich would set up a $250 million revolving fund against which young men and women anning careers in engineering, science, teaching and medicine, could borrow up to 50 a year or $5,000 for an entire college career.

ATIONAL CONFERENCE ON AERONAUTICAL ELECTRONICS Dayton, Ohio, will be the scene, on ay 13, 14, 15, 1957, of the Ninth Annual National Conference on Aeronautical Elecronics, which will be co-sponsored by the Institute of Radio Engineers, Dayton hapter. The keynote is "ELECTRONICS, the Key to Aviation's Future," and Paper utoriums will be held about such subjects as Navigation, Communication, Electronic quipment and Environment, in which everyone may participate. Principals in a orum on the subject of "New Ideas in Airborne Electronics" will be H. Leslie Hoffan, president of Hoffman Electronics, and RAdm. Rawson E. Bennett, Chief of Naval esearch.

# A Reunion And An Award

*The Veteran Wireless Operators Association presents the Armed Forces Communications and Electronics Association an award for ten years of service in the Communications-Electronics field.*

The presentation of the Lee De Forest Commemorative Plaque was made by Mr. William McGonigle (right), President of the VWOA. On the left is Brig. General David Sarnoff, Chairman of the Board of Directors, RCA, who was a guest speaker at the banquet. George W. Bailey, former National President of the AFCEA, received the award for the AFCEA.

On February 21, 1957, the Veteran Wireless Operators Association assembled in New York and united in celebrating the thirty-second anniversary of their founding. Mr. William McGonigle, president of VWOA and toastmaster for the occasion, arranged for a social event long to be remembered.

It is interesting to note that the purpose of the VWOA is to foster and extend an "esprit de corps" among wireless operators. It promotes a fraternal and comradely sentiment among its members and recognizes meritorious service rendered by wireless operators on land, at sea, or in the air, by the erection of memorials and by the bestowal of testimonials, medals, scholarships, or other suitable awards. Also, the VWOA functions to acquaint the public with the work, traditions and ideals of wireless operators, and to perform and encourage any other purely fraternal activities [illegible] helpful to the wireless profession.

Since the inception of this organization, awards have been made to the most deserving based on achievement, code proficiency, commemoration, history, honor, merit, pioneering, service and valor.

Since the very beginning of the Armed Forces Communications and Electronics Association, we have believed that the overall principle of inseparability of the civilian-military team would be the essential cornerstone in our efforts to build for the economic future and the military strength of our United States.

In this age of prolonged international tension, social revolution and industrial revolution, struggle for power and leadership may be long and costly but well worth the effort if we are to fulfill our national objectives of peace on earth without damage to our American way of life. Therefore, the cementing and promotion of the civilian-military team concept becomes ever increasingly meaningful. The AFCEA, since its foundation in 1946, has through its magazine, Signal, consistently covered the technological advances, new developments, and requirements in the fields of communications, electronics and photography. By so doing, Signal has been the contact between, and a strong supporter of, our industrial and military establishments.

Being a patriotic, scientific and non-political organization, it has bridged the gap for information— information which has been beneficial to our industrial development and economic growth and to the strengthening of our national security.

### *Recognition for Service*

In recognition of the part which the AFCEA has played in keeping with the above-mentioned objective, the Veteran Wireless Operators Association, in conjunction with its 32nd Annual Dinner Cruise, Hotel Sheraton-Astor, New York, on Thursday, February 21, 1957, presented the Association with a plaque. The presentation was made by Mr. William J. McGonigle, President, in acknowledgement of a decade of meritorious service in the fields of communications and electronics. Mr. George W. Bailey, a past National President of AFCEA and a member of its Executive Committee, received the plaque in the absence of Colonel Percy G. Black, National Presi-

*Electronic News*

**Honored guests at the 32nd Annual Veteran Wireless Operators Association Dinner held at the Sheraton-Astor are: (Seated) Col. W. J. Baird, Editor, SIGNAL; Raymond F. Guy, National Broadcasting Co.; Charles A. Rice, United Electronics Co.; E. H. Rietzke, Capitol Radio Engineering Institute; Maj. Gen. James D. O'Connell, Chief Signal Officer, U. S. Army; Brig. Gen. David Sarnoff, Chairman of the Board of RCA, who received the first Lee De Forest Gold Medal; William J. McGonigle, N. Y. Telephone Co., and George W. Bailey, Executive Secretary, Institute of Radio Engineers. (Standing): Thompson H. Mitchell, RCA Communications, Inc.; Maj. Gen. Robert E. Condon, Director of N. Y. Civil Defense; H. T. Hylkema, Radio Holland, Amsterdam; E. N. Pickerill, RCA (retired); A. J. Costigan, RCA Communications, Inc.; Captain Lawver, 3rd Naval District, N. Y.; Thomas P. Seward, 3d, Malverne, N. Y. high school student who was presented with the first Lee De Forest Scholarship; Emery H. Lee, Federal Communications Commission and J. R. Poppele, Voice of America.**

dent of the Armed Forces Communications and Electronics Association, who was unable to attend because of illness.

Highlighting the events of the evening was an address by Dr. Lee De Forest, affectionately known as "Doc" by his many friends. Dr. De Forest spoke from California and his message was relayed over long-lines to the banquet hall where the gathering of three hundred members of the VWOA listened attentively and applauded his stimulating address loudly. Among the many inspiring remarks made by Dr. De Forest was the following tribute to the Armed Forces Communications and Electronics Association:

> "I salute the American Armed Forces afoot, afloat, and in the air, for bringing about the rapid development of the electronics industry; from its crudest beginnings of wireless to the modern miracles of radar, sonar, and guided missiles.
>
> "It is therefore my pride and pleasure to know that the Veteran Wireless Operators Association is presenting a Lee De Forest Commemorative Award to the Armed Forces Communications and Electronics Association. I can wish you no greater honor than that AFCEA continues to expand, to keep apace with the almost inconceivable progress of the Art, the Service, and the Industry known today as 'Electronics.' "

### *Other Presentations*

Another highlight of the evening was a down-to-earth talk given by General David Sarnoff, past National President and a present Director of AFCEA, and the presentation to him by president McGonigle of the first Lee De Forest Gold Medal. The award was made for 50 years of outstanding accomplishments and service in the fields of wireless, communications, and electronics. Also honored at the dinner were Major General James D. O'Connell, Chief Signal Officer of the Army and Rear Admiral H. C. Bruton, Director of Naval Communications. Both of these distinguished military leaders received certificates awarding them honorary membership in the VWOA. Other members of the AFCEA who have been honored in the past and both of whom are past presidents were George W. Bailey and Rear Admiral Joseph R. Redman USN, (Ret.).

**Brig. Gen. David Sarnoff receives the first Lee De Forest Gold Medal from William McGonigle as Maj. Gen. James O'Connell looks on.**

**Major General James D. O'Connell is awarded an honorary certificate for membership in VWOA by President William J. McGonigle.**

# Mobilization Readiness

# 1957

*by Paul A. Longo*

**Chief, Planning Division**
**New York Chemical Procurement District**
**U. S. Army**

THE CURRENT WORLD SITUATION necessitates the maintenance of a strong U.S. Military Force consistent with our national economy. Thus, military preparedness must include industrial readiness as an integral part of defense mobilization.

The United States Government has developed a mobilization plan which establishes the industrial base and furnishes logistic support for the operational readiness of the Army, Navy, and Air Force. The Government wartime organization and necessary controls have been predetermined and are in standby for immediate implementation. Proclamations have been written. The Nation could be under control within twenty-four hours if total war should break out. This will insure the most effective use of the Nation's resources geared to a wartime economy. The Office of Defense Mobilization, the top Government Agency responsible for this phase of the Planning Program, has promulgated the necessary wartime controls.

Standby legislation is in the books ready to be invoked incident to any emergency. For example, the Defense Production Act provides the legislative authority for the application of priorities and allocation powers. Civilian control agencies are in being which can readily be expanded to cope with increased wartime procurement.

### *Ultimate Objective*

The ultimate objective of today's plan is to have sufficient material in stock and provide immediate production from tooled-up facilities or arsenals to support a major conflict in the first stages of war. To produce the weapons of war, roughly fifty-five percent of the national economy will have to be diverted from civilian to military production on M-Day.

The military planning program of today is dynamic. It must keep pace with the changing concepts of war and the rapid advances in technology and design. Hence the planning, of necessity, is directly concerned with the operational plant and product level.

### *Three Essential Elements*

Practical production engineering is applied to assure a realistic industrial base to the Services. For example, three essential elements must be taken into account: 1) production, 2) inspection, 3) packaging and preservation. Concentration in any one of these fields without considering the other two can be disastrous. Production may satisfy requirements, but if quality is sacrificed for quantity the items may be useless to the troops in the field. For example, consider the waste of human and material resources that are sacrificed if the items produced do not function because of sub-standard quality. When the element of inspection is overlooked or subordinated, the enemy finds itself with an unexpected ally. Such was the situation in World War II when in the Pacific our torpedoes failed to explode time and time again.

Consider, also, the waste of materials and dollar losses when the end product, although complying with specification requirements and inspection standards, is destroyed or deteriorated due to faulty packaging or inferior preservation. The cost to the United States during World War II ran into the millions of dollars, particularly in the Pacific Theatre. Therefore, production, inspection, and packaging must be considered as integral parts of the production plan. Planning military production must be practical and realistic and it must parallel industry planning for commercial production. To do this, a detailed technical review is made of the drawings and specifications for items to be produced. These must be completely definitive to be adequate for mass production. The technical review establishes the tooling requirements for the job to be done.

In computing the manufacturing rate, the lead time necessary to get into production is a primary consideration. The production losses resulting from uncoordinated lead time cause materiel deficits during the critical first year of war. Since the time-scheduling of requirements is congruent with the war plans of the Joint Chiefs of Staff, the lead time production losses cannot be made up. Therefore, aggressive production planning must be continued. Machinery is set in motion for action by the Military Services to minimize or eliminate the production deficits.

### *Avenues For Military Planning*

What avenues are open to the military planner to eliminate critical shortages? There are several, and each is based upon the specific cause for the loss in time. For example, a facility would not be expected to have on hand special tooling peculiar to the manufacture of a mechanized flamethrower. This tooling would consume approximately 12 months of valuable time to fabricate during an emergency. The Service, therefore, must acquire these tools and place them in long term storage at an arsenal or the facility designated for the manufacture of the end item.

(*Continued on page* 24)

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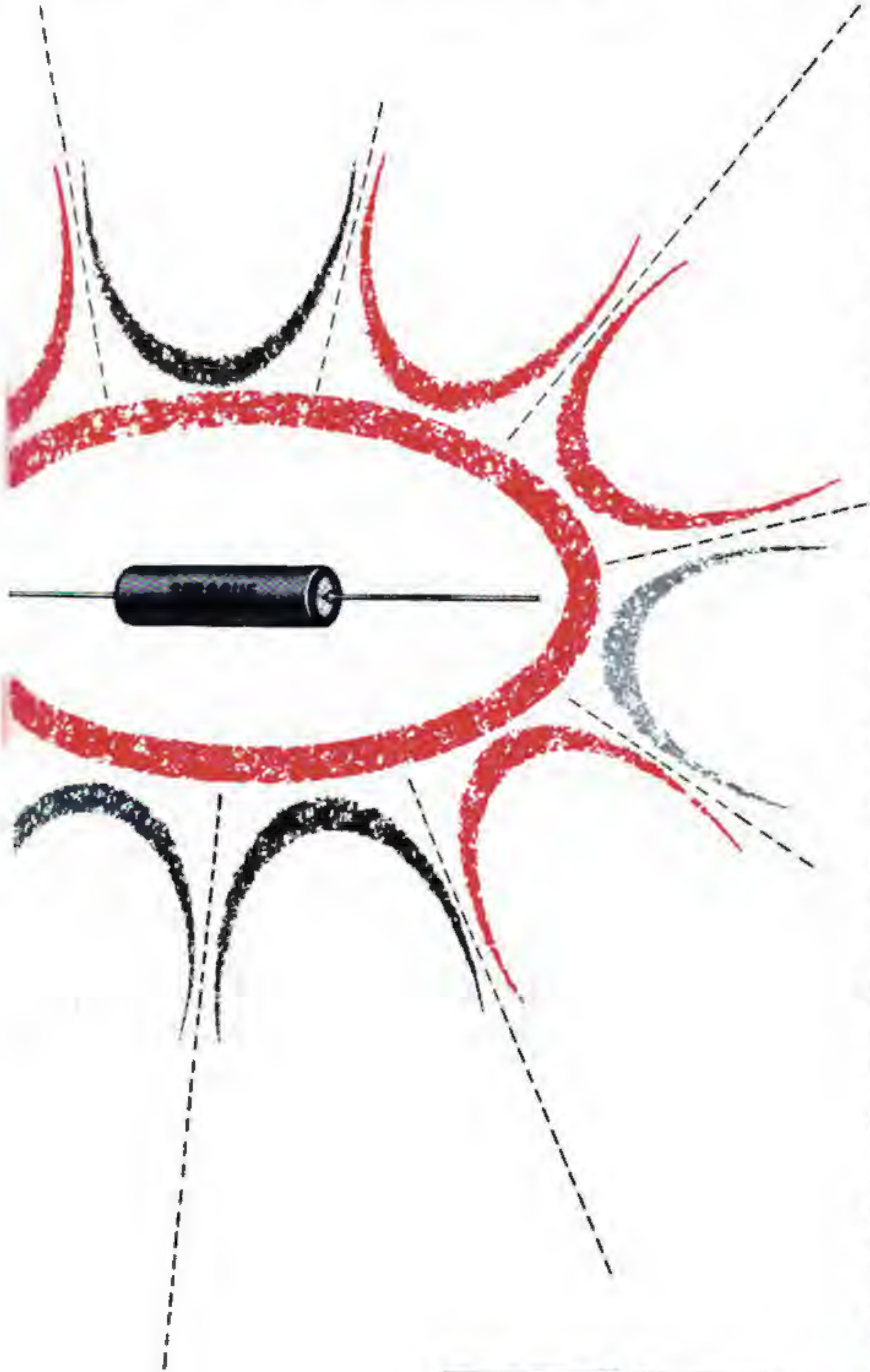

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Complete technical information is provided in Engineering Bulletin 2900 and Specification PV-100. Both are available on letterhead request to the Technical Literature Section, Sprague Electric Company, 287 Marshall St., North Adams, Mass.

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*(Continued from page 22)*

Obviously, having these tools in reserve eliminates this element of delay and permits production during the early quarters of the first year after M-Day.

When a current production job is completed, the tools and equipment may be either stored and maintained at the producing facility under contractual arrangements with the Government or placed in Government storage. It is more desirable to retain tooled-up integrated production lines under power if possible. These lines may include special tooling, inspection gauges and long lead time production equipment. This, of course, is expensive. With the emphasis on practical economy, only in cases of the very highest priority can the maintenance of production lines under power be justified.

### *Effects of Technological Advances*

Production planners recognize technological advances being made in industry and consider the effects upon machine tools in the military reserve. To avoid stagnation characteristic of inactive facilities, the planners consider changes in techniques and production processes as they affect this tooling. For example, great strides are being made in the field of automation. The adaptation of an automatic production system can obsolete existing production lines in storage. Therefore, critical reviews are being made of the equipment in the military reserve. Only that equipment of the quality and capacity desired is to be retained. The retention of equipment is justified only by the return to the Government of immediate production upon demand. The Department of Defense has taken this practical viewpoint into consideration and a new look is being given the Reserve Tool Program.

To improve industrial production capabilities and to further minimize production losses caused by lead time, the industrial plant reserve program is a necessary adjunct to mobilization readiness. Although the Department of Defense places maximum reliance upon American private industry for materiel, certain specialized facilities were retained by the Army, Navy and Air Force. To fulfill the United States and allied materiel requirements procured by the Army during World War II, the Government authorized over $10,000,000,000 for expansion of industrial facilities. Most of the plants were declared surplus after World War II. Sixty complete, specialized industrial plants were authorized to be retained after the war; the aggregate cost being in excess of $2,300,000,000. Since World War II, additional plants were sponsored by the Services. For example, the Navy sponsored 221 industrial plants; the total acquisition cost approaching $4,000,000,000. Eighty-six percent of these plants were active and privately operated. These plants now form the nucleus of a ready production base for specialized critical military items having little or no commercial counterpart.

### *Production Plants*

Whenever possible, plants were leased or sold to industry subject to recapture to minimize the maintenance cost to the Government. After World War II, the cost was estimated for Army plants at approximately $25,000,000 annually to maintain the special purpose plants. However, maximum leasing of these facilities to industry has resulted in the reduction of maintenance costs at an annual savings to the Government of approximately $11,000,000.

These plants will be ready for operation by the lessees as mobilization producers. M-Day production schedules will be arranged and many technological details worked out with respect to plant rehabilitation or conversion. The combined assets of machine tools and reserve plants will permit the U.S. military machine to function with a minimum loss of time.

Another deterrent to early production is the lack of critical materials or components. Much time and loss of production had resulted from the lack of advance planning in the field of materials allocation. Here again the Department of Defense has eliminated "Administrative Delays" to insure distribution of materials for ratable items. Uniform policies and procedures for applying controlled materials allocations plans for implementation on M-Day have been prepared by the Office of Defense Mobilization and the Department of Defense. The materials allotment requests will be documented and processed by the responsible Government authority to ascertain the ultimate allotments of required materials.

With increased emphasis on new weapons and their impact on strategic plans, mobilization requirements for these weapons are correlated to existing technology and production capacity. These changes dictate revisions to mobilization plans. Similarly, changes in industrial technology require a re-evaluation of production plans. Production methods must be re-explored for improved techniques and reduction in costs and critical materials affected. This is accomplished by projects known as Industrial Preparedness Measures, which are conducted by industry under contract with the Military Services. For example, contracts are let to investigate the application of new or alternate materials. New tools or fabrication methods may be developed or production procedures formulated. Chemical plants and processes may be redesigned to improve efficiency and reduce costs.

To insure current production know-how, educational production projects are arranged with industry by contract. These are plant scale pilot orders designed to educate facilities in new techniques applying new equipment or materials.

The flexibility of the mobilization plan permits its implementation for any type of war, whether it be short or long range. There are no administrative shackles of rigidity which will delay the implementation of the plan.

No longer are we lacking legislative authority. The National Security Act of 1947 has been amended to adjust to current situations. Standby legislation can be implemented with minimum loss of time. Production plants and materials can readily be mobilized. Standby orders are a reality.

### *Action on D-Day*

Since we have established a flexible mobilization base to support any type of war, the plans can be invoked at any time. The competitive bidding system, under full mobilization conditions, will not predominate the procurement program. Although price remains as a primary consideration under any procurement situation, it loses its position of supreme importance on M-Day in relation to schedules of delivery of weapons to the troops engaged in active warfare.

Today's planning has been blended with the vital ingredients consisting of "Plants and Products." Realism is constantly being injected into the program. Within the limitation of funds available to the Department of Defense and its Military Services, a dynamic planning program is in operation to assure and maintain a practical and ready mobilization production base.

What remains on D-Day is action to put this forward progress into operation. This is a must lest we repeat the inadequacies of the past.

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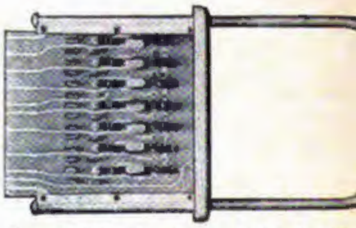

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# The Sunny Side

**by Robert F. Brady**
**Chief Engineer for Communications Systems**
**Office of the Chief Signal Officer**

***Although known for its wartime accomplishments, the Signal Corps performs many activities which have their "sunny" side in peace-time application. Such an example is the ANGRY-9.***

ELSEWHERE YOU WILL READ OF the Army Signal Corps as an agency with an unmatched record of activity in many of the sciences, primarily as they relate to military purposes. But any work in the sciences will have its peaceful applications as well. The Signal Corps' services in meteorology preceded those of the U. S. Weather Bureau. Its work in aeronautics dates back to the Wright brothers. It has won its "Oscar" in photography and received numerous other evidences of recognition of its continuing excellence in this field. The Army Signal Corps has pioneered many advances in electronics, and these too have their "sunny" side.

Radio wave propagation research, radar and communications equipment development, electronic components work, cooperation in standards and regulatory activities, and extensive operations and training missions in the field of electronics are among the many and varied efforts of the Army Signal Corps, in the most rapidly advancing science of electronics. All of these activities are paying dividends for peaceful purposes.

### *Origins of the "Angry-9"*

The history of our nation is one of peaceful endeavor. By comparison our years of warfare have been relatively few. It is logical then, to expect our military agencies, to as great an extent as possible, to contribute to our peacetime well-being.

The story of one radio communication set has, in addition to its primary military aspects, certain examples of the use of Army Signal Corps equipment in peaceful roles.

Officially known as "Radio Set AN/GRC-9", this equipment has been dubbed the "ANGRY-9" by troops. Its story really started in 1942.

Many will remember that we had the SCR-131, SCR-161 and SCR-171 radio sets when the war started in 1941. The SCR-284 was rushed into production to replace these three sets for general purpose field radio communications, with provisions for operation in a vehicle also. This was the so-called "short-wave" set, using part of the high frequency (HF) band. Miniaturization had not then had its effect, and the SCR-284 was not compact (to say the very least!).

By mid-'42, when the initial attacks on our forces had been blunted, we in research and development began to receive requests for advanced type equipment—to be delivered in a few weeks' or months' time. Parachute troops, special missions, jungle warfare and other operations dictating new tactics also required new equipment.

Parachute battalions being organized in 1942 required a long range radio set that could be dropped by parachute to provide them with communications from their drop zone to base station. A development contract was given to The Rauland Corporation by the Signal Corps laboratories and work on a "Radio Set SCR-694-( )" was begun. It had to be a small and rugged set, versatile in operation. The task was not an easy one at that time, with the components available and urgency needed. Were you to go back and look over the shoulder of the design engineer, you would recognize the basic configuration of the AN/GRC-9. Rauland had worked before with Signal Corps laboratory engineers in production and development of sets of similar nature, and that experience contributed to the design of the SCR-694. The set got to the paratroops, and we heard stories such as that about the one that dropped into a small river in Northern France during Operation Overlord and was not retrieved for two days, yet operated when set up.

### *SCR-694's on Special Mission*

Meanwhile, late in 1942, the First Special Service Force planned an operation that would use small tracked vehicles and require a radio set to fit in a restricted area in the vehicle. The development of the SCR-694 was progressing and the Rauland Corporation undertook to produce the required quantity of SCR-694's and a number of receivers alone (the SCR-714) in a matter of weeks. Rauland's people worked closely with personnel of the First Special Service Force and the Signal Corps in meeting the special requirements of the mission. And one of the special requirements was that the sets be painted *all white!* So, to distinguish these from later models to be furnished for regular troop use, they were identified as "SCR-694-AW" and "SCR-714-AW"! The SCR-694-AW was the first version of the design that became the ANGRY-9.

Wasn't it the famed "Merrill's Marauders," under General Stilwell in Burma, that needed a set that could be packed through the jungle and communicate over hundreds of miles? Because the frequency range of the SCR-694 was limited to 3.8 to 6.5 mcs., a companion transmitter and receiver were hurriedly designed in the frequency band of 2.0 to 3.5 mcs., and both of these with a variety of accessory gear were produced and assembled under the nomenclature "Radio Set AN/TRC-2( )." This was in 1944, and the daddy of the ANGRY-9 had its first taste of the jungle.

### *Need for Compact Radio Set*

The mounting evidence of need for a better, more compact and portable general purpose set of this type, with a sufficiently wide frequency band to enable communications in various parts of the world over short distances and over extended distances by sky-wave under all ionospheric conditions, impelled the continuation of development work by the Signal Corps with Rauland. A conference held on June 1, 1944, at the Laboratories, set the stage for development of a replacement for the SCR-694 and the AN/TRC-2. By the end of 1944, the ANGRY-9 had taken shape and production orders placed. The band of 2.0 to 12.0 mcs. was now covered in one case only an inch or two larger than the SCR-694; and greater versatility, especially in the antenna circuit, had been included.

### *Advanced Design and Adaptability*

Because of the stringent requirements for and the demands made by troops whose tactics depended so largely upon communications, and because of the exceptional efforts of the engineers involved in the development work on the SCR-694 and the AN/GRC-9, the ANGRY-9 was far in advance of the general state of the art when it was completed. So far advanced was its design that only with the advent of transistors and printed circuits did the design engineers foresee the achievement of the very substantial improvements in physical or operational characteristics of the ANGRY-9.

That there is a continuing need for such equipment — despite the opening of new frontiers in the frequency spectrum, the enticements of frequency modulation in the very high frequency (VHF) range where room for its bandwidth might be made, and the disadvantages from atmospheric noise and interference that plague the HF band—may be argued from the rest of the story—the part really about the ANGRY-9 itself.

The "work clothes" of the ANGRY-9 may be said to be the dust of deserts, the mud of swamps, the damp of jungles and the ice of polar areas. It has worn all with honor.

In its prototype stage it was tested by: the Airborne Command, Mountain and Winter Warfare Board, Infantry Board, Antiaircraft Board, Coast Artillery Board, Military Police Board, Landing Vehicle Board, U. S. Navy, Office of Strategic Services, and British Signals Research and Development Establishment. It has been installed in jeeps, trucks, cargo carriers and LVT's, carried by men and packed on animals. It will float.

The ANGRY-9 is used extensively in the Army and the Marine Corps. It has been produced not only in the United States but also in France and lately in Germany, to equip the Armies of some of our NATO partners in defense. But it is not only in the military that the set has found favor.

### *"Angry-9" in Research*

When preparations were being made in 1946 for the "*Kon-Tiki*" raft expedition across the South Pacific, a Norwegian Assistant Military Attaché inquired as to what Signal Corps radio communications equipment might be suitable for its purposes. The ANGRY-9 might have served, but it was not then ready to commence its non-military service. (Other Signal Corps equipment was taken on the raft—but that's another story.)

Then, in 1947, the Signal Corps had an opportunity to support an expedition by the University of California to the Union of South Africa for anthropological investigations, and among the several items of signal equipment furnished were two ANGRY-9's for their communications from the camp to their base.

About 1949, another scientifi pedition which went by dog across ice to a northerly island stayed during the summer, isol after the ice break-up, received ANGRY-9 for communications to base 200 miles away. One of party returned to the Office of Chief Signal Officer to report sur ingly that it had been out of com munication only one day!

Mountain climbers, too, hav wanted the ANGRY-9 for communi cations between the bases they estab lish on their routes to earth's highes peaks.

It has been on the South polar expeditions preparing the way for the work of scientists during the coming International Geophysical Year. Agencies of Great Britain and New Zealand have sought out the ANGRY-9 for their activities also in the south polar area during the IGY.

And in December 1955, it was recommended to University of Pennsylvania archeologists for use durin their program to reopen, from the jungle of northern Guatemala, the ancient Mayan city of Tikal. The ANGRY-9 may, at this time, have its antenna on a 1000 year old temple in that ancient city!

The job of the ANGRY-9 is to provide communications. For some ten years now, it has carried the voice of military command. It has also carried the voice of science, coordinating its anthropological and archaeological research, and the voice of constructive activities working to increase Earth's resources in the broadest sense.

### *Value of AN/GRC-9 in War and Peace*

Briefly, then, this is part of the story of the ANGRY-9 up to now. This set, in the hands of an operator who knows *his* part of the job, is a means of communication that serves in war and peace, anywhere, anytime, in a way that gives high credit to the military-industry team that designed and produced it, and to those fighting men whose combat needs and experience forced the development and proved, in the fire of warfare, that the highest standards of design are none too good a match for their patriotism and sacrifice.

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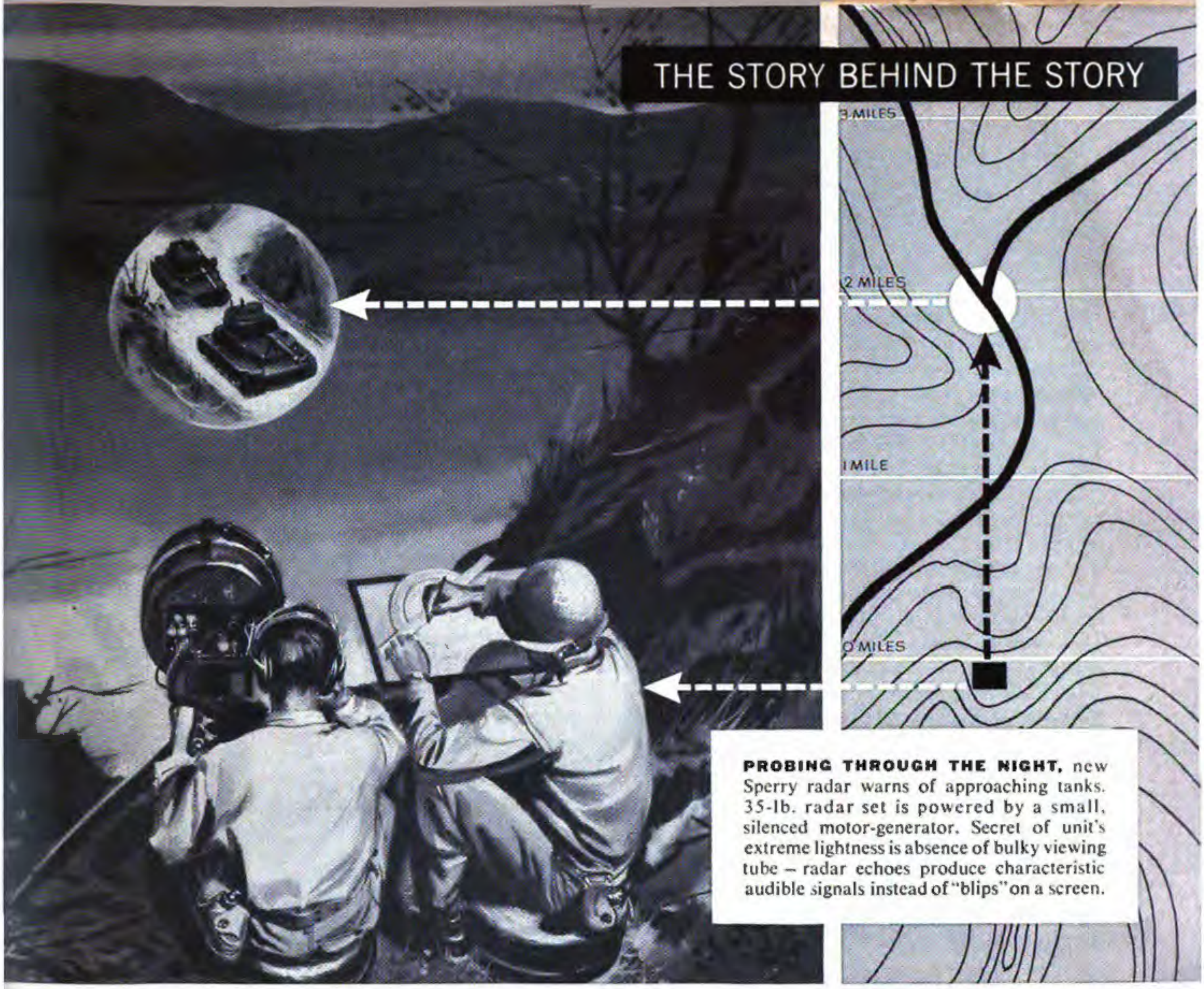

**PROBING THROUGH THE NIGHT,** new Sperry radar warns of approaching tanks. 35-lb. radar set is powered by a small, silenced motor-generator. Secret of unit's extreme lightness is absence of bulky viewing tube – radar echoes produce characteristic audible signals instead of "blips" on a screen.

# RMY HAS "SILENT SENTRY" RADAR OR FRONT-LINE USE

**LIGHT VIEW** of Sperry radar and forward observation team. rator (r.) interprets audible radar echoes while second soldier ks reported movements on plotting board. Unit supplies accurate ation, azimuth and range data.

Newspaper readers across the country learned recently the good news that Army troops will soon be able to call on the world's smallest radar set to warn of surprise over-the-ground attack by an aggressor. The device greatly enhances the effectiveness of battle area surveillance.

Developed jointly with the Army Signal Corps, this new Sperry portable radar instantly reports any movement of men or vehicles within a 3-mile range—at night, in fog or smoke. So accurate is the set that it detects *one* soldier walking half a mile away, even tells whether a vehicle has wheels or tracks.

This new "Silent Sentry" is one more result of the joint efforts of our military leaders and Sperry to keep our defenses up-to-date. Like the Sperry MPQ-10 Mortar Locator, which tracks enemy shells and computes their origin for instant, accurate counter-fire, or the Sperry flight control systems which enable SAC bombers to fly to pinpoint targets anywhere in the world, it helps preserve peace by deterring aggression.

**SPERRY** *GYROSCOPE COMPANY*
*Great Neck, New York*
*DIVISION OF SPERRY RAND CORPORATION*

# Letters to the Editor

*The Editor of Signal is pleased to publish the following extracts from a letter written to the AFCEA by the Honorable Wilber M. Brucker, Secretary of the Army.*

"The conditions of future warfare will in all probability render impossible the kind of deliberate mobilization and unhurried training of units which was possible after the outbreak of our former wars.

"Consideration for our national economy precludes the maintenance of a standing Army of sufficient size to meet all of our defense requirements. Consequently, our defense plans in case of war place reliance on the carefully integrated employment of the active Army, the National Guard, and the Army Reserve. All parts must be ready to mesh smoothly and efficiently according to a carefully timed mobilization schedule. Every element of this force must have a peace-time readiness permitting it to meet its schedule for deployment.

"The prohlem, therefore, is to find a means to insure individual and unit training for mobilization missions in time. In the case of the active Army there is obviously little difficulty. However, the National Guard and the Army Reserve present a different problem.

"The only acceptable solution to this training problem which has thus far been advanced is the one proposed by the Army. This proposal is to require all future enlistees in the National Guard and Army Reserve to take six months active duty training. Six months is by no means an arbitrary figure but was arrived at only after the most detailed analysis of the mobilization requirements of our reserve forces. The six months period is essential to give all soldiers in the reserve components individual training, and some unit training so that they will return to their reserve units in their home areas prepared to fit into the military organization as a useful member of the military team. The local commander will be freed from the present requirement to train individuals in varying stages of basic subjects and can concentrate his efforts on raising the level of unit training to the point required by its mobilization mission.

"Specifically, this program has the following merits. It provides four months basic survival training before being sent overseas. It gives additional time to permit basic unit training. It is the most efficient from the teaching viewpoint. It permits continuity of instruction. It brings a man to top physical condition at the outset to absorb the strenuous training. It assures the effective inoculation of discipline and the personal habits needed in military life. Finally, it obtains the greatest return in terms of effective training from the very substantial investment in money and manpower required to support the reserve program.

"I am aware of the concern expressed by members of the National Guard over the effect of this requirement of six months training on the number of National Guard enlistments.

"Some of the advantages which I propose to give the National Guard are the following:

a. The Army Recruiting Service will use its resources to recruit concurrently for the active Army and the National Guard.

b. The National Guard will be allowed an exclusive period of 60 days to seek recruits among all two-year inductees and enlistees returning from duty in the active Army before the latter are assigned to a U.S. Army Reserve unit. Beginning August 9, 1957, nearly 10,000 per month of these individuals will be available for recruitment.

c. Up to now the six months training program has been available only to young men between the ages of 17-18½. We have recently extended the program to all young men between the ages of 18½ and 26.

"I am considering other possible forms of aid to the National Guard recruitment but consider that the foregoing actions invalidate any grounds for concern that the Army program will work injury to the Guard. Rather, it will strengthen the National Guard and give it the very trained manpower it needs."

Sincerely,
Wilber M. Brucker
Secretary of the Army

* * *

### *An Invitation*

Dear Sir:

Since returning to Tokyo from attending the Armed Forces Communications and Electronics Association Convention held in Boston in May, 1956, the thought has often
curred to me that occasionally m
bers of the AFCEA stop or p
through Tokyo. In order that in
future it will be possible for s
members to meet American and Ja
nese fellow AFCEA members,
company wishes to inform you
the Overseas Engineering Corpo
tion, Japan Branch, desires to kn
of any AFCEA member visiting T
kyo.

It is felt that in a strange la
where customs and language
ferences complicate a business
sion, my company is in a positio
assist AFCEA members and g
member companies in making
visits and contacts in Japan more
joyable and profitable.

Please contact me should the
casion arise of a visit to Tokyo
representative of your company.

Sincerely,
James J. Green
Electronics Division
Overseas Engineering Co
Tokyo

* * *

### *A Clarification*

Dear Sir:

The article in your issue of Oct
ber 1956 entitled "ICBM Problems
be Solved by Electronic Brain" stat
that the UNIVAC Scientific 1103
was the only machine in the wor
versatile enough to interrupt o
complex problem to solve a new, hig
priority problem while retaining
its "mind" all work on the first
subsequent solutions.

This, of course, is no more
less than the "interrupt feature
which is available for both the IB
704 and the 709, large-scale el
tronic digital computers. Two 70
systems equipped with the interru
feature will be in operation by m
jor aircraft companies on the We
Coast by next month. One of the
will be applied specifically to th
ICBM program.

Neither of these customers has
yet released information on its co
puting installations. We expect th
they will in the near future.

We appreciate your interest
clarifying this point. I trust that yo
will call on us for any material whic
we can furnish for your magazine.

Cordially,
Daniel A. Shepard
International Business
Machines

## ANOTHER VARIAN FIRST!

# 2 kW SHF Varian Klystron

The VA-804D (4.85—5.0 kMc) mounted in its focusing magnet, the VA-1504.

The heart of the new Canadian Westinghouse SHF scatter transmitter, now being operated in a "proving ground" circuit between Hamilton and Kinmount, Ontario, is the Varian VA-804 klystron amplifier, designed specifically for forward scatter communication service. The now familiar qualities of all Varian klystrons — remarkable efficiency (see below), economy, reliability, and proved performance — made this tube the logical choice for Westinghouse.

*Electrical Characteristics:*

Frequency – 4.4 to 5 kMc
Power – 2 kW minimum
Gain – 50 db
Efficiency – 40% nominal

For a complete description of this and other Varian klystrons contact your local Varian Representative or write Varian Associates, Application Engineering Department, Palo Alto, 11, California.

*THE MARK OF LEADERSHIP*

**VARIAN associates**
PALO ALTO 11, CALIFORNIA

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Simple in operation, small and light enough to be carried in quantity by single-seat Interceptors, "Sidewinder" can be fired singly or in salvos. It requires no complex launching system or special pilot training, and it maneuvers deftly at supersonic speeds. The missile displays extremely high single-shot accuracy —and even more important, *it can be launched well beyond reach of the target aircraft's defense.*

"Sidewinder" was developed by the Naval Ordnance Test Station of the Navy Bureau of Ordnance at China Lake, California. Philco assisted NOTS in the research and development program, and performed the subsequent engineering required for manufacture of the missile. "Sidewinder" is *now in full production at the Philco Government and Industrial Division.*

Philco is proud to have made this important contribution to the development of more effective electronic systems for our national defense.

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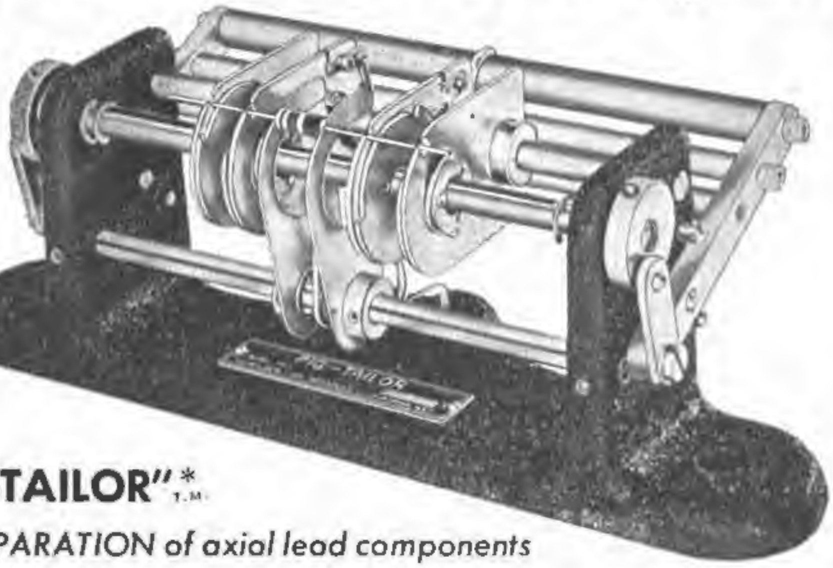
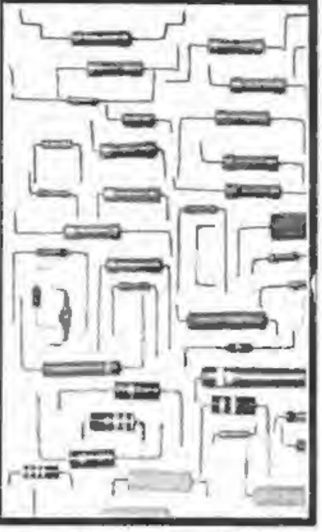


**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*



# PIG-TAILORING"

***. . . a revolutionary new mechanical process for higher oduction at lower costs. Fastest PREPARATION and ASSEMBLY Resistors, Capacitors, Diodes and all other axial lead mponents for TERMINAL BOARDS, PRINTED CIRCUITS and INIATURIZED ASSEMBLIES.***

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

Uniform component position.
2 Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6 Individual cut and bend lengths.
7 Better time rate analysis.
8 Closer cost control.
9. Invaluable labor saving.
0 Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

**"SPIN-PIN"*** T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

PATENT
ENDING

*Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-4P*

**BRUNO-NEW YORK INDUSTRIES CORPORATION**
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

# Chapter News

*Augusta-Fort Gordon*—Inspecting a Television Monitor during a tour of Augusta's Southern Bell Telephone Co. are left to right: Mr. Tom Baker, Mr. J. C. Woodward, both of Bell, and Captain Walter W. Smith of the Signal Training Center.

### *Arizona*

Dr. H. R. J. Grosch of the Computer Department of General Electric, Phoenix, addressed the February 7th dinner-meeting which was attended by some 150 members and guests. Dr. Grosch's topic was "Sex Life of an Electronic Computer," and dealt with the use of computers in the computer industry in the following phases: designing, manufacturing, selling and maintenance.

In the designing of computers, Dr. Grosch said that existing machines could be utilized to "improve the breed" by asking the machine how it could improve itself. Also he stated that through this same process the machine's technical language could be simplified in order to make its use easier.

Computer machines could be built in automatic factories that would be designed by other machines. Dr. Grosch added that it is quite possible for the mountain of paper work needed in the manufacturing process to be taken over by electronic computers, replacing the hundreds of people now needed for the ordinary processes of purchasing, storing and assembling of parts and supplies.

Even the selling process could be helped by the use of computers. For example, Dr. Grosch suggested that prospective customers' likes and dislikes in computer machines could be analyzed in an electronic computer to find out what features would sell best.

Maintenance, which is an increasingly important aspect in the use of computers, would be made easier by having the machines diagnose their own ills to tell the repair technicians what is wrong with the maze of wiring inside them. Today's use of miniaturized tubes and electronic components makes it very difficult to service these electronic marvels.

Finally, Dr. Grosch cited some of the benefits of using electronic computers instead of human beings for much of the work of the business world. He said that computers can work faster than people, work more accurately, do more work in a day, and, after the initial cost of the computer is absorbed, do work much cheaper than is possible with humans on pencil and paper.

Presiding at the meeting was Colonel Kirk Buchak's last official act as president of the chapter. The following day he left for Fort McPherson for his new assignment as Signal Officer of the Third Army, Vice president Arthur H. Mudgett will act as president until the next election of chapter officers.

### *Augusta-Fort Gordon*

A tour of the Southern Bell Telephone and Telegraph Company in Augusta highlighted the February chapter program which was followed by a dinner and business meeting at Timmerman's Restaurant.

Personnel of the Signal Training Center at Fort Gordon and chapter members and guests were shown such points of interest as the long-distance switchboard, the power room, a coaxial television monitor, and other facilities of the telephone company.

Southern Bell representatives who arranged the program were E. H. Gibson, district manager; Tom Baker, Edward Breedlove, W. R. Christian and G. W. Simms.

### *Baltimore*

"Communications in Fire Fighting" was the theme of the January meeting which was held at the Baltimore Cou Fire Department headquarters. Ch Anthony P. Orban was host for occasion.

The following officials of the F Department were introduced and plained the duties of their various partments and the techniques ployed: Deputy Chief F. Lee Cock Fire Prevention Chief Louis Mai Chief Winfield Wineholt of the Tra ing Center, Chief Paul Miller in char of the Repair Shop, and Arson Ch Nelson Williams.

A conducted tour of the headquarte revealed the most modern fire fighti equipment. The two-way radio equi ment and map viewer permit any mob fire fighting equipment to be "de reckoned" or promptly directed to fire anywhere in Baltimore Coun Headquarters follows the equipme visually and is in continuous conta with the crew.

Following the tour, there was actual fire fighting demonstration sho ing modern techniques of fire fighti and rescue.

### *Decatur*

The annual election of officers wa the main item of business at the Janu ary 22nd meeting, with Robert M Burns (Major, USAR), of B. B. Burn Co., Inc., chosen as the new president.

Other officers selected were: vice presidents—Adolph M. Hetzler and Maj. Edward I. Melton; secretary treasurer—Capt. Walter L. Beddingfield; member Executive Committee—Lt. Col. Fred J. Hays, past president; board of directors—Jack Hathaway, Fred Zickuhr, Merle Morrison and Doyle McCord. These officers are all from the Decatur Signal Depot.

The program session consisted of three films—"Quality Control in Photographic Lenses," "The Sound and the Story" and "The Story of Television."

### *Chicago*

Allied Radio Corporation was host to 200 chapter members and guests on January 31st.

Featured speakers were J. Lewis Powell, Office of the Assistant Secretary of Defense, Washington, and George Hale, Deputy Director, Small Business Administration, Chicago.

The meeting was followed by a tour of Allied's newly expanded facilities which were of particular interest to supply personnel. (Photo page 37)

### *Fort Monmouth*

Michael E. McCabe, public relations official of the New Jersey Bell Telephone Company, presented a lecture-demonstration on the many uses of the transistor, "The Mighty Midget," at

: chapter's February meeting.

Gibbs Hall Officers' Club was the ·ne of the dinner and the program, ·h several hundred members and ests in attendance.

### ·waii

Recent activities of the chapter con- ted of a dinner-dance at the Cannon ub, Fort Ruger and a luncheon- ·eting at which the Hawaiian Tele- one Company presented a program "Continuous Flow Dry Air Pressure stems."

At a meeting of the Board of Direc- 's on January 22nd, the following re appointed to offices vacated be- use of transfers: Lt. Col. Wayne L. Hern, USAF, became First Vice esident to succeed Lt. Col. Michael Killian; and Mary Evans, Naval mmunications Station, was chosen easurer to replace Ira Mercer.

### ·nsas City

Robert B. Alexander, Assistant Proj- t Manager, Engineering, Western ectric Company, New York, pre- nted an up-to-date report on the EW Line project at the chapter's nuary 31st dinner-meeting.

Following his address, Mr. Alexander owed a color film depicting some ry unusual scenes of the terrain en- untered as well as some of the unique nstruction methods employed in the mpletion of the project. The prn- am was interspersed with personal terest anecdotes which were entertaining as well as interesting.

Some 120 members and guests at- nded, and the chapter reported the ent as "one of the most instructive id entertaining meetings it has had a long time."

### ·eflavik

A color slide presentation and a lk on "Scenery of Iceland" was the rogram feature of the chapter's Febru- ry 13th meeting. Lt. Col. Giesen, orps of Engineers, conducted the pro- ram and the chapter reported that his photographic skill and excellent nowledge of Iceland did much to dispel the idea that Iceland is a bleak wasteland."

New chapter officers were elected as follows: president—Maj. John D. Lynch, Commander, 1971st AACS Squadron; vice-president—T/Sgt. F. A. Antonaccio, 1971st AACS Squadron; secretary—T/Sgt. D. P. Hall, 1971st AACS Squadron; treasurer—Capt. William A. Elbracht, ADFCE IADF.

### Nagoya

Sixty officers and civilians from the Nagoya area, representing the entire communications field, attended the chapter's first meeting of 1957, held on February 25th.

Highlight of the luncheon meeting at Moriyama Air Station was the presentation of the official chapter charter. Col. Steve J. Gadler, chapter president and Director of Communications-Operations at Fifth Air Force Headquarters, accepted the charter from the chapter secretary, Craig D. Elderkin, RCA supervisor. (Photo page 39)

During the business session, plans were made for future activities and a membership drive was set in operation.

### New York

"Techniques of Color TV Productions" was the subject of the February 27th dinner-meeting at the Belmont-Plaza Hotel. Mr. Reid R. Davis, Manager of TV Technical Operations of the National Broadcasting Company, presented the program and discussed the many factors encountered in producing a TV show in color.

Mr. Davis also illustrated the equipment used in color television, the lighting required, the problems that settings introduce, as well as other related matters such as colors used in costumes and the complications of effective make-up. At the conclusion of his presentation, Mr. Davis conducted a question and answer period.

### North Carolina

The annual election of officers was held on February 6th with the following results:

President—Lt. Col. Cuggie E. Kyzer, Post Signal Officer, Fort Bragg; vice presidents—James R. Fowler, Carolina Telephone and Telegraph Co., Fayetteville; John E. Johnston, American Telephone and Telegraph Co., Charlotte; and Lt. Col. Fred W. Hemmrich, 82nd Airborne Signal Co., Fort Bragg; treasurer—T. P. Williamson, Carolina Telephone & Telegraph Co., Fayetteville; secretary—Maj. F. G. Sheviak, USA Airborne & Electronics Board, Fort Bragg.

National Council members: Luke W. Hill, Carolina Telephone and Telegraph Co., Tarboro; and Col. Henry J. Hort, 1st Logistic Command, Fort Bragg. Director: Dan J. Lawson, Southern Bell Telephone and Telegraph Co., Charlotte.

### Northeastern University

New officers of the two divisions of the student chapter are:

Division A: president—Wilfred Picard; vice president—William C. Regan, Jr.; secretary—Thomas R. King, Jr.; treasurer—Edward O'Keefe.

Division B: president—Neal Atkinson; vice president—Peter Lanzilotti; secretary—Jason Brooks; treasurer—Harry F. Giberson.

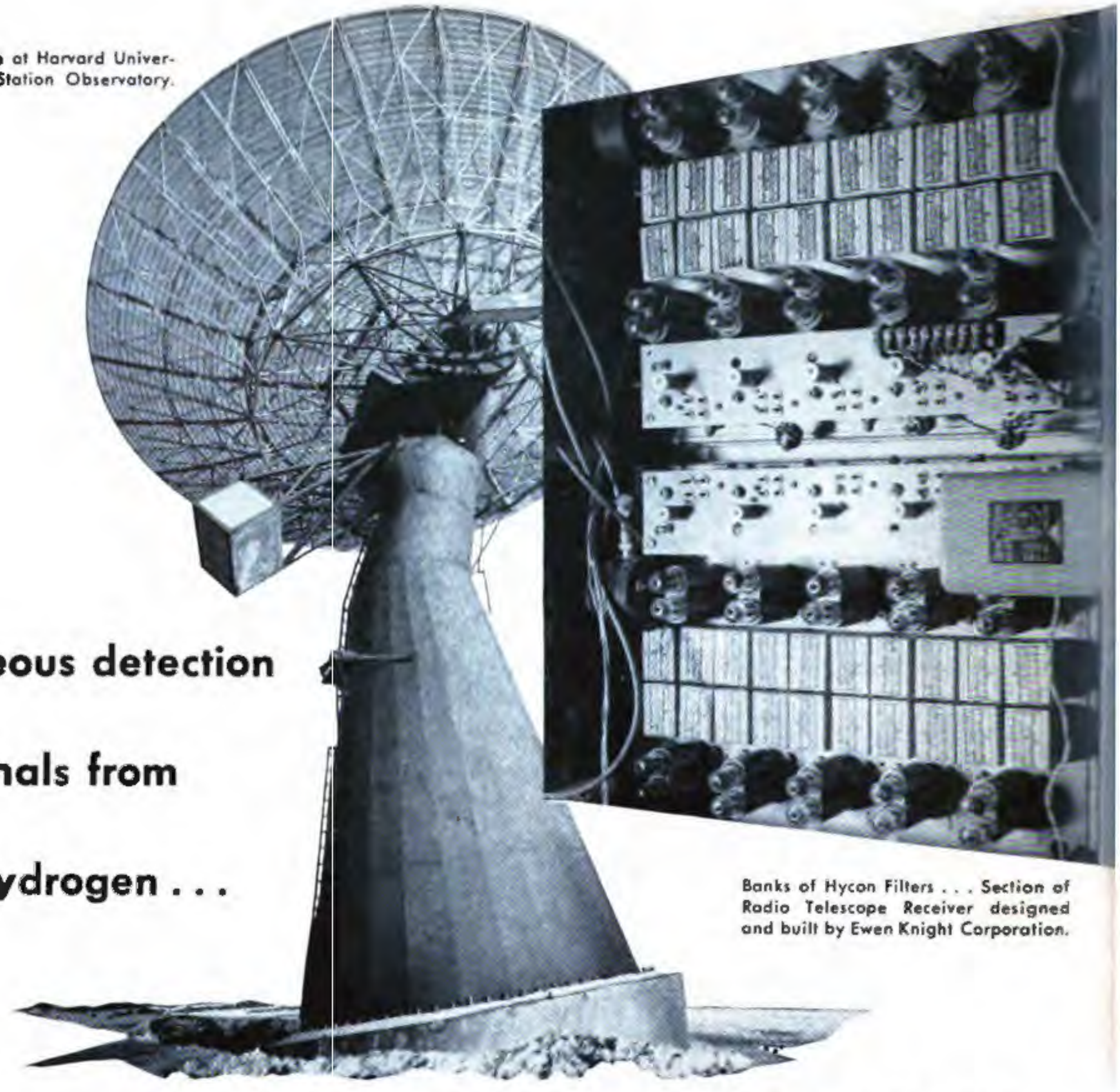
The schedule of activities for the winter term (Division A in school) were as follows: January 30—movie, "Origin of the Motion Picture"; February 6—double feature movie, "Research and Development" and "Weapons of Artillery"; February 13—speaker from Hi-Fi Labs; February 20—mnvie, "Challenge of Outer Space"; March 6—movie, "Role of the Combat Cameraman"; March 13—speaker on underwater photography and movie on the atomic cannon; March 20—movie, "The Steel Ring" (Nike around America); March 27—business session to plan participation in AFCEA natinnal convention.

In addition to these activities, the electronics and photo groups of the chapter met regularly for furtherance of their projects. Also, chapter members were invited to participate in the MARS program to secure ham licenses.

(Continued on page 39)

**Chicago**—Close to 200 members attended the January meeting of the chapter which was held at Allied Radio Corp.

**Radio Telescope** at Harvard University's **Agassiz** Station Observatory.



Banks of Hycon Filters . . . Section of Radio Telescope Receiver designed and built by Ewen Knight Corporation.

## Simultaneous detection of 20 signals from neutral hydrogen . . .

## another problem solved by HYCON FILTERS

Extending man's view into the depths of the universe is a giant new Radio Telescope at Harvard University's Agassiz Station Observatory. Astronomers are reconstructing the spiral structure of our Milky Way by measuring Doppler Shift of radio signals originating from neutral hydrogen.

**ELECTRICAL SPECIFICATIONS - NARROW BAND SERIES**

**Frequency range: 10 Kc - 30 Mc**

**Relative Bandwidth: .02% to .5% of center freq.**

| | Type 11 | Type 22 | Type 44 |
|---|---|---|---|
| **Shape Factor:** | 8 | 3 | 1.8 |

Playing a vital role in the Radio Telescope Receiver which makes these measurements possible are Crystal Filters designed and manufactured by Hycon Eastern. Hycon Filters were selected for their accuracy, stability and selectivity. Spaced at 100 Kc intervals from 5.5 Mc to 9.5 Mc, these Type 11 Filters from Hycon's Narrow Band Series have a 3 db bandwidth of 5 Kc and insertion loss of less than 3 db.

Hycon Eastern is currently producing Crystal Filters in the 10 Kc to 30 Mc range. Because they make possible a reduction in the number of conversions, Hycon Filters are finding wide application in mobile and fixed radio receivers and transmitters.

*Write for Crystal Filter Bulletin.*

**HYCON EASTERN, INC.**

***75 Cambridge Parkway, Dept. G-4, Cambridge 42, Mass.***

**Affiliated with HYCON MFG. COMPANY, Pasadena, California**

ove—The presentation of the Chapter's Charter was made at the February meeting. to right: Lt. Col. Harry C. Ross, vice-pres.; Craig D. Elderkin, RCA Field Manager and sec.; Col. Steve J. Gadler, pres.; Col. Robert W. Dickerson, vice-pres.

Signal Corps officers who serve as ulty advisors to the chapter are: jor Fred J. Frank, Major James J. Kenna, Captain Frank D. Stevens d Captain Charles P. Skinner.

### me-Utica

Col. George M. Knauf, commander the 2845th Air Force Hospital, Grif- Air Force Base, discussed "Medical ctronics" at the chapter's February h meeting. Fifty members and sts heard Colonel Knauf stress the portance of the union between medi- e and electronics in order to advance medical and electronics frontiers.

A tour of part of the hospital pre- led the program. Richard C. Benoit, chief of the Direction Finding and ecommunications branch of the Di- torate of Communications, RADC, s chairman for the occasion.

Colonel Knauf stated that many wn fundamental electronic phe- nena and laws are analogous to the ctions of the human body, and that e laws of the more advanced forms y explain the excellent sonar capa- ties of the bat and the homing capa- ties of the lunar moth.

He further pointed out that in the oratory man is attempting to build ces to compress data and develop puters which at best fall far short he capabilities of the human body. examples, he cited machines which press data by electronic means by ctor of six, compared to the human eye which can compress material to a ratio of 25 or more to one in an extremely small space. He also stated that the brain is one of the most efficient computers and storage devices known to man and that it has a retention capability far in excess of any man-made machine regardless of size. Physiological processes are typical of goals scientists hope to achieve in the laboratory, he pointed out.

The Air Force doctor outlined the efforts being made by the Air Force in a program of medical research to better understand the effects of micro-wave energy on the human mechanism. At the present time, knowledge is short of factual data and he said it is felt that the program being pursued at Griffiss AFB will supply answers to many existing problems.

At the close of the meeting, the group was given an opportunity to observe the operation of the electronic oven which is used in hospitals to prepare special diets.

### Scott-St. Louis

"Our Mr. Sun," the first in the Bell System's new series of color film programs on science, was presented at the February 1st dinner-meeting at Augustine's Restaurant in Belleville. Approximately 100 members and guests were in attendance.

The chapter reported (as did other AFCEA chapters who used this same program) that the film was a remark-

***Monmouth***—Shown at the Chapter's January meeting are from left: Brig. Gen. Earle ook, Commander, Army Signal Engineering Labs; Col. Olin L. Bell, president of the ter; Michael McCabe, New Jersey Bell Telephone Co. official and guest speaker, and Brig. Gen. S. S. Hoff, Commandant of the Signal School.

able production and that it was received with great interest and enthusiasm. Edward H. Gray, office of the Defense Activities Engineer, Southwestern Bell Telephone Company, introduced the program.

*Southern Connecticut*—Newly elected officers for 1957 are left to right: Bernard Ros
berg, chapter treas.; E. P. Hurley, pres. elect; I. T. Shapiro, chapter sec.; Col. R. B. To
linson, FESA; John N. Higgins, vice-pres.; Lincoln Thompson, retiring pres.; R. E. Nels
vice pres.; Charles Ecklund, vice-pres. elect, and S. Montgomery, vice-pres.

### South Texas

Dr. Hubertus Strughold, head of the Department of Space Medicine at the Air Force School of Aviation Medicine, addressed the chapter on February 26th.

The dinner-meeting was held at Randolph Field Officers' Club, with 100 members and guests in attendance. Among those present was Major General Gordon A. Blake, AFCEA national director, who had recently taken over his new assignment as commander of the Air Force Security Service in San Antonio.

Dr. Strughold, who is the author of "The Green and Red Planet; A Physiological Study of the Possibility of Life on Mars," and more than 150 professional papers on aspects of physiology, aviation medicine, and space medicine, discussed the subject of space medicine in general and, in particular, touched on some of the problems involved in maintaining existence aboard a space ship in interplanetary travel.

### Southern California

Brigadier General Milton W. Arnold, Vice President, Air Transport Association, was guest speaker at the chapter's February 18th meeting. His topic was "Traffic Control in the Jet Age."

Discussing operational efficiency and safety of aviation, General Arnold pointed out that traffic control in any age depends upon the proper balance of airplanes, airports and electronics. He gave the audience a "quick look at the facts and stark reality as effecting the utilization of electronics" as follows:

"The use of the airspace is growing by leaps and bounds. Military aviation will continue to grow in numbers and the utilization will increase slightly up to 1965. Airline operations will continue to grow 1 to 3% per year through 1965 due to the introduction of faster equipment, although the number of airline aircraft will remain almost static through 1965, except for the good possibility of a greatly increased number of aircraft operated by the local service airlines.

"What is possible and what is new in the field of electronics up to 1963? Certainly there are new gadgets or devices and improvements in the old ones, but there is nothing to replace our basic tools prior to 1963. We will continue to utilize voice communications enroute and in the high density traffic areas, and radar in the high density areas for expediting traffic, with some improvement in capacity through the limited introduction of computers by 1960 to 1963. This improvement will quickly be absorbed by the increased demand. . . . radar has the capability of vastly increasing the capacity of our system prior to 1963 or 1965 provided aviation has a universal airborne beacon or transponder to work with military and CAA ground radar.

"Today it appears aviation is further away from attaining the goal than we were two years ago. The difficulties lie not in the technical field but in the operational use of frequencies. The operational use of the transponder was clearly defined as early as 1948. There are several technically satisfactory transponders on the market today. Without the transponder, we are tending to oversell the use of radar enroute. Radar in the high density areas for approach and departure does a magnificent job and will continue to do an ever-increasing safe and efficient job with the introduction of electronic times, and further improvement in circular polarization, even with our inh
ent limitations and saturation of the u
of voice communications. All of us ha
been doing wishful thinking on the
gree of improvement through the u
of more and more radar enroute wi
out a beacon. The enroute problem
the bottleneck of the system and w
continue to restrict the capacity un
1965, at which time I expect data li
or telemetering to solve the problem
enroute separation."

*Rome-Utica*—Explaining the electronic oven is Col. George M. Knauf, third from the left. Looking on are, from left, Maj. Stanley J. Wisniewski, RADC; D. S. Kirby, chapter sec.; Col. William S. Heavner, R & D; Richard C. Benoit Jr., chairman of the day, and Harold J. Crowley, who arranged the affair.

### Southern Connecticut

The recent transfer of the chapt
secretary, I. T. Shapiro, to Philad
phia necessitated the appointment of
successor. Joseph A. Leopold of t
Dictaphone Corporation was selected
fill this post.

Named to the board of directors
the recent annual election were: T.
Beard, Dictaphone Corp.; J. B. Coo
Whitney Blake Co.; CharlesEcklun
Dictaphone Corp.; John N. Higgin
KIP Electronics Corp.; Edwin P. Hu
ley, Southern New England Telepho
Co.; Edgar L. Love, Whitney Bla
Co.; Spencer Montgomery, Sr. a
Spencer Montgomery, Jr., of the Mo
gomery Co.; Rodney E. Nelson, Mac
lett Laboratories, Inc.; H. S. Serva
Soundscriber Corp.; Kurt Steinitz, Ka
EssCo; Lincoln Thompson, Raymo
Engineering Corp.; W. W. Wren
Southern New England Telephone Co
and Bernard Rosenberg, Army Sign
Supply Agency.

Committee chairmen have been a
pointed as follows: membership—Be
nard Rosenberg; publicity—Willia
Shaw, Southern New England Tel
phone; program—John N. Higgin
civil defense—Sidney Rosenberg, S
marius Electronic Corp.

### Tinker-Oklahoma City

Perry A. Norman, Southwest Divisio
Manager of private wire service f
Western Union Telegraph Company
Dallas, gave a complete up-to-dat
story on "Modern Facsimile" at th
February 21st dinner-meeting.

He illustrated the importance of thi
communication technique with colo
slides, sample messages and picture
He also had some newly develope
samples of facsimile paper, and gav
interesting inside facts on how facsimil
messages and pictures are sent.

## CHAPTER NEWS

A veteran telegraph man with thirty years' experience, Mr. Norman presented an authoritative talk and demonstration. A member of the North Texas Chapter, of which he had been secretary-treasurer, he also reported on AFCEA activities in that area.

### *Washington*

The chapter's February 7th luncheon-meeting at the Willard Hotel was addressed by Rear Admiral Roy A. Gano, Deputy Commander and Chief of Staff, Military Sea Transportation Service.

Admiral Gano described and illustrated with colored films many of the unusual and sometimes hazardous problems of logistics confronting the Military Sea Transportation Service in supplying and transporting the Armed Forces in many areas throughout the world, including the Arctic and Antarctic, and in moving displaced peoples.

**Washington**—Rear Admiral Roy A. Gano, Deputy Commander and Chief of Staff, Military Sea Transportation Service, is seen here addressing the chapter's February meeting.

Other guests at the head table were: Congressman Clifford McIntire of Maine; Rear Adm. T. Burrowes, Director (Logistics Plans) OCNO; Rear Adm. H. C. Bruton, Director, Naval Communications Division, OCNO; Capt. W. I. Bull, Asst. Chief of Electronics, Bureau of Ships; Capt. W. S. Butts, ACNO (Fleet Operations) OPNAV; Rear Adm. M. V. O'Regan, ACNO (Logistics); Maj. Gen. A. H. Johnson, Deputy Director, Joint Logistics Plans Group (SECDEF); Capt. G. L. Caswell, Asst. Director, Naval Communications Division (CNO); Capt. J. S. Dorsey, Head, Shore Systems Branch (OPNAV); Capt. F. K. B. Wheeler, Director, Electronics Ship Division, Bureau of Ships; and Lt. Comdr. E. R. Hubenette, Aide to Admiral Gano.

# NEW PRODUCTS FROM INDUSTRY

## Portable Electronic Fish Finder

For the fisherman who wants to insure his luck, the Radio Corporation of America has unveiled a handy portable device which does the next best thing to putting fish on the hook—it finds them electronically.

Designed to ferret out sardines to whales, in depths of 18 inches to 500 feet, the RCA portable electronic fish finder instantly notifies the man behind the hook about schools of fish or a single truant, identifies the unsuspecting fish by size and type, and indicates the most likely spot to dangle the bait.

Technically, the portable fish finder uses a portable indicator scope and a hull-mounted transmitter-receiver unit to provide the fisherman with a continuous picture of fish activity under the keel. It does it with sound-short, focused, ultrasound impulses transmitted downward through the water. Fish which interrupt the sound waves are projected as distinctive "blips" on the indicator scope, and a practiced eye soon identifies a tuna "blip" from haddock or cod "blips."

The fish's exact location and depth are projected on the indicator, after lightning-fast electronic computation of the time it takes the transmitted ultrasound wave to strike the fish and bounce back to the transceiver unit.

The indicator unit measures less than a foot square, weighs approximately 26 pounds, and may be obtained handle-equipped to enable the user to wander the length of his rowboat or yacht.

## Remote Safety Monitor System

For personnel safety in hot labs, hospitals, reactor installations, or wherever radio-isotopes are used, the Universal Atomics Corp. of New York City has developed a compact, multichannel radiation monitor system.

The unit is ideal for area and background monitoring for personnel protection, exposure and health monitoring, film exposure determination in industrial radiography, water supplies, water sewerage, and stack monitoring.

The basic unit, Model UAC 450, is a five-channel master console type remote monitor located at a central control station, and can be used to monitor radiation up to several thousand feet away in each of five different locations. Each channel is independent of the others and is connected to an automatic alarm, thereby eliminating the necessity for anyone to watch the meter.

A wide variety of UAC-GM probes and scintillation detectors are used, including specially designed Alpha, Beta, Gamma, and neutron detectors.

## Portable Blueprint Machine

A newly developed portable blueprint machine manufactured by Product Engineering Labs Co., Inc. of Newark, New Jersey, is light and compact enough to be carried. Weighing only 5½ lbs., and measuring only 18 x 9½ x 4 inches, the new PELprinter "60" contains its own luggage-type, unbreakable carrying case.

It operates on a dry vapor process and reproduces any type of drawing or written matter up to 8½ x 14 in. Operating time is less than 1½ minutes and the cost approximately 1¢ per copy sheet.

The PELprinter "60" needs only a 110v outlet and is easily adapted for use in automobiles.

## Portable Public Address

A transistorized, completely portable public address system that requires no external power source and weighs only 18 lbs. has been made available by the Antrex Corp. of Chicago, Ill.

The unit—called "REDCAP"—is built into an attaché case about 6 inches wide, 14 inches deep and 18 inches long with a self-contained microphone to be used either in hand, or stand-mounted. It is convenient for use at sporting events, sales meetings, conventions, and banquets as it adjusts itself easily for functions indoors and outdoors.

Components include a high fidelity transistor amplifier, a heavy-duty eight-inch speaker, a microphone and controls, and two flashlight batteries. All of its power is drawn from two batteries and thus is ready for instant use anywhere without electrical connections. Batteries are easily replaceable and give up to 50 hours of service.

The transistor amplifier has a frequency response from 50 to 15,000 cycles per second, assuring distortion-free sound reproduction throughout the range of audibility. Sufficient volume can be heard over an area of 6,000 sq. ft. without auxiliary speakers.

## TV for the Aircraft Industry

Philco Corp., Philadelphia, Pa., has developed a complete new line of closed circuit television equipment for the aircraft industry. It contains all of the latest developments in cameras, monitors, controls, lenses and other accessories that are required to create camera chains for any purpose.

Featured are fully remote camera controls for the adjustment of focus, for iris apertures and for both high and low speed tilt and pan. Outstanding developments include special weather-proof and explosion-resistant housings as well as a new four lens camera turret.

Closed circuit television has many uses at airfields such as traffic control, runway surveillance, the observation of hidden areas and the remote reading of radar scopes and other instruments. Where distant or inaccessible areas or operations must be kept under observation in aircraft manufacturing and other industrial plants, it has been found indispensable.

## New Ear Protector

A new "noise-barrier" ear protector, the smallest, lightest, and most flexible of its type, will enable ground crews to work around jet engine aircraft without danger of hearing loss or ear damage.

This protection has been developed by the Radio Corporation of America to meet a need for more effective and comfortable ear protection for ground crews and maintenance personnel at military and commercial airfields, particularly those with jet aircraft.

The RCA ear protector resembles a set of ear phones, weighs less than 10 ounces and exerts only moderate pressure on the head. Despite the ultra-light weight and pressure, the protector remains "sealed" to the head by automatically adjusting according to working position and movements.

In its design it combines fluid-filled sealing pads and a self-adjustment feature to provide virtually universal fit and maximum noise-shunting protection.

(*Continued on page 44*)

Photo at right shows operators inserting secondary coils and connecting leads to commutators for units like the compact Sangamo "GY" Flatpak—a rugged, small size dynamotor for mobile radio use.

Final assembly operation. Push line type of operations contribute substantially to overall efficiency and accelerated production . . . aids in fulfilling all delivery schedules, even for units like the Type SF below, which are built to the most exacting specifications.

# Now... dependable power supply units on dependable delivery schedules

## Sangamo expands facilities to meet growing demand!

Sangamo power supply units for the military and commercial fields—Dynamotors, Rotary Converters, Generators, Special DC Motors—are built to meet your most exacting specifications for quality and performance.

And... Sangamo has the facilities to insure prompt, efficient, volume delivery to meet *your* production schedules.

A new 200,000 square foot "controlled conditions" plant, in Pickens, South Carolina is equipped with the newest, most modern equipment to utilize the latest production techniques in the manufacture of these power supply units. This plant is geared for full-capacity production for units and components for mobile communication equipment. Look to Sangamo for your requirements.

SG57-1

**SANGAMO**
**Electric Company**
*Electronic Components Division*
SPRINGFIELD, ILLINOIS

# NEW PRODUCTS

## Cushioned Phono Slide

A newly developed cushion mounted phono slide, which eliminates acoustical feedback in hi-fi systems where speakers are located near record players, has been made available by the Sherry Co., Mamaroneck, New York.

The new development makes it feasible to place the speaker system in the same cabinet enclosure with the other components of the system.

The unique design of the phono slide provides an absolutely smooth glide. Such smoothness is added by the spring which is mounted on nylon rollers for the drawer slides to ride on, thus allowing minimum effort to operate the drawer.

## New Intercom Wireless

A new 6-station selective wireless intercom system designed to operate on any one of six channels without interference with other communication within the system has been announced by the Talk-A-Talk Phone Co., Chicago, Ill.

Selective wireless staff stations and selective paging with reply are featured in the new model. The wireless staffs are designed to operate in combination with the Talk-A-Phone selective wireless masters, and can be used separately as well as in groups of stations to provide individual wireless systems. Individual systems can be used in the same area on the same transformer without interference. Calls placed by masters to paging channels will be received simultaneously at all wireless staffs operating on the channel called.

Wireless staffs are designed to operate with the new Talk-A-Phone LCM-8806 selective wireless master and purportedly provide the only selective wireless system available. Selective communication, conference calls, paging and the exclusive "Sonic Gate" circuit are offered under this system.

Additional units are adaptable since the units plug into the conventional electric outlet and no preparatory installation is necessary.

## New Photographic Process

A new physical system of photography called the Kalvar Process has been demonstrated in Boston by the American Research and Development Corp. Major advantages of the process are the elimination of all chemicals and the time normally required for development, fixation, washi and drying of conventional processe superior storage permanence a simplicity of use. These films a not sensitive to ionizing radiation that, under conditions of atom bomb fall out, this would be the on photographic system remaining operation.

The process involves photographi production of light scattering cente in its surface structure, rather th light absorbing grains, enabling K var photographic materials to be us in all photographic applications whe high light sensitivity is not require It should be of special interest to th newspaper industry, where a varie of applications in photo composi and proofing is necessary.

## New Double-Pole Switch

Mechanical and electrical functio are completely separated in a radically new type of double-pole switc developed by the Tait Manufacturin Co. of Dayton, Ohio. The principal feature is that the parts necessary to the mechanical operation of the switch, including the spring, do not carry electric current. A division inside the switch case made of non-conducting, non-absorbent plastic material separates the mechanical (upper) part of the switch from the electrical (lower) part.

Reportedly the dangers resulting from loss of tension and failure in the spring due to overheating and metal fatigue have been eliminated.

The switch is a lever-actuated, double pole, single-throw, normally closed type. Contact points are heav silver and are self-cleaning. The electrical conductor is made of beryllium; copper and steel parts are cadmium plated to resist moisture.

## Flaws Detected in Metal

Immunol 438, a new, low cost U.S. Government approved material for aqueous phase magnetic particl inspection of metal to detect flaws has been developed recently by Harr Miller Corp., Philadelphia, Pa.

By replacing kerosene and minera spirits, Immunol 438 prevents rusting and obtains a better definition o flaw. In addition, the product is non flammable, odorless, self-cleaning and economical.

Composition includes one part Immunol 438 to seventeen parts wate and this mixture suspends uniforml either fluorescent or non-fluorescen paste.

(*Continued on page* 46)

# WHICH OF THESE JOBS CAN YOU FILL?

| | **COMPUTER AND CONTROL ENGINEERING** | **MISSILE GUIDANCE ENGINEERING** |
|---|---|---|
| **ELECTRICAL AND ELECTRONIC ENGINEERS** with 2 or more years experience in: | • Gyro Development<br>• Servo-mechanisms and Feedback Systems<br>• Analog Computers<br>• Military Specifications<br>• Electronic Circuitry<br>• Magnetic and Transistor Amplifiers<br>• Network Design<br>• Inverters<br>• AC and DC Servo Motors<br>• Electronic Research<br>• Fire Control Systems<br>• Microwaves and Radar<br>  • Antennas<br>  • Beacons<br>  • Receivers<br>  • Transmitters<br>  • Pulse Circuits<br>• Digital Computers and Data Processing | • Gyro Development<br>• Servo-mechanisms and Feedback Systems<br>• Analog Computers<br>• Military Specifications<br>• Electronic Circuitry<br>• Magnetic and Transistor Amplifiers<br>• Network Design<br>• Inverters<br>• AC and DC Servo Motors<br>• Electronic Research<br>• Missile Control Systems |
| **MECHANICAL ENGINEERS** with 2 or more years experience in: | • Inertial Guidance Systems<br>• Gyro Development<br>• Military Specifications<br>• Servo-mechanisms<br>• Product Design and Packaging of Electro-Mechanical Devices<br>• Fire Control Systems | • Inertial Guidance Systems<br>• Gyro Development<br>• Military Specifications<br>• Servo-mechanisms<br>• Product Design and Packaging of Electro-Mechanical Devices |
| **NUCLEAR ENGINEERS AND PHYSICISTS** with experience in: | **NUCLEAR REACTORS**<br>• Control<br>• Metallurgy<br>• Physics<br>• Instrumentation | |

Do you dare tackle tough problems? At Ford Instrument Co., finding the answer to problems is the engineer's prime responsibility. As a result, the engineer who meets this challenge receives the professional and financial rewards his work merits. Our qualifications are high, and we want to be sure you can match the high standards of our present engineering staff. Our projects are too important and too complicated to trust to most engineers. What will you do at FICo? That depends on your specific abilities and experience. For details about the challenge, environment, and opportunity at FICo, write Philip F. McCaffrey at below address.

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DIVISION OF SPERRY RAND CORPORATION

31-10 Thomson Avenue • Long Island City 1, N.Y.

# NEW PRODUCTS

## New Dummy Load

A new high-power, L-band, Dummy Load with direct indicating calorimetric wattmeter, is now in production at WacLine, Inc., 35 So. St. Clair Street, Dayton, Ohio.

The lightweight element of the dummy load is composed of two tapered fluid elements of molded fiberglass construction which are centered inside of a four foot long section of aluminum waveguide. A remote heat-exchanger unit pumps a constant volume of glossy liquid through the tapered fiberglass elements. The glossy liquid absorbs the microwave energy, and the heat is then dissipated by the heat-exchanger unit. The differential liquid temperature between input and output flow connections to the load element is measured by a thermopile element, and a remote meter reads directly the kilowatts of energy absorbed.

The unit operates in a frequency range from 1150 megacycles to 1750 megacycles with a voltage standing wave ratio of less than 1.15 and is rated at 1500 watts maximum average power and 5 megawatts peak pulse power.

## Cementable Teflon Tapes

A complete new line of cementable, glass-supported and unsupported Teflon tapes has been announced by Continental-Diamond Fibre Corp., Newark, Delaware. This miracle material, which has a low coefficient of friction, a non-sticking, corrosion-resistance, and excellent electrical properties, has also been found to be cementable to virtually any type of surface.

Having special value in the electrical and electronic fields, applications include coil, motor winding and electronic chassis insulation, and surface facing on other insulating materials. The glass-supported material differs from the unsupported tape in that it is reinforced with finely-woven strong glass cloth, giving it much greater abrasive resistance, higher tensile strength, lower cold flow, improved dimensional stability, and generally superior mechanical properties.

## Navigation Automatic

Expected to change fundamentally field army flight operations in the future is the newly developed au matic navigator designed by th Ryan Aeronautical Company, Sa Diego, Calif. This self-containe electronic automaton enabled a pilo to fly on course for a distance ove several cities enroute without depending in any way on ground navigational aids.

Information provided by the automatic navigator consisted of exac location, course yet to fly, and distance already flown.

## Plastic TV Screens

Plastic television screens are bein produced by G. Felsenthal & Sons Inc., of Chicago, Ill., which it claim are implosion-proof. When televisio tubes break and their vacuum create inward pressures opposite in direction to explosion, it is called implosion. There is a danger create when parts of a tube bounce forwar after the implosion.

The new plastic screen is said to be able to withstand inward suction and to keep usual flying piece safely confined. According to Felsenthal, the screens, which are manufactured on half the weight of glass, soon will be available for sets in various sizes.

### ower Transient Analyzer

Introduced by American Machine Foundry Company of New York ity is a compact, portable, power ansient analyzer that simultaneously easures, displays and records generor output voltage, frequency, wave-rm and power. This highly de-ndable precision instrument called e "TA-120" directly provides in-rmation that previously required veral pieces of equipment.

Voltage, frequency and KVA are multaneously measured under both eady state and transient conditions. heir ranges are selected with cali-rated, front-panel dials. A string dvanometer oscillograph is supplied ith each analyzer.

Any one of four nominal voltages in be selected. A special channel included to record the voltage aveform on the string galvanometer. oltage and frequency error is less ian 0.1% and less than 1% for a onstant phase to neutral voltage VA output.

### ime Saving Connector and lug Holder

Macdonald and Co., of Glendale, alif., has announced a "Jiffy 157" onnector and Plug Holder for cut-ing down time required to make con-ections to electronic and electrical lugs. Holding any size Cannon or mphenol Connector or Plug, it has he advantage of being adjustable to he operator's most convenient posi-ion for easy soldering or assembly.

The "Jiffy" holder is strong, dur-ble and safe with an all steel case nd parts, and a baked enamel finish. t measures 3¾" in width, 4" in eight, and 4" in depth.

### Mechanical Vibration Measured

Epic Inc. of New York City has eveloped a convenient method to ieasure mechanical vibration with ts Hand Vibrograph. The vibra-ions can be detected in aircraft, ships, nd vehicles, in machinery and its asings or bases, or in component arts such as charts or springs. More laborate measurements are available ith the aid of accessory equipment.

By mere contact with the feeler tube he instrument is able to sense the ibration. Records are inscribed on noving waxed tape and can be evalu-ited immediately. No power line is ecessary because a flashlight battery erves for the time markers.

## New Literature

### Containers for Aviation and Electronics

Craig Systems, Inc. of Danvers, Mass., has issued a new brochure illustrating and describing many types of reusable cases and containers for the aviation and electronic industries. They have passed such tests as submersion, splash, drop, impact, pressure, and vibration.

These cases are designed to protect vital cargo such as guided missiles, missile components, electronic equipment, and airplane parts during transit and storage.

Also included in this brochure are descriptions and illustrations of allied equipment such as spare parts cabinets, operator consoles, and general purpose electronic equipment racks.

### Photoconductors for Detection and Guidance

Infrared-sensitive lead sulfide photoconductors for detection and guidance systems are described in a new bulletin offered by Electronic Corporation of America. Charts for cell response as a function of both wavelength and source temperature are included with technical specifications and ordering information for four general cell types.

Applications of lead sulfide photoconductors are found in fire control, missile guidance, aerial mapping, data reduction and spectropsy.

Copies of the bulletin may be obtained by writing to Electronics Corporation of America, Photoconductor-Transistor Division, 1 Memorial Drive, Cambridge, Mass.

### Selenium Rectifier Replacement Guide

A 52-page Replacement Guide with detailed information on selenium rectifier replacements for servicing literally hundreds of different TV and radio receiver chassis and a variety of other electronic products has been compiled by the Components Division of Federal Telephone and Telegraph Corp. of Clifton, N. J.

This guide also contains trouble shooting, servicing, and testing information on selenium rectifiers, and provides information on the rectifiers in tabular and diagrammatic form. Other sections of the Guide present electrical characteristics of the rectifiers with photos and a cross reference table for replacement of rectifiers of other manufacturers.

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## APPLICATION FOR INDIVIDUAL MEMBERSHIP

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I am a citizen of the U.S.A. .......... ☐ Foreign Associate — $5.00 ☐

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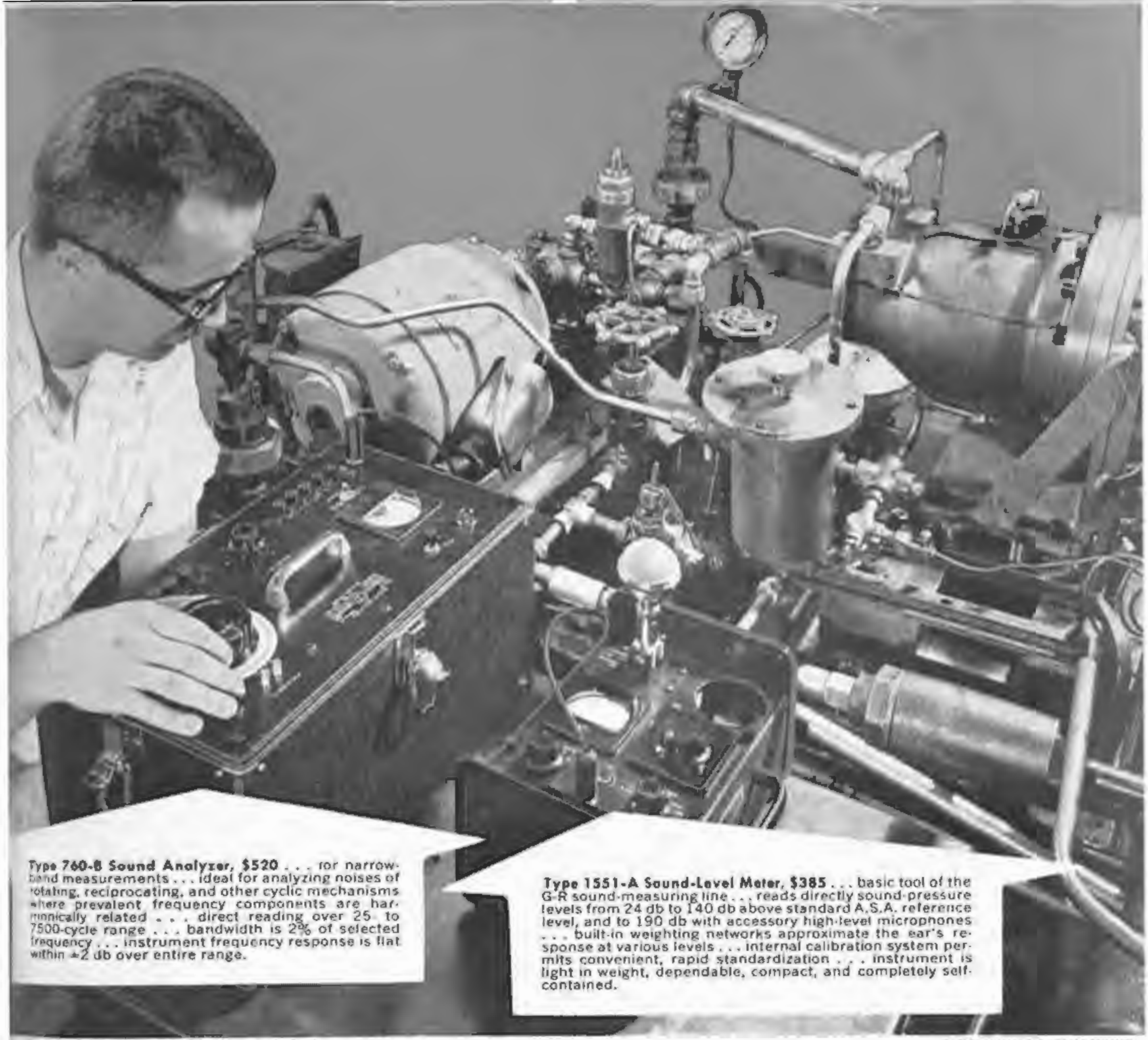
Enclosed find $ .......... for annual dues for AFCEA membership, which includes subscription to the monthly magazine SIGNAL.

DATE: .......... SIGNATURE: ..........



**Type 760-B Sound Analyzer, $520** . . . for narrow-band measurements . . . ideal for analyzing noises of rotating, reciprocating, and other cyclic mechanisms where prevalent frequency components are harmonically related . . . direct reading over 25 to 7500-cycle range . . . bandwidth is 2% of selected frequency . . . instrument frequency response is flat within ±2 db over entire range.

**Type 1551-A Sound-Level Meter, $385** . . . basic tool of the G-R sound-measuring line . . . reads directly sound-pressure levels from 24 db to 140 db above standard A.S.A. reference level, and to 190 db with accessory high-level microphones . . . built-in weighting networks approximate the ear's response at various levels . . . internal calibration system permits convenient, rapid standardization . . . instrument is light in weight, dependable, compact, and completely self-contained.

PHOTO COURTESY THE OILGEAR COMPANY

# NOISE an important factor in Product Sales Appeal

Unwanted sounds emitted by modern-day products must ot constitute a hearing hazard — nor must such noise intere with the efficiency or comfort of the user. Manufacturers f home appliances find noisy products meet sales resistance. roducers of heavy industrial machinery and equipment have milarly learned that noise must be kept to tolerable levels.

The importance of noise control is becoming increasingly cognized. At The Oilgear Company, fluid-power pumps, otors, transmissions, and accessory products must meet efinite performance standards where noise levels are conerned. While these specifications are set forth increasingly y customers themselves, this is to a degree unnecessary — very unit produced is tested, regardless, for conformance to inimum noise level standards. Management well underlands that noise is one more important criterion determining the market position of their product.

At the Oilgear laboratories, the General Radio Sound Analyzer is used in conjunction with the G-R Sound-Level Meter. Here, sound-level data vs. fluid-power pump load and stroke help establish safe operating limits. Studies determine the relationship between discrete frequencies and the various pump components. Information obtained through analysis of the frequency spectrum not only aids in designing better products, but eventually serves as a useful guide in the trouble shooting of pumping equipment malfunctions.

**Increasingly, sound measurements and analyses are being used by industry. Sound measurements can be an important tool in Product Design and Quality Control . . . Safeguarding Against hearing Damage . . . Maintenance . . . and Sales Promotion. Such measurements may be of help to you!**

***WRITE FOR THE SOUND BULLETIN***... **for A Complete Description of General Radio Sound-Measuring Instruments Available For This Work.**

## GENERAL RADIO Company

**275 Massachusetts Avenue, Cambridge 39, Mass., U.S.A.**

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MR. FRED ANDEREGG, SUPERVISOR
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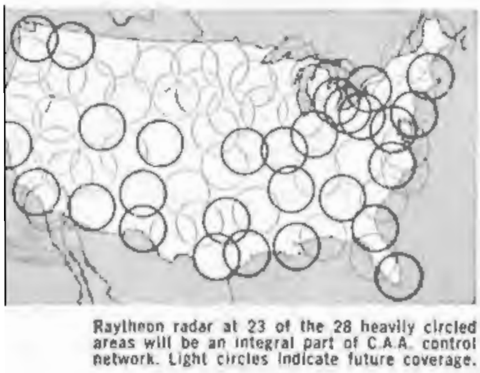
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICH.
A-2-58

C.A.A. buys 23 new Raytheon "Flight-Tracker" Radar

*Long-range equipment to speed schedules, reduce "stacking" and air lane congestion; assure positive air traffic controls—create "more sky to fly in"*



Raytheon radar at 23 of the 28 heavily circled areas will be an integral part of C.A.A. control network. Light circles indicate future coverage.

The Civil Aeronautics Administration has just taken a giant step to solve aviation's biggest problem: air traffic control.

New Raytheon radars with huge 40-foot antennas will be a key part of a complex nationwide air surveillance system that follows and helps safeguard all aircraft during every stage of flight. Radar scopes that display air lane maps pinpoint plane positions at distances up to 200 miles, altitudes to 70,000 feet.

These "Flight-Tracker" radars d tect and track aircraft in all kinds o weather—even see through storms. A unique indicator tells the operator when the unit needs servicing.

By making possible precise new air traffic patterns, by speeding arrivals and departures, Raytheon radar readies the air lanes for the Jet Age. Here is another instance where Raytheon's "Excellence in Electronics" clears a roadblock from America's path to air progress.

RAYTHEON MANUFACTURING COMPANY

Waltham 54, Massachusetts

RAYTHEON

Excellence
in Electro

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# SIGNAL

## AFCEA

## Eleventh Convention Issue

MAY 20, 21, 22, 1957
SHERATON-PARK HOTEL
WASHINGTON, D. C.

THEME:

**Marconi to Mars**

*Communications—Electronics—Photography* **MAY 1957**

SOUVENIR PROGRAM

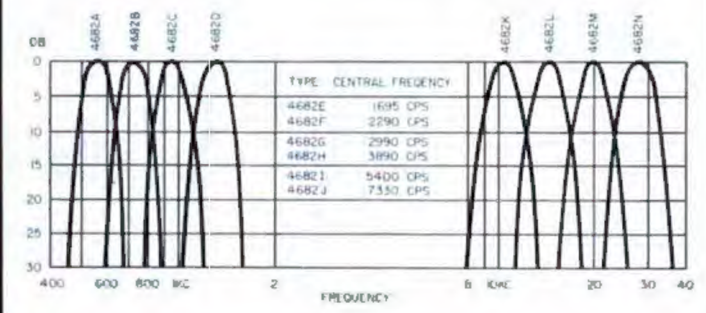
*OUR MILLIONTH FILTER SHIPPED THIS YEAR...*

# FILTERS

## FOR EVERY APPLICATION

### TELEMETERING FILTERS

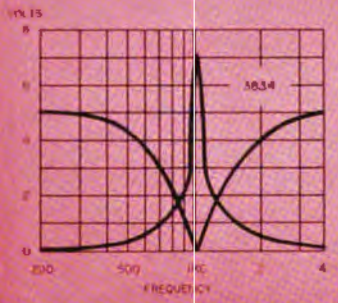
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.

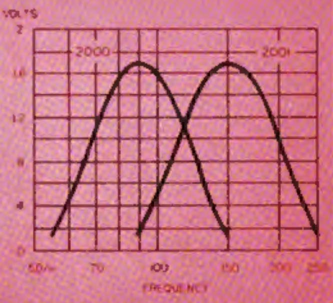


| TYPE | CENTRAL FREQENCY |
|---|---|
| 4682E | 1695 CPS |
| 4682F | 2290 CPS |
| 4682G | 2990 CPS |
| 4682H | 3890 CPS |
| 4682I | 5400 CPS |
| 4682J | 7330 CPS |

**Dimensions:**
**(4682A)** 1½ x 2 x 4"

**Dimensions:**
**(3834)** 1¼ x 1¾ x 2-3/16".
**(2000, 1)** 1¼ x 1¾ x 1⅝".





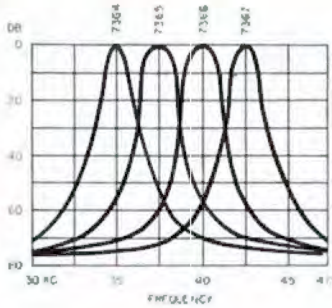
### AIRCRAFT FILTERS

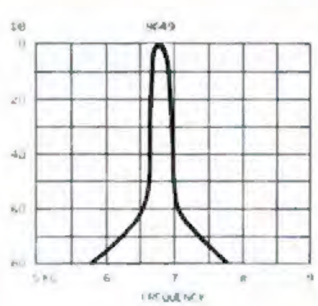
UTC has produced the bulk used in aircraft equipment a decade. The curve at th that of a miniaturized (102 range filter providing high tion between voice and r quencies.

Curves at the right are th miniaturized 90 and 150 cy for glide path systems.

### CARRIER FILTERS

**A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.**

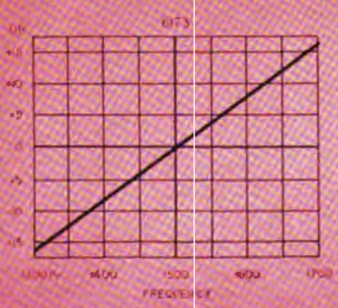


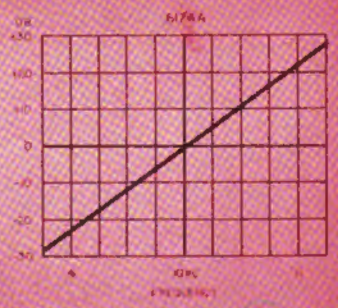


Dimensions:
**(7364 series)** 1½ x 1¾ x 2¼"
**(9649)** 1½ x 2 x 4"

### DISCRIMINATORS

**These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.**





**Dimensions:**
**(6173)** 1-1/16 x 1⅜ x 3".
**(6174A)** 1 x 1¼ x 2⅛".

These are just a few of the items of complete telephone service. A package can be made up for **your own particular needs at home or in the office.**

# A Bigger Package of Telephone Service

***New services and equipment have been developed to meet trend to greater comfort and convenience***

One of the most significant developments of recent years has been the great increase in comforts and conveniences for more and more people.

Recognizing the trend and alert to it, the telephone companies have been accelerating their efforts to find out, and anticipate, what people want and provide it at a reasonable price. The result is a wholly new concept of what is meant by telephone service.

Where formerly it was thought of as just one black instrument, the modern trend is toward a number of telephones at convenient places around the house.

We have helped this new concept by making new style telephones available, along with color, and with spring cords, illuminated dials, volume control, etc.

But the main reason for the success of the idea is that people have found that there is no greater aid to new convenience and comfort than adequate telephone service.

In offices, as well as homes, there is now a much bigger package of telephone service available for everyone.

**Be sure to see the Bell System exhibit. Booths 88-92**

# The gray felt belongs to a LEWYT Engineer...

He's been hanging his hat along side those of the military for years. And at some pretty important places too. Like, M.I.T.'s Lincoln Laboratories, for example. Or the Air Force Cambridge Research Center...or the Signal Corp Engineering Laboratory...or any of the major government research centers for that matter. Lewyt engineers have work with them all in developing the most advanced electronic equipment for the military.

Take Lewyt's Coordinate Data Monitor, for example. Working closely with Air Force Personnel and Lincoln Laboratories...Lewyt engineers helped speed the developm of this complex, urgently needed device...carried the project from idea stage to operating prototype IN JUST 7 MONTHS!

Lewyt's skill and resourcefulness in the application of the most advanced electronic techniques are being applied with equal success to other projects in Data Processing and Data Transmission, UHF and VHF communications, Navigation Guidance, Infra-Red and related fields. Lewyt Manufacturing Corporation, Long Island City 1, N. Y.

*Pictured at left: Lewyt's Coordinate Data Monitor, employs new, improved techniques to synchronize rotation of PPI display with that of remote radar antennas.*

**LEWYT**

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# SIGNAL

**Communications-Electronics-Photography**

Journal of the Armed Forces Communications and Electronics Association

**VOLUME XI** **MAY 1957** **NUMBER 9**

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*Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.*

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*Advisory Editor*
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hoto News
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# ALFAX *opens new horizons in Facsimile Communication and Instrumentation*

# FOR THE ARMED SERVICES

**Serious people all over the world** are now learning first hand the new possibilities opened up by Alfax Paper FROM speeding idea transmission with least possible circuit time and reorganizing of information TO unveiling full resolution of electronic instruments, computers, and detection devices.

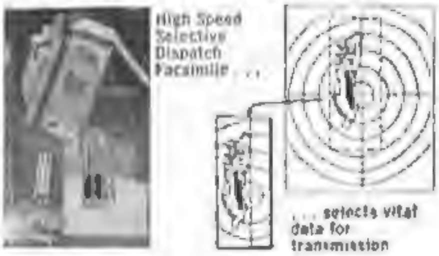
### FORECASTERS ENTHUSIASTIC over new ALDEN WEATHER MAPS

Recording crisp, clear Alfax weather maps with clean white background.

Forecasters are enthusiastic over Alfax maps with their clean white background upon which they can write and erase. The crisp, clear Alfax maps are non-smudging, non-bleeding. They can be overlaid for comparison – and copied easily by Ozalid or Bruning process.

Alfax used in automatic, continuous Alden Recorders is providing fumeless virtually noiseless recording on the widespread U. S. Weather Map Network. Over closed loop or microwave circuits, Alfax records 15 times present telephone speeds.

### ALFAX SPEEDS VITAL RADAR INFORMATION to WARNING CENTERS



Flat Copy Scanner scans only vital portion of radar plot – speeds transmission.

Leaders feel it is almost unbelievable how Alfax in Alden Selective Dispatch Facsimile Systems anticipates nearly every requirement of practical convenience to get pertinent information where needed with a minimum of circuit time.

This system permits selection of pertinent data from any copy–letters, dispatches, and reports–for transmission at speeds up to 72 square inches (900 typewritten, 1800 newspaper type words) per minute. Ideal for sending vital bursts of information and commands–it can also send complete reproduction of any copy in strip form.

Worcester to Boston Test installation of simple, direct transmission of vital radar information.

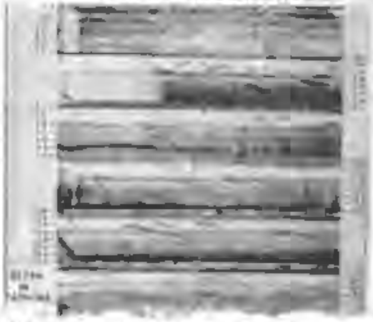
Trial installations for U. S. Weather Bureau have provided operational radar data using induction coupling to telephone lines–private telephone lines – high speed transmissions over short haul lines.

Men concerned with the early severe storm warning have been tremendously intrigued with the results of trial installations for providing Alfax radar dispatches from remote radar station to Warning Centers. Alfax recordings of echo outlines, intensities with movement, heights and obvious weather interpretations annotated – provide 3 to 4 hours advance warning to such centers.

### ALFAX RECORDINGS PIN POINT CEILING HEIGHTS

Alfax paper and Alden recorders demonstrate new high resolution in recording cloud heights from Rotating Beam Ceilometer signals.

### NEW OCEANOGRAPHIC DATA UNVEILED by HIGH RESOLUTION ALFAX RECORDINGS



Alfax recording of suspended echo sounder resolves individual sea life in 25 foot echo return intervals.

Veteran underwater sound men at Woods Hole Oceanographic Institute use the wide tone shade response of Alfax Paper to *record up to 13 echo returns from one output pulse of the Echo Sounder.* Even when the transducer is placed where the noise ratio is higher than the echo return, they still catch the echo returns as distinct, legible recordings.

These versatile, high resolution echo sounder recording systems, designed by the Institute's technical staff around Alden 8" and 19" paper width Recorders, record in discreet steps from 6 to 1200 "flying spot" sweeps/min. by merely flipping a switch. They can record whole echo intervals up to 24,000 ft. depths to "look at" the bottom or magnify full scale some interval as small as 25 feet between the surface and the bottom with an accuracy of one part in 30,000.

### ALFAX INTRIGUES TOP SCIENTISTS

Scientists working in the cardiograph field–brain waves–or like studies have been highly excited. They realized that the Alden recorders, plus shade gradations of Alfax Paper in proportion to output, particularly because of its response in the lighter shades or in responding to transient or weak signals, opened for them new horizons in graphic recording, and they are now able to study layers of strata of phenomena for which previously there had been no ready way of obtaining a record.

Scientists are now using or exploring Alfax Paper for new high resolution recording of:–

- **Magnetic, Ultrasonic, Atomic flow detectors**
- **Infrared, sonar, loran**
- **Frequency spectrum monitoring**
- **Analogue computer outputs**
- **Normalized or sampled radar signals**

**NOTE:** *For specific information on Alden Recorder and Scanner Components or Facsimile equipment, call or write to Alden Electronic and Impulse Recording Equipment Co., Westboro 7, Mass.*

### FOR AN EXCITING GLIMPSE OF THE NEW HORIZONS

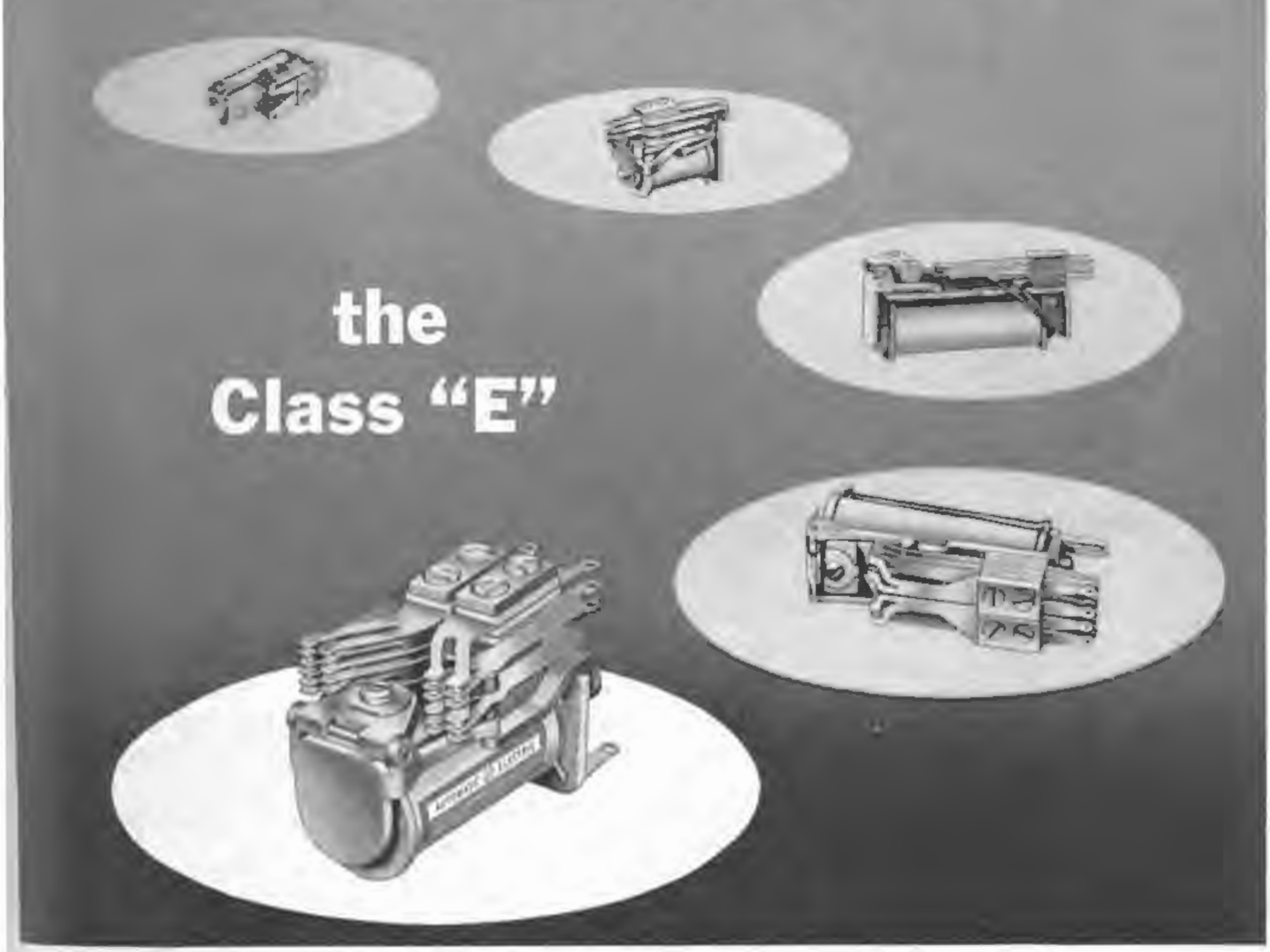
being opened by Alfax Paper in facsimile communication and direct graphic recording, see us at Booth 68 and 69 at AFCEA Convention, Sheraton-Park Hotel, Washington, D.C., May 20-22.

*There's more to tell–write for your Free subscription to ALFAX NEWS.*

## ALFAX PAPER AND ENGINEERING COMPANY

**Alden Research Center, Westboro, Mass.**

# Newest in a long line of relays for industrial control



This is the relay you've asked us to build. Now Automatic Electric is happy to present its latest achievement—the miniature Class "E". We're proud because this husky baby brother of the Class "B" condenses all of its famous features in a minimum of space and weight . . . with no sacrifice of quality! Many Class "E" features appear for the first time in a relay of such compact size. Here's a relay which is indispensable where small size and weight (coupled with reliable performance) are of prime importance.

This new miniature relay comes to you with a solid reputation, backed by 65 years of leadership in automatic dial telephone equipment for America's Independent telephone companies and leadership in industrial controls for industry.

Check these features of the new Class "E"—

- miniaturized, telephone-style, base mounting for rear-connected wiring.
- heavy thickness armature arms (previously available only in larger relays).
- heavy-duty backstop that won't wear out.
- adequate terminal clearances for easy wiring.
- long-life, lubricant-retaining bearing also allows for an easy check of the heelpiece airline setting, without disturbing the adjustment.
- fully independent twin contact springs.
- sturdy, strain-relieved heelpiece insures stability of adjustment.

For more information, call or write Automatic Electric Sales Corporation, Chicago 7. *In Canada:* Automatic Electric Sales (Canada) Ltd., Toronto. *Offices in principal cities.*

**AUTOMATIC ELECTRIC**

A MEMBER OF THE GENERAL TELEPHONE SYSTEM

ONE OF AMERICA'S GREAT COMMUNICATIONS SYSTEMS

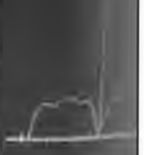
# Leadership: Avionics Design and Packag

## COLLINS in GROUND COMMUNICATION

Collins engineers, designs and supplies the equipment, installs, and puts into operation integrated point-to-point communication systems of any scope. The Collins system engineering staff is backed by the finest equipment in the world, whether standard MF, HF or VHF, Transhorizon "scatter," microwave relay and multiplex or single sideband HF. Typical of Collins communication progress is "Kineplex" — a high speed data transmission system doubling communication capacity.

## COLLINS in AMATEUR RADIO

In the early 1930's Collins set the standard in Amateur radio and, through continuous design and development, has raised this standard to its present single sideband station — the most honored and prized in the Amateur fraternity. This station is the top performing rig on the air with its kilowatt KWS-1 transmitter and highly selective 75A-4 receiver. Many of the leaders in the electronics industry became acquainted with Collins through the Company's superior Amateur equipment.



Collins

CREATIVE LEADER IN AVIATION ELECTRO

*Collins CNI is an efficient electronics package designed to each aircraft type and provides a common logistics base by utilizing identical modules for all aircraft.*

*unication*
*tion*
*cation*

**ced packaging techniques plus increased attention to**
**ms regarding vibration, heat transfer and mutual**
**rence have led to development of the Collins-designed**
**SQ-19 Integrated Electronics System.**

**nnell Aircraft Corporation, first to use this design,**
**en instrumental in proving and refining the system.**

NS In
TION

ompletely outfits airline, military and busi-
raft with the most advanced communica-
igation, flight control and instrumentation
n aviation. Many new lightweight, reduced-
ions are now being delivered. Collins
the original Integrated Flight System, leads
ining comm/nav/ident units into a single
t "CNI" package for new military aircraft,
tinues to pace the industry in developments
rne radar, ADF, ILS, VOR, HF and VHF
nication.

## COLLINS in
## COMPONENTS AND TEST EQUIPMENT

The degree of precision and reliability of Collins products requires development by Collins engineering of components such as Autotunes and Autopositioners, Mechanical Filters, oscillators, heat reducing tube shields and ferrites. These developments and other high quality components are sold by a Collins subsidiary, Communication Accessories Company of Hickman Mills, Missouri. The same principles of accuracy and reliability apply to Collins test equipment, built especially for Collins but adaptable to testing other equipment types.

*Visit the Collins Exhibit at the AFCEA Convention*

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA • DALLAS • BURBANK • NEW YORK
WASHINGTON, D. C. • MIAMI • SEATTLE • COLLINS RADIO COMPANY OF CANADA, LTD., TORONTO • COLLINS RADIO COMPANY OF ENGLAND, LTD., LONDON

From radar antennas to "readout" equipment...

# AMF has experience you can use

• Giant search antennas made by AMF form a vital part of the nation's air surveillance network • And converting the incoming radar signals into instantly understandable information are brain-like AMF Electronic Data Display Systems. The ultimate in "readout" equipment, these compact console units accept either analog or digital information, instantly convert, coordinate, and display the data on the face of a cathode-ray tube. Incoming signals can be interleaved with synthetic symbols for immediate reference, and any segment of the display can be offset and enlarged whenever desired. • See for yourself why, for radar control of air, ground, and harbors, or for general-purpose computer reading, AMF has the experience and equipment you can use.

**Don't miss booths 148-49 at the AFCEA Convention**

*• Armament*
*• Ballistics*
*• Radar Antennas*
*• Guided Missile Support Equipment*
*• Auxiliary Power Supplies*
*• Control Systems*

Another AMF Product
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PRESIDENT PERCY G. BLACK, AFCEA

*Colonel USA, (Ret.)*
*Assistant Vice President*
*Automatic Electric Company*

# A Convention Welcome

I wish to extend a hearty welcome to all members and guests of the Association who are present in Washington or with us in spirit on the occasion of the Eleventh Annual AFCEA Convention.

This Convention in the Nation's Capital opens a new era in AFCEA activities. Here, for the first time, our Exhibitors have an opportunity to display their exhibits to the rank and file of the Department of Defense. These exhibits will be an education to the many visitors who may never have an opportunity to view a communications and electronics display of such variety and magnitude outside of Washington.

Here in Washington, too, the leaders of our industry should be more than ever impressed with their responsibility in the national defense.

In addition to the audience from official Washington, selected engineering students from the universities in and around the Capital have been invited to view the industrial exhibits. This is in furtherance of the AFCEA policy to encourage scientific education throughout the United States, a policy so ably presented by our first President, General David Sarnoff, in an article in this issue.

Your Convention Committee has prepared a splendid program, which, for the first time, will include the presentation of selected technical papers.

The theme, "Marconi to Mars," is aptly descriptive of the scope of the Convention. The speakers, who will address the various meetings, are outstanding in the fields of communications and electronics. The setting for the Convention, Washington in May, is perfect, and I can assure those ladies attending an interesting and colorful program which only Washington can offer.

As my term of office as President of your Association draws to a close, I wish to thank one and all for your loyal support. The untimely death of our Executive Vice President laid a heavy burden on the National Headquarters staff. Thanks to their work and devotion, the Association has weathered a difficult period of readjustment and through their efforts has grown and prospered during the past year.

I would also like to add my deep appreciation to the Officers, Executive Committee, the Board of Directors and the Chapter Officers for their splendid support during my term of office.

# ★ ★ ★ ★ a tribute from Defense

**Wilber M. Brucker**
**Secretary of the Army**

On the occasion of the annual convention of the Armed Forces Communications and Electronics Association, I congratulate its members on the vital role their industrial-military chapters play in our Nation's preparedness. The Association enters upon its second decade of existence, distinguished by an impressive record of national service and achievement.

Your theme, "Marconi to Mars," characterizes the forward-looking concept of your Association, which is helping immeasurably to marshal American resources of skill and knowledge in order that the Army and its sister Services may continue to keep abreast of every advance of modern science and technology, and fully measure up to the challenge of the atomic age.

My best wishes for an inspiring convention and a new year of accomplishment which will be as fruitful for you and our Nation as have been those which are behind you.

Wilber M. Brucker.

★ ★ ★ ★

To the members of the Armed Forces Communications and Electronics Association, I extend greetings and welcome to the Nation's capital. The theme of your convention this year exemplifies progress—a half century of progress which can be matched by few other scientific fields in this fast moving age.

The Air Force is dependent upon the communications-electronics industry to a major degree, not only for the production of new and better devices and systems, but, in association with the military, for developing better methods and techniques to provide for a more effective Air Force combat potential. It is through such close association and the pooling of our experiences that better ways of doing things are evolved. We should do all we can to enhance this mutually profitable relationship in the interest of continued progress, which is so essential to the maintainance of security and world peace.

With best wishes for a successful 1957 convention and continued growth in the future.

**James H. Douglas**
**Secretary of the Air Force**

★ ★ ★ ★

**Thomas S. Gates, Jr.**
**Secretary of the Navy**

The theme of the 1957 AFCEA Convention, "Marconi to Mars," gives occasion for all of us to contemplate the remarkable advances in communications-electronics which have taken place in this Century in which we live. We are especially conscious of this in the Navy, where communications-electronics are so vital to our far flung operations over the vast ocean areas, with the constant necessity for close coordination of our surface, air and sub-surface forces.

Hence, from the days of the spark-gap to the present day of the controlled satellite, the Navy has maintained a continuous and increasing interest in communications-electronics. Last year the Naval Research Laboratory received the first radio waves from the planet Mars, thus opening new vistas for communications-electronics throughout the entire universe.

The AFCEA is to be congratulated on the selection of a convention theme which offers such a challenge to further progress in this field. I extend best wishes for a most successful and stimulating national convention.

EDITORIAL

# M to M

TRULY, IT WAS A GREAT MOMENT IN the history of mankind and the history of Communications when, on March 27, 1899, Guglielmo Marconi, the father of radio, sent a received message from the vicinity of Boulogne, France, to the South Foreland, England, a distance of 32 miles. But today, only 58 years later, hundreds of received messages are sent thousands of miles daily, radar signals are being transmitted to the moon and back, and radio astronomers are picking up waves from stars millions of light years from Earth. Thus has Communications expanded and space dwindled since Marconi. And an entirely new science—a sister to Communications—has come into being, Electronics.

Against this backdrop of startling technical advance, members of the Armed Forces Communications and Electronics Association are now holding their eleventh annual convention at the Sheraton-Park Hotel in Washington. In accordance with their constitution, they are gathering to preserve and foster the spirit of fellowship among Communications, Electronics and Photography personnel of Industry and the Armed Forces; to promote efficiency in military Communications, Electronics and Photography; to further the general growth and development of these fields, and to encourage measures necessary to the national defense.

For the sake of defining mood and direction, a convention deserves a theme, and one has been chosen for the 1957 AFCEA show: To focus thought on both the past and the future of Communications and Electronics and to suggest the rushing, swift pace of progress in these fields, the phrase *Marconi to Mars* has been adopted. *Marconi to Mars!* — the words call to mind great things already accomplished and, at the same time, hint of even greater things yet to come.

*Marconi to Mars!* In recent years particularly, Communications and Electronics have made rich contributions to the welfare and advancement of mankind. Television, radar, electrophotography, facsimile transmission, microwave relays, high speed electronic computers, automatic navigation devices, electronic microscopes and telescopes—these are some of the miracle children already given to society by Communications and Electronics in the Twentieth Century.

And many another boon to civilization can be seen on the horizon, ready and waiting to come out of the future and benefit human life. Instantaneous, two-way communication between individuals anywhere in the world is even now far more than science-fiction. International television broadcasting—what could do more to break down the barrier of strangeness, create sympathy and understanding between nation and nation?—can safely be predicted. The electronic use of thermonuclear materials to produce heat and cold forecasts a completely new approach to heating and refrigeration. And two of Man's oldest and dearest dreams are also apparently about to come true: automation and space travel.

Already automation begins to usher in the Second Industrial Revolution and freedom of the human mind and spirit from the slavery of monotonous labor. The gifts of electronics, data handling machines and systems able to analyze marketing and sales data, schedule production, control manufacturing processes and timetable delivery of finished goods, will not only free human energy for more creative purposes and greater leisure, but they will also guarantee a speed and accuracy of work never before obtainable.

And space travel! *Marconi to Mars!* In this International Geophysical Year, with satellites soon to e launched, the exploration of space seems close at hand and is predicted by many within the next fifty years. What does space travel offer Man? New frontiers for settlement? Possibly, though most scientists think not. But, even if planets suitable for human habitation are never found, it is certain that science itself will be greatly enriched. The exploration of space will give scientists new frames of reference in which to test their hypotheses, their theories and their knowledge; the exploration of space will surely be the most fruitful project in scientific research ever undertaken.

But enough of bright pictures of a brilliant future for Communications, Electronics and the human race. There is much in the present and in the past to presage an entirely different sort of future—or even no future at all!

Much of the unparalled scientific advance this Century has seen does not bode good for civilization; indeed, much of it bodes only waste and destruction. Hydrogen and atom bombs, intercontinental guided ballistics and uranium casings—these are the weapons of mass devastation and ruin—weapons which misguided men of other nations, befuddled by fanatic ideologies, caught in the press and swirl of quickly changing world situations, might seek to use.

*Marconi to Mars!* In one last sense the theme of the convention particularly applies to its business. Both the military and civilian members of the Armed Forces Communications and Electronics Association have, as a chief purpose, the encouragement of measures necessary to the national defense. Surely all would agree that, if the weapons of modern war are ever launched against this country, there may be no future for Communications, Electronics, or the United States of America, unless we are fully prepared to counter with successful military action.

To the Romans, Mars was a symbol of military strength and preparedness. In our day, Mars remains a scientific symbol for electronic research and exploration. Times may have changed through the years but it still makes sense to hitch your wagon to a STAR.

## ADM. ARTHUR W. RADFORD, USN

*Chairman, Joint Chiefs of Staff*

**It gives me great pleasure to greet the members of the Armed Forces Communications and Electronics Association on the occasion of your Eleventh Annual Convention. We in the Armed Forces gladly acknowledge the significant contributions to our military effectiveness which have been made by the segment of American industry and science represented at your Convention.**

**Your Association, with its basic aim of improving cooperation between the Armed Forces and industry in communications, and of preserving the spirit of fellowship among the communications, electronics and photography personnel of industry and the Armed Forces, has provided an invaluable means of liaison among these groups. The vital importance of electronics to national defense makes it imperative that this relationship continue and be firmly cemented.**

**My congratulations and best wishes to each of you for a successful Convention. I regard your Association as a valuable component of our Defense Team. It is more important than ever that the Armed Forces and Industry remain partners in defense.**

★ ★ ★ ★ Arthur Radford

## GEORGE W. BAILEY

*Toastmaster, AFCEA Convention*

**Mr. Bailey was born in Quincy, Massachusetts. He received an A.B. degree from Harvard College in 1907, and is Treasurer of his class.**

**During World War II, Mr. Bailey served in Washington, D. C., as Chief of the Office of Scientific Personnel under Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, for which he was awarded the certificate of merit by President Truman. He was appointed Executive Secretary of the IRE in 1945.**

**He has long been well known as an amateur radio operator. From 1940 to 1952 he held the offices of President of the American Radio Relay League and President of the International Amateur Radio Union.**

**In 1950 he was appointed to the Engineering Sciences Advisory Committee by Major General Lewis B. Hershey, Director of the Selective Service System, and served until the Committee was disbanded in 1953.**

**Mr. Bailey served as President of AFCEA for two terms, having been elected initially by the Board of Directors on May 7, 1954. Presently, he is a Director of the Association and a member of its Executive Committee.**

**Possessing a pleasing personality and know how, he has been instrumental in furthering the progress of many organizations and has become known world-wide in the field of communications and electronics.**

## REAR ADMIRAL JOSEPH R. REDMAN

*Vice President, Western Union*

AFCEA CONVENTION CHAIRMAN

★ ★ ★ ★

**Affectionately known as "Joe" by his many friends, Admiral Redman is a Westerner by birth and cut his eye teeth in a "he man" gold mining town in California. Graduating with a BS degree from the U.S. Naval Academy and later completing studies in electrical engineering at the Post Graduate School, Annapolis, Maryland, and Columbia University, he received his Master of Science degree in 1921. In 1946, Admiral Redman was awarded an honorary Doctor of Law Degree from the University of Nevada—the institution he attended before entering the U.S. Naval Academy. With seventeen years of distinguished service at sea and fifteen years of service in positions of great responsibility ashore, Admiral Redman was a natural choice to become a Vice President of Western Union upon his retirement in 1946. He makes his permanent headquarters in Washington, D. C., to insure effective coordination of the telegraph company's domestic and international communications facilities with the heads of the military and other Government departments. His sense of humor, drive and enthusiasm are those characteristics which mark him as "that type of leader" we like to think about whenever we refer to civilian-military progress.**

**On the military side, in Admiral Redman, the Navy found a man in whom was combined sound naval training, long experience on surface and undersea craft, administrative ability, a scientific and technical background, and a flare for leadership. He was the second officer in the history of Naval Communications Service to hold the Directorship of Naval Communications for two tours of duty.**

**Through his exercise of foresight, energy, knowledge and wisdom, the world-wide expansion and modernization of the Navy's communications system was accomplished during World War II. For this he received one of our Nation's meritorious awards, the Distinguished Service Medal. Under his direction, certain methods, which had a vital part in the successful prosecution of the war, were developed. They may not be disclosed but are known to a past President of the U.S. and a Secretary of the Navy.**

**He served in the Southwest Pacific Forces on patrol in the Coral Sea as Commander of the Cruiser *USS Phoenix* from October 1942 to April 1943. Among his many other decorations is an award made by the King of England, as Commander of the Military Division of the Order of the British Empire. Admiral Redman was the Navy Representative during the war on the Joint Communications Board, the Combined Communications Board, the Board of War Communications, and the State Department's Telecommunications Committee. Having been selected three times by the State Department to represent the U.S. at international communications conferences (known as CCIR), he served with distinction at Copenhagen, Madrid and Cairo. He is an honorary member of the Veteran Wireless Operators Association and a past national President of AFCEA.**

**The Armed Forces Communications and Electronics Association wishes to express its appreciation and thanks to Admiral Redman and his staff for the efficient organization of this year's convention. As Convention Chairman, he has scored again.**

# AFCEA NATIONAL CONVENTION PROGRAM

**May 20, 21, 22, 1957.**
**Monday, Tuesday, Wednesday.**

- 103 Exhibitors
- 150 Exhibit Units
- Daily Technical Sessions

**Washington, D. C**
**Sheraton-Park Hote**

- Trip to Naval Research Lab
- 6 Important Social Event
- Special Program for Ladie

## EVENTS

### Monday, May 20th

8:30 AM—Sheraton Hall
**Opening Breakfast**
9:30 AM— **Official Opening of Exhibits**
10:00 AM—Caribar Room
**Chapter Presidents Conference**
10:00 AM-12:00—Continental Room
**Engineering Papers on Research and Application**
12:30 PM—Sheraton Hall—**Keynote Luncheon, RAdm. R. Bennett**
2:00 PM-5:00 PM—Adams Hamilton Room
**Industrial Movies**
2:30 PM-4:30 PM—Sheraton Hall
**Panel on Scatter Propagation, Moderator; RAdm. J. Wenger**
7:00 PM—Continental Room
**Reception**
8:00 PM—Sheraton Hall
**Buffet Supper**

**Exhibits: 9:30 AM—9:00 PM**

### Tuesday, May 21st

9:00 AM—Caribar Room
**Council & Directors Meeting**
10:00 AM-12:00—Continental Room
**Engineering Papers on Research and Application**
12:00 AM—Busses to Naval Research Laboratory
**Embark at hotel, clearance at NRL, lunch, tour, return at 3:30 PM**
2:00 PM-5:00 PM—Adams Hamilton Room
**Industrial Movies**
7:00 PM—Continental Room
**Reception**
8:00 PM—Sheraton Hall—**Banquet**
Speaker: **Donald C. Power,** President, General Tel. Corp.

**Exhibits: 9:00 AM—9:00 PM**

### Wednesday, May 22nd

8:00 AM—Caribar Room
**Officers & Directors Breakfast**
10:00 AM-12:00—Continental Room
**Engineering Papers on Research and Application**
12:30 PM—Sheraton Hall
**Industrial Luncheon**
Speakers: **The Hon. Frank D. Newbury,** Asst. Sec'y. Def., Research & Engineering, and **Mr. James M. Bridges,** Director of Electronics, Office of Asst. Sec'y. Def., R. & E.
Question and Answer Period
2:00 PM-5:00 PM—Adams Hamilton Room
**Industrial Movies**

**Exhibits: 9:00 AM—5:00 PM**

## FOR THE LADIES

### Monday, May 20th

9:30 A.M.—Assemble in the Madison Room for a Continental breakfast, "get acquainted hour," and review of plans.
11:30 A.M.—Assemble in the Madison Room
12:00 Noon—Buses leave for Fort McNair—Quarters 11
12:30 P.M.—Mrs. James D. O'Connell will greet the ladies at her home.
1:30 P.M.—Luncheon—Fort McNair Club
There will be a nominal charge of $2.00 to help defray expenses.
7:00 P.M.—RECEPTION AND BUFFET SUPPER, Sheraton-Park Hotel.

Mrs. Frances C. Engel

### Tuesday, May 21st

9:45 A.M.—Assemble in the Madison Room
10:15 A.M.—Private cars leave for Georgetown and Embassy Tour (If you are the scientific type, an interesting tour of the Naval Research Laboratory is scheduled at 11:30—Transportation and lunch—$2.75)
1:45 P.M.—Assemble in the Madison Room
2:15 P.M.—Buses leave for Capitol Tour
7:00 P.M.—RECEPTION AND BANQUET

### Wednesday, May 22nd

9:45 A.M.—Assemble in the Madison Room
10:15 A.M.—Buses leave for National Gallery of Art

Committee: Mesdames Engel (Chairman), Black, Clark, Finley, Finley, Jacocks, O'Connell, Redman, Saddler, Wenger.

# *Technical Papers:*

### *Monday, May 20, 1957*

***10:00-10:30*** "Rapid Fault Elimination in Complex Electronic Systems" by J. F. Scully, Monroe Calculating Machine Co.
SYNOPSIS: Rapid elimination of faults in complex electronic systems is mandatory if full operational use is to be made of their inherent capabilities. An automatic diagnosis system employing dual equipments for detection and location of defective components has been in field use for some time. Extension of the system is being made to non-dual circuits. In addition, the new system employs automatic marginal checking during operation without loss of operational time.

***0:30-11:00*** "Single Sideband Receivers" by H. F. Comfort, Radio Corporation of America
SYNOPSIS: A single sideband receiver equipment with pulse locked generator frequency control system is described. This equipment was developed with frequency control that will meet performance requirements for multiple-tone operation, voice and twin sideband. The advantages and disadvantages of single sideband versus double sideband are discussed as well as the stability requirements.

***1:00-11:30*** "Single Sideband for Air-Ground Communications" by E. W. Pappenfus, Collins Radio Co.
SYNOPSIS: A discussion of the present-day requirements for air-ground communications with a listing of limitations of airborne high frequency equipment. The advantages to be offered by single sideband emission will be given and special operating features of airborne single sideband transmitters and receivers will be stressed. The paper will conclude with a brief description and specifications of an airborne single sideband transceiver now in development.

***11:30-12:00*** "A Single Sideband Radio Central to Replace Military Wire Lines" by A. M. Creighton, Motorola, Inc.
SYNOPSIS: A description of a practical system and equipment for communication between mobile stations that would function in a manner similar to the telephone. Duplex type speech transmission is achieved and also selective calling of the different subscribers. The system is a multiplexed communications system supplying full duplex telephone type service to mobile subscribers. Employed in the system are single sideband techniques, and it operates in the 150 mc range. Spectrum efficiency is achieved by channel spacing of only 6 kc.

## *Tuesday, May 21, 1957*

***10:00-10:30*** "The Trend of Facsimile in Military Communications" by A. G. Cooley, Times Facsimile Corporation
SYNOPSIS: The trend of facsimile in military communications began in 1923 with ship-to-shore transmissions and plane-to-ground transmissions in 1930. At present its greatest application is in meteorological services. Other uses include: message communications and transmission of X-ray films. The successful transmission of a newspaper to San Francisco over a video channel has encouraged communicators to look toward high speed facsimile as the answer to trunk line communications. Facsimile's commercial success points to widespread adaptation in military systems.

***10:30-11:00*** "Processing, Narrow-Band Transmission, and Remote Display of Radar Data" by S. P. Detwiler, Lewyt Manufacturing Corporation
SYNOPSIS: The processing and narrow-band transmission of gap-filler-radar data for use in the SAGE system is discussed with a minimum of theoretical detail. The performance of these functions by Coordinate Data Transmitter AN/FST-1 is described, with particular attention being paid to the digital integration techniques employed. The possible application of these techniques to other radar display problems is discussed. A short description of the Coordinate Data Monitor OA-947 remote indicator and its operation is also included.

***11:00-11:30*** "Multiplexing Circuits in the National Air Defense Communications Networks" by J. B. Nangle, Lenkurt Electric Co.
SYNOPSIS: An acute problem in developing a communications network for the continental air defense system is the linking of remote outposts with computing and command centers and with each other. Point to point and forward scatter microwave systems multiplexed with single sideband carrier have proven one of the most practical methods. This carrier equipment is similar to that used by commercial telephone companies and permits the maximum number of channels to be transmitted over a microwave system. The availability of proven commercial carrier equipment as an interim measure has been of great value to air defense communications.

***11:30-12:00*** "The Air Route Surveillance Radar for U.S.A. Air Traffic Control" by B. I. McCaffrey, Raytheon Manufacturing Co.
SYNOPSIS: The increase in speed of aircraft and in the amount of air traffic during the last decade is going to make Grand Canyon crashes all too common if we do not soon have a major overhaul of our air traffic control system. The decision to undertake the overhaul has been evidenced by the procurement program sponsored by the Civil Aeronautics Administration, designed to provide complete nationwide radar coverage by means of long range surveillance radar equipment. Some of the important characteristics of a long range surveillance system for air traffic control are range performance, resolution in range and in azimuth, ability to separate moving from fixed targets and discrimination against clutter and reliability of operation. Performance is to be achieved in the CAA radar by many proven techniques as well as a few recently developed devices. Circular Polarization, cascade cancellation for Moving Target Indication, high angle cosecant squared antenna coverage, low noise figure and L-band components are some of the means used by experienced design engineers to meet the tough requirements specified by the CAA. This will result in the installation within the U.S.A. of excellent Air Route Surveillance facilities leading to improved air traffic safety coast to coast.

## *Wednesday, May 22, 1957*

***10:00-10:30*** "The Vanguard Launching Vehicle Instrumentation System" by V. J. Crouse, The Glenn L. Martin Co.
SYNOPSIS: Instrumentation plays a vital role in the flight test program which will precede the launching of the first earth satellite. Precision measurements must be made in the presence of liquids and gases corrosive enough to etch most types of steel and at temperatures ranging from more than 900 degrees Fahrenheit to 300 below zero. Each test vehicle will carry an instrumentation system capable of making between 150 and 200 different measurements of such items as pressures, voltages and currents, temperatures, strains and acceleration.

***10:30-11:00*** "Results of a Simple Technique for Handling Complex Microwave Circuits" by Alexander Horvath, Sylvania Electronic Defense Laboratory
SYNOPSIS: A brief description of a technique to obtain the design parameters for complex circuits consisting of short lengths of transmission line. Several examples are presented of the application of the technique to common problems. Results show the superior performance that has been obtained with a variety of components in the .5 to 10.0 kmc range. The components include filters, couplers, and a 90° differential phase shifter.

***11:00-11:30*** "A Fully Automatic Teletypewriter Distribution System" by Leith Johnston, Automatic Electric Co.
SYNOPSIS: A description of a fully automatic teletypewriter distribution system which delivers a message to a plurality of local and remote stations as directed by three character delivery distribution indicators included in the heading of the message. Each delivery distribution indicator can direct the message to as many as ten stations. While the system was designed to meet military specifications, the switching principles used are applicable to commercial teletypewriter traffic also.

***11:30-12:00*** "Some Aspects of Telegraphic Data Preparation and Transmission" by W. B. Blanton, Western Union Telegraph Co.
SYNOPSIS: A brief explanation of the use of telegraphic principles and equipments in the original preparation and transmission of data, and in directing, switching, and sorting data at telegraph or computer centers. Inasmuch as most present-day telegraph networks operate with 5-level punched paper tape, particular emphasis will be given to describing a 5-level transmission system arranged for detecting transmission and equipment errors, and automatically assuring a correct received copy. A model of this equipment will be displayed.

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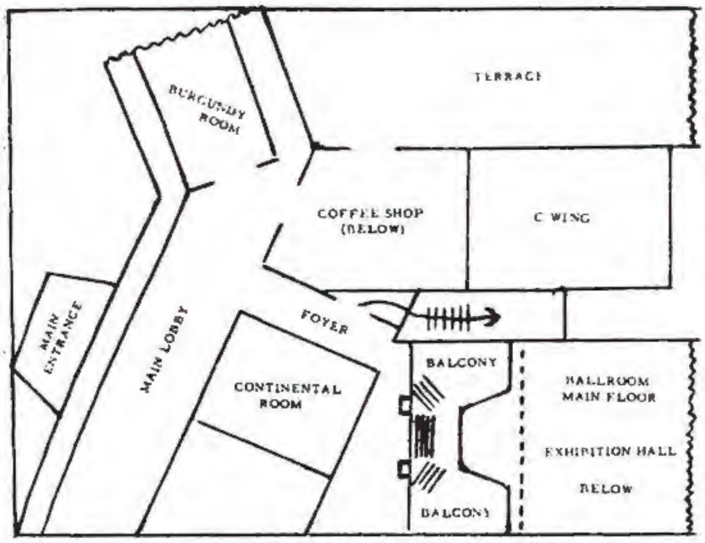
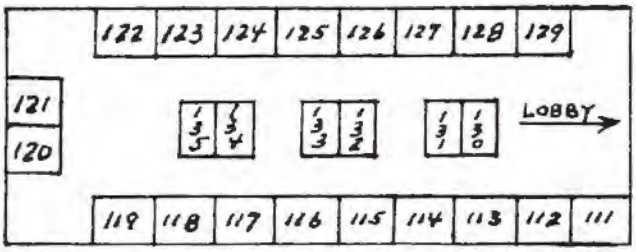
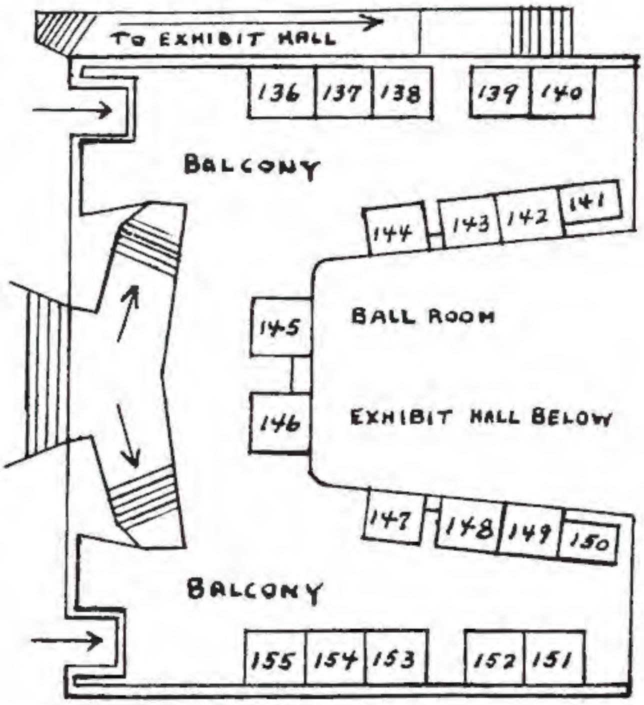




Burgundy Room

Technical sessions and forums will be held in the Ballroom or Continental Room. Exhibits will be held in the Burgundy Room; Balcony of Ballroom; and Exhibit Room below the Ballroom.



Balcony of Ballroom →

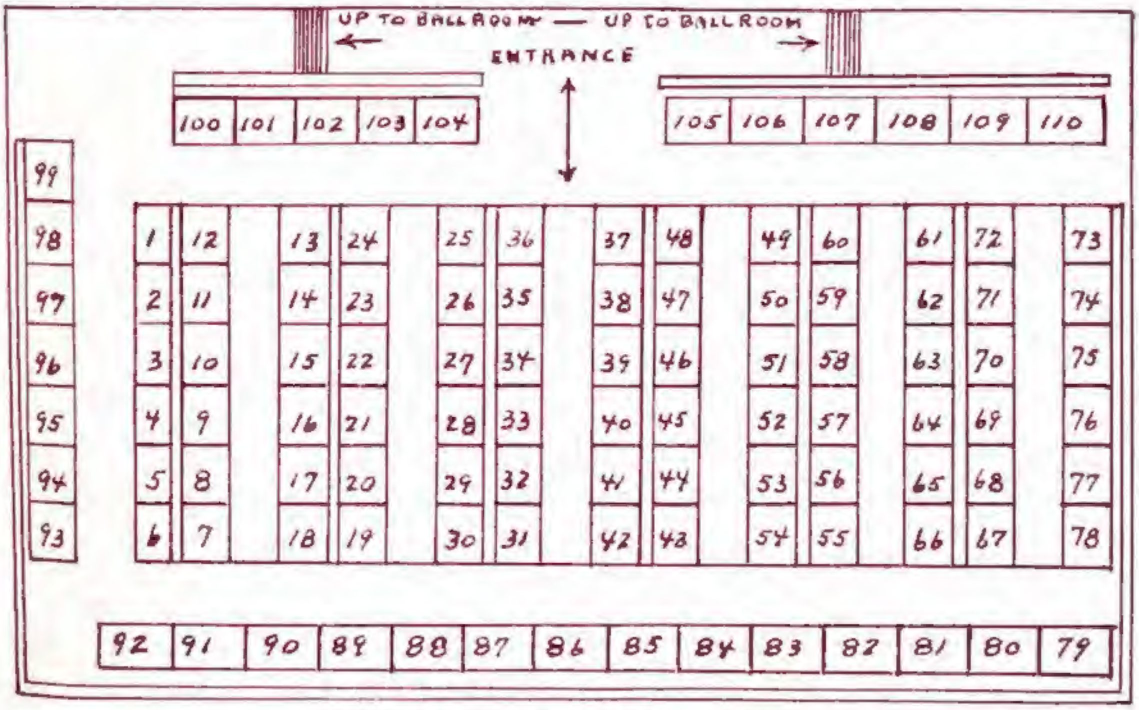


Exhibit Room below the Ballroom

# Convention Speakers

★ ★ ★ ★

**Donald C. Power**
**President**
**General Telephone Corp.**

## BANQUET ADDRESS

### Stairways to the Stars

Synopsis: The American telephone industry has long been a natural breeding and testing ground for electronic research and development of greatest importance to progress by Government scientists and others engaged in projects required in our national interest. The mutual and reciprocal benefits of this co-operative relationship for both the federal Government service and the public service performed by this industry have been clearly demonstrated. The new horizons opened up by such projects as the earth satellite, Vanguard, and the probing of outer space will prove no exception. The brainchildren of daily business operations are already climbing their earth-made stairways to the stars.

★ ★ ★ ★

## INDUSTRIAL LUNCHEON ADDRESS

### Defense Research and Engineering

Synopsis: The Honorable Frank D. Newbury will explain the operations of the office of The Assistant Secretary of Defense for Research and Engineering and the relationship of this office and its organization to industry and national security.

**The Hon. Frank D. Newbury**
**Assistant Secretary of Defense**
**Research & Engineering**

★ ★ ★ ★

## INDUSTRIAL LUNCHEON ADDRESS

### Defense Research and Engineering

Synopsis: A discussion of the ever-increasing complexities of electronic equipment and systems in military applications. Major emphasis will be given to the critical problems developing in our national defense effort. Among these are included sky rocketing costs for weapon system electronic development and production, unrealizable demands upon scientific and engineering manpower, continually more difficult problems of attaining acceptable reliability, and the extension of weapon system development time cycles. Another important aspect of Mr. Bridges' talk will relate to some of the causes for expensive research and development costs for engineering efforts.

**James M. Bridges**
**Director of Electronics**
**Office of Asst. Sec. of Defense**

RAdm. Joseph N. Wenger
Director, Communications and Electronics, Joint Chiefs of Staff

# SYMPOSIUM MODERATOR ON SCATTER PROPAGATION

★ ★ ★ ★

RAdm. Rawson Bennett
Chief of Naval Research

# SPEAKER KEYNOTE LUNCHEON

★ ★ ★ ★

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## EXHIBIT MANAGEMENT

**WILLIAM C. COPP & ASSOCIATES**
**1475 Broadway • New York 36, N. Y. • BRyant 9-7550**

***Ace Electronics Associates, Inc.*** ***Booth #30***
**99 Dover Street, Somerville 44, Mass.**
Acepot, sub-miniature ½" precision wire wound potentiometer, Acepot, nonlinear potentiometer 1" to 3"; Acetrim, sub-miniature precision wire wound potentiometer trimmer; Aceohm, sub-miniature precision wire wound potentiometer trimmer; Ace-relay, subminiature relay.

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***Admiral Corp.*** ***Booths #79, 80***
**3800 Cortland St., Chicago 47, Ill.**
Two of Admiral Corporation's contributions to the Communications of the Armed Forces are featured in the exhibit: The light weight 1750 channel communications receiver AN/ARC-55 and its amazing subminiaturized control box. Selection of any of the 1750 channels from a remote position is demonstrated.

► **See ad on page 129** ◄

***The Airpax Products Co.*** ***Booth #137***
**Middle River, Baltimore 20, Md.**
High vibration chopper, demonstration of Ferrac magnetic amplifier, demonstration of miniature magnetic circuit breaker, magmeter frequency detector for telemetering, and Pulsite pulse transformers.

***Alden Electronic & Impulse Recording Equipment Co.*** ***Booth #68***
**Alden Research Center, Westboro, Mass.**
High speed facsimile communication systems, flat copy optical scanning, "Quick See" visible recording ceilometer, weather, and radar recording.

► **See ad on page 4** ◄

***Alfax Paper & Engineering Co.*** ***Booth #69***
**Alden Research Center, Westboro, Mass.**
New 1,000 inch/sec. instantly visual electrosensitive recording paper.

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***American Instrument Co., Inc.*** ***Booth #19***
**8030 Ga. Ave., Silver Spring, Md.**
Aminco Climate-Lab for testing electronic components under MIL and JAN specifications; Aminco-Aire for separate chamber humidity conditioning; Humidity sensing elements and Hygrometer control systems, NEW ice, snow, sleet detector for outside installation.

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***American Machine & Foundry Co.*** ***Booths #148, 149***
**Defense Products Group**
**1101 N. Royal St., Alexandria, Va.**
AMF "Digitron"—a dynamic display of selected symbols on a cathode-ray tube. Power Transient Analyzer. Frequency Meter. Potter and Brumfield Relays. AMF Silver-Zinc Batteries.

► **See ad on page 8** ◄

# EXHIBITS—continued

***American Telephone & Telegraph Co.* *Booths #88, 89, 90, 91, 92***
**32 Ave. of the Americas, N. Y. 13, N. Y.**
Bell System looks ahead for defense. New magnetic core amplifier and new UHF radio service with off-site supervisory control. Communications networks are ready in case of enemy attack. Bell System effort is helping to make the DEW line a reality.

▶ See ad on page 1 ◀

***A.R.F. Products, Inc.* *Booth #1***
**7627 Lake St., River Forest, Ill.**
Exhibit displays equipment from A.R.F. Products. Inc., Research and Manufacturing Facilities: AR-1A Deviation Meter; AN/UPM-15 Pulse Generator; Pulse Type Transmitter and Receiver for Remote Control; URM-48 FM Signal Generator; ARN-18 Glide Slope Receiver; Dummy Load for Testing Radar; Fabricated Components such as Transit Cases, Dust Covers, Chassis, etc.

***The Arnold Engineering Co.* *Booth #129***
**P. O. Box G, Marengo, Ill.**
Exhibit highlights magnetic materials which include Alnico permanent magnets, cast and sintered; Silectron "C," "E," and "O" cores; tape wound cores of high permeability alloys, including Deltamax, Supermalloy and 4-79 Mo-Permalloy; bobbin cores for computer applications; Molybdenum Permalloy powder cores; iron powder cores; Vicalloy, Cunife, Supermendur and other special magnetic materials.

▶ See ad on page 133 ◀

***Automatic Electric Sales Corp.* *Booth #61***
**1033 W. Van Buren St., Chicago 7, Ill.**
Automatic Electric, whose relays and stepping switches form the "brains" of the Signal Corps' AN:FGC-30 central office teletypewriter switching center, introduces its class "E" relay that reduces the best of the class "B" relay features to a minimum on space and weight.

▶ See ad on page 5 ◀

***Automatic Telephone & Electric Co., Ltd.* *Booth #21***
**Strowger Works, Liverpool 7, England**
Telegraph distortion measuring sets; Electronic regenerative repeaters; Narrow-band frequency-shift and pilot-carrier telegraph systems as used by Airways and Air Communication Service of USAF on "STRATCOM" system. All equipment being demonstrated.

***Autonetics, A Division of North American Aviation, Inc.* *Booths #29, 30***
**9150 E. Imperial Highway, Bellflower, Calif.**
Exhibit will feature Autonetics "Jewels of Industry" as applied to automatic navigation, armament control and flight control systems, analog and digital computers, automatic machine tool controls, airborne instrumentation and special products.

***Behlman Engineering Co.* *Booth #146***
**114 So. Hollywood Way, Burbank, Calif.**
The Behlman invertron is an electronic AC power source. It features exceptional stability, accuracy and versatility. It can be obtained in a wide variety of models to cover any desired frequency range, either fixed or variable, and any desired power output. The invertron is completely electronic; there is no rotating equipment involved.

***Bell Aircraft Corp., Avionics Division* *Booths #97, 98***
**P. O. Box 1, Buffalo 5, N. Y.**
Bell Aircraft's exhibit presents newsmaking achievements in the field of avionics. The automatic carrier landing system, inertial instrumentation system, radar-guidance and control components, servo valves, precision accelerometers, integrators and transistorized temperature control amplifiers represent only a few of the systems and equipments which are highlighted.

▶ See ad on page 147 ◀

***Bell & Gossett Co.* *Booth #118***
***(See listing page 24)***

***Bendix Aviation Corp., Pacific Div.* *Booth #45***
**North Hollywood, Calif.**
Decca Navigation System for helicopters makes navigation as simple as following a road map in any weather.

***Bendix Aviation Corp., Bendix Radio Division* *Booth #44***
**Baltimore, Maryland**

***Bird Electronic Corp.* *Booth #128***
**1800 E. 38th St., Cleveland 14, Ohio**
Products Exhibited: Power measuring equipment for UHF-VHF frequencies; Termaline & Thruline R. F. Wattmeters; Termaline RF Resistors; Coaxial Switches; Coaxial RF Filters.

***Bodnar Industries, Railway Electronics, Inc.* *Booth #83***
**238 Huguenot St., New Rochelle, N. Y.**
New Amendments to Government Specs make it increasingly important to see and hear about the latest developments: Bodnar Panels and Dials in accordance with MIL-P7788 'Special Coating' approved process, Integral lighting of instruments and meters as outlined in Air Force Exhibit WCLSI-2-204, 'Railway Electronics' Portable Telegraph, Bias and Distortion Meter designed by Western Union.

***Boston Insulated Wire & Cable Co.* *Booth #114***
**65 Bay St., Boston 25, Mass.**
Insulated wires and cables specifically designed for military applications.

***Burgoyne Testing Laboratories, Inc.* *Booth #138***
**542 Main St., Westbury, N. Y.**
Military Equipment Manufacturers, including: Environmental — High — Low Temperature — Altitude — Humidity — Salt Spray—Sand and Dust—Sunshine —Rain — Immersion — Fungus — Explosion Proof — Shock — Vibration — Acceleration, etc. *Mettalurgy*—Photomicrographs — Metalographs — Experimental Heat Treating—Micro Hardness—Tensile, etc. *Chemical*—Qualitative—Quantitative analyses of metals and materials. *Quality Control*—X-Ray—Magnaflux. Zyglo. etc. Other facilities for testing.

***Burroughs Corp., Defense Sales Dir.* *Booths #55, 56, 57***
**6071 2nd Ave., Detroit 32, Mich.**
Demonstration of new techniques in lenticular optics; BCT 301 core tester; magnetic core memory plane and other core devices; transfer storage counter; magnetron beam switching tubes; miniature and jumbo Nixie indicator tubes; printed circuit cards and other electronic components from SAGE computer; electronic and electro-mechanical communications gear.

▶ See ad on page 111 ◀

***Capitol Radio Engineering Institute* *Booth #12***
**3224 16th St., N.W., Washington, D. C.**
CREI residence and home study programs in electronic engineering technology and management.

▶ See ad on page 56 ◀

***CGS Laboratories, Inc.* *Booth #63***
**391 Ludlow St., Stamford, Conn.**
Multicoupler for 2-32 mc, CU-483 with our FDA (Frequency Distributed Amplifier). Live demonstration of TRAK Code Converter producing page copy automatically from Morse Code off the air. TRAK Static Rejector with circuitry newly arranged on hinged vertical panels. TRAK Panoramic Receiver with no moving parts for 100-150 mc. Model PAN-1C tuned with INCREDUCTOR saturable reactors. Registration in ECM organization, Association of Old Crows.

▶ See ad on page 134 ◀

***Collins Radio Co.* *Booths #94, 95***
**Cedar Rapids, Iowa**
Exhibit stresses Collins' participation in single sideband, scatter and microwave systems, typical items of Collins airborne and ground communications equipment developed for the military services.

▶ See ad on pages 6, 7 ◀

***The Combined Book Exhibit, Inc.* *Booth #126***
**950 University Ave., N. Y. 52, N. Y.**
A subject display of recent technical books of many publishers will be shown.

***Connecticut Telephone & Electric Corp.* *Booth #62***
**70 Britannia St., Meriden, Conn.**
Telephone communication equipment, carrier equipment. UHF-VHF radio. miscellaneous electro-mechanical and

electronic equipments and components (unclassified) manufactured for the Navy, Air Force, and Signal Corps.

***Copperweld Steel Co.*** ***Booth #22***
**Glassport, Penna.**
Exhibit features Copperweld products made by the unique molten-welding process, in which a heavy copper covering is inseparably welded to an alloy steel core. These products are: line wire, guy and messenger strand, antenna wire, ground pads and clamps, anchor pads, insulator ties and fine wire.

***Craig Systems, Inc.*** ***Booths #64, 65***
**Danvers, Massachusetts**
HELICOP-HUT Radio Relay Station and HELICOP-HUT Radio Navigation Station. Two self-contained, lightweight, highly mobile communications systems that can be packed up and transported by helicopter to remote locations and put into operation within minutes. Extra mobility features include device for truck load and dolly for towing HELICOP-HUT over land.

***Dage Television Div., Thompson Products, Inc.*** ***Booth #67***
**W. 10th St., Michigan City, Ind.**
Dage Television Division will exhibit newest military weather vision console, model 785-W-2 complete with basic weather vision system accessories. Dage weather Division equipment now installed at Grandview AFB, Missouri; McGuire AFB, New Jersey. Weather Vision, newest means of providing complete weather briefing and information from one central point on a base to many remote receiving locations saving personnel, time, money and effort.

***Daystrom, Inc.*** ***Booths #41, 42***
**430 Mountain Ave., Murray Hill, N. J.**
Newest equipment from all Daystrom divisions for use in aircraft communications and navigation control, electronic and electrical instruments for general military use and other specialized electronic systems for defense use. See Daystrom for quality leadership and dependability in instrumentation.

**► See ad on pages 36, 37 ◄**

***Dictaphone Corp.*** ***Booth #11***
**430 Lexington Ave., N. Y. 17, N. Y.**
New dictaphone dictet portable tape recorder—under three pounds, battery-powered, transistorized amplifier. New dictaphone multi-channel continuous recording equipment dictatape, dictacord, dictalog.

***Douglas Microwave Co., Inc.*** ***Booth #54***
**232 E. 3rd St., Mt. Vernon, N. Y.**
Complete line of microwave and radar test equipment and components including our new coaxial continuously variable attenuators and broad band high directivity directional couplers.

**► See ad on page 146 ◄**

***Du Mont Laboratories, Inc., Allen B.*** ***Booth #99***
**750 Bloomfield Ave., Clifton, N. J.**
A variety of special tubes including cathode-ray tubes, multi-gun tubes, multiplier phototubes, image converters, display cathode-ray tubes, airborne and shipborne radar; bright display equipment for airport use; military television equipment; mobile communications equipment; oscilloscopes and air traffic control scopes; special transformers and transistorized electronic units.

***Eldico Electronics Corp.*** ***Booth #47***
**72 E. 2nd St., Mineola, N. Y.**
SSB-100 MIL—SSB, 100 watt P.E.P. designed for simplex telephone or telegraph operation. Frequency coverage 2.2—30 mcs.—crystal controlled stable filter type exciter—50 db or greater attenuation of unwanted sideband and carrier—SSB-100 MIL—Linear Amplifier 650 watts P.E.P. output—frequency range 2.2—30 mcs.—30 watts P.E.P. drive requirement—self-contained including power supply. (Both products are new equipment).

***Electro Impulse Laboratory, Inc.*** ***Booth #10***
**208 River St., Red Bank, N. J.**
Power meters, calorimeters, direct-reading calorimeter bridge.

***Electronic News*** ***Booth #141***
**7 E. 12th St., N. Y. 3, N. Y.**
Electronic News—the industry's weekly newspaper—with copies of the latest issue available at the booth. Late news bulletins posted in booth as gathered by Fairchild News Service, the largest business news gathering organization in the world.

***Export Packing & Crating Co., Inc.*** ***Booth #153***
**5401 1st Ave., Brooklyn 20, N. Y.**
Illustrations of modern methods of military packaging and packing. Displays of our box and crate section, our carton factory and processing methods. Illustration of a huge radar screen and a tiny resistor packed for export, showing range of our flexibility exhibits of waterproofing and dehydration packs, heat sealing barriers, materials handling methods.

***Fairchild Camera and Instrument Corp.*** ***Booths #31, 32***
**Robbins Lane, Syosset, L. I., N. Y.**
Radar moving target simulator system; Automatic voice data link; Weight deviation recorder (fractional gram range); High speed Motion Analysis Cameras; Aerial Reconnaissance Systems featuring IR, Radar and Photo.

***Federal Telecommunication Labs., A Div. of International Telephone & Telegraph Corp.*** ***Booth #37***
**500 Washington Ave., Nutley 10, N. Y.**
Model display of another microwave "First" by Federal Telecommunications Lab.: over-the-horizon broad-band microwave radio and the recently declassified TACAN automatic recording and data link for air traffic control.

***Federal Telephone & Radio Corp., a Div. of International Telephone & Telegraph Corp.*** ***Booth #38***
**100 Kingsland Rd., Clifton, N. J.**
Radio communication equipment, TACAN and other radio aids to aerial navigation test sets, airborne power supplies.

**► See ad on pages 118, 119 ◄**

***Ford Instrument Co., a Division of Sperry Rand Corp.*** ***Booths #100, 101***
**31 - 10 Thomson Ave., L. I. City 1, N. Y.**
Computers and controls for government and industry, including airborne and vehicular navigational systems, missile controls, gunfire control computors and a variety of other systems—as well as a line of computer and servo components.

**► See ad on page 141 ◄**

***General Bronze Corp.*** ***Booth #127***
**711 Stewart Ave., Garden City, N. Y.**
The General Bronze Corporation is foremost in the design, development and precision manufacture of UHF waveguide systems, waveguide test components, complete radar, scatter communications and radio telescope antennas and systems, including pedestals and pedestal drive mechanisms as well as proprietary designs for antenna feed systems and high-power rotary joints.

***General Electric Co., Heavy Military Electronic Equipment Dept.*** ***Booths #84, 85, 86, 87***
**Syracuse, N. Y.**
Military electronic systems and their applications in the "Systems Age"—detection and location, tracking, data handling, missile guidance and control and ground control of interceptors—developed and produced by a closely integrated team of engineers, scientists and technicians with the support of the complete research and production facilities of the Company.

**► See ad on page 33 ◄**

***General Electric Co., Light Military Electronic Equipment Dept.*** ***Booths #25, 26***
**French Rd., Utica, N. Y.**
Military Aviation Electronic Systems—Communication and Navigation (including synchronous communications, data link and doppler navigation), Electronic Warfare (countermeasures and special electronic techniques), Weapon Control (radars, missile guidance, fuzes and automation systems) and Airborne Detection (ASW, AEW and search radars). Features new circuitry display for the synchronous detection adaptor which has aroused significant interest in Airborne communication areas.

**► See ad on page 44 ◄**

# EXHIBITS—continued

***General Electric Co., Missiles & Ordnance Systems Dept.***
***Booths #27,28***
**3198 Chestnut St., Philadelphia, Pa.**

1) Display will consist of Army, Navy and Air Force missile models and how the Missile and Ordnance Systems Department of General Electric is helping to develop missiles. 2) News item of interest will be a description of a new, multi-million dollar data processing center for use by Ground Instrumentation operations.

***General Electric Co., Semiconductor Products Department*** ***Booth #29***
**1224 W. Genesse St., Syracuse 4, N. Y.**

Transistors and Rectifiers.

***Gorham Manufacturing Co.***
***Booth #93***
**Elmwood Station, Providence 7, R. I.**

New Gorham designed slip ring assemblies. Fabricated and cast microwave components and electro-mechanical assemblies manufactured to customer's design. Services include most types of metal fabrication quality controlled from raw material through finishing and testing. Foundry, machine shop and assembly departments constitute chief facilities operating in one plant.

***Gramm Trailer Corp.***
***Booths #120, 121***
**425 E. O'Connor Ave., Lima, Ohio**

Trailers, custom-designed for electronic equipment.

***The Hallicrafters Co.*** ***Booth #74***
**4401 W. 5th Ave., Chicago 24, Ill.**

The Hallicrafters Company exhibit will feature a new single sideband transmitter incorporating the most recent Hallicrafters' development—a 5.0 mc quartz crystal filter. In addition, a new matching 1 kilowatt amplifier utilizing ceramic tubes will be displayed. Hallicrafters' latest, high performance SSB receiver also will be shown.

► **See ad on page 128** ◄

***Hoffman Laboratories, Inc.***
***Booths #109, 110***
**3761 So. Hill St., Los Angeles 7, Calif.**
**Washington office: Room 1022, Cafritz Bldg., 1625 Eye St., N.W., Wash. 6, D. C.**

Air Navigation, (TACAN), communication, and test equipment. Includes Hoffman beacon simulator; single sideband transmission and reception; ECM tuning techniques.

***Homelite, a Division of Textron, Inc.***
***Booth #108***
**Port Chester, N. Y.**

Exhibit will highlight lightweight Homelite engine—generator sets specifically designed to meet the latest MIL specifications. Featured will be a new, highly efficient acoustical housing, developed to match Homelite Military engine—generator sets for use in field operations where minimum audio noise levels are required.

***Hunter Mfg. Co., The*** ***Booth #124***
**305525 Aurora Rd.**
**Solon, Ohio**

Heating and winterization equipment.

***Hycon Eastern, Inc.***
***Booths #116, 117***
**75 Cambridge Pkwy., Cambridge 42, Mass.**

Communications, data handling are enhanced by new crystal filters, by test instruments like part-in-a-billion Ultra Stable Oscillator* and Phase-Locked Klystron*; and by the rapid data-access Timing Generator* and high speed Tape Search Unit*. Communications systems planning and installation now cover public, private customers in U.S., 12 foreign countries including microwave, scatter, wire, and intricate switching, storage facilities. (*new products)

***Institute of Radio Engineers***
***Booth #122***
**1475 Broadway, New York 36, N. Y.**

"Proceedings of the IRE", IRE Directory, Convention Report, Professional Group Transactions, Membership Information.

► **See ad on page 149** ◄

***Instruments Publishing Co.***
***Booth #115***
**845 Ridge Ave., Pittsburgh 12, Penn.**

A new pubication, Military Automation; Instruments and Automation Instrument & Apparatus News; Handbook and Buyers Guide; Computer Handbooks; Electronic Control Handbook; The Automatic Factory; Process Control; Applications of Industrial PH Controls and other books.

***International Radiant Corp.***
***Booth #123***
***Low Temperature Division***
**4 Manhasset Ave., Port Washington, N. Y.**

Designers and manufacturers of environmental test equipment to MIL-JAN specifications and to individual standards. Test chambers are available for: temperature exercisers, altitude chambers, humidity chambers, sand and dust, explosion chambers, sunshine chambers, rain chambers, salt spray, salt fog, fungus chambers, dry ice chambers, vacuum ovens, low temperatures, high temperatures, plastic bell jar, diaphragm exercisers, liquid hot and cold baths, immersion tests, walk-in room for all environmental, and test chambers with vibration panels. Among our leading manufacturers in government and commercial operation.

► **See ad on page 82** ◄

***Jodon, Inc., F. R.*** ***Booth #53***
**8510 Beech Tree Rd., Washington 14, D. C.**

Plug-in units, tranducers, vacuum tube and transistorized AC & DC meters, various recorders, tape, directs writing, strip chart, galvanometer, etc. Pre-amplifiers, electronic filters and chain amplifiers, airborne equipment such as power supplies, amplifiers, voltage regulators, etc., electron tube short detector.

***Kay Electric Co.*** ***Booth #46***
**14 Maple Ave., Pine Brook, N. J.**

Instrument test equipment: sweeping oscillators 50KC to 1000MC, noise figure measure equipment, transistorized audio oscillator and video amplifier. *New*—vari-sweep model radar sweeping oscillator 10-145 MC with variable marker and crystal marks at fundamental.

► **See ad on page 104** ◄

***Kin Tel (Kay Lab)*** ***Booth #136***
**5725 Kearny Villa Rd., San Diego 12, Calif.**

High ambient noise TV system. Includes 1985CN Ruggedized Camera, ACH-6 Acoustical Housing, ARC-10A heavy duty Pan and Tilt unit, and ARM-14R Monitor. Drift-free DC instrumentation with 111A DC amplifiers. 202B microvoltmeter for measuring microvolts to kilovolts. New 204A Electronic Galvanometer. New 301 voltage standard.

► **See ad on page 72, 73** ◄

***Kleinschmidt Laboratories, Inc., a subsidiary of Smith-Corona, Inc., Deerfield, Ill.*** ***Booth #20***

Exhibiting printed communications equipment. Operating display will include page teleprinters, typing reperforators, tape transmitters and complete station teleprinter sets.

***Lenkurt Electric Co., Inc.*** ***Booth #51***
**1105 Country Rd., San Carlos, Calif.**

Lenkurt features new 4-channel miniaturized all-transistor carrier system prototype for Signal Corps: visual and audible demonstration of circuit noise eliminator with Lenkurt compandors. Lenkurt 45BX single-sideband frequency division carrier equipment. Used in Texas Tower communications.

► **See ad on page 47** ◄

***Lewyt Manufacturing Corp.***
***Booths #49, 50***
**43 - 22 Queens St., L. I. City 1, N. Y.**

Exhibit highlights: major components and sub-assemblies of the SAGE system in the fields of data transmission and remote display, as well as radar test equipment; also shown will be the Lewyt-manufactured mechanical components such as detent drives, precision tuning cavities, and variable capacitors.

► **See ad on page 2** ◄

***Mack Electronics Division, Inc.***
***Booths #139, 140***
**1120 So. 2nd St., Plainfield, N. J.**

Audio level meter ME-83( )/U, control monitor C-1737/GRA, telephone set TA-263/PT, radar set AN/APN-22, digital building blocks.

► **See ad on page 95** ◄

***Maryland Electronic Mfg. Corp.*** ***Booths #151, 152***
**5009 Calvert Rd., College Park, Md.**
New Products: Transistor power supplies, standard horns, precision beacon transmitters, filters, scatter antennas, telemetering components, coaxial directional couplers, and bipolarized broad band horns. Also beacon and radar antenna systems, ground navigational systems, diplexers, circularly polarized antennas, frequency stabilized power supplies, servo-driven antenna pedestals, instrument landing systems, VOR systems, crystal mounts.

► **See ad on page 127** ◄

***Miles Reproducer Co., Inc.*** ***Booth #3***
**812 Broadway, N. Y. 3, N. Y.**
Displaying miniature conference recorder—records in closed briefcase. No wires or plugs. Picks up voice within 60 feet. Screens surrounding noises. Voice-activated . . . starts-stops at sound of voice, automatically. Standard dry batteries used. No exposed microphone. Indexed groove finder. Built-in loudspeaker. Ideal for recording in car, train, plane—in the field, office, conferences, dictation, two-way telephone. Records for a full 4 hours.

***Monroe Calculating Machine Co.*** ***Booth #155***
**Hanover Ave., Morris Plains, N. J.**
Monroe Automatic Internal Diagnosis (MAID), magnetic storage drums and heads, and other Monroe products.

***Motorola Communications and Electronics, Inc.*** ***Booth #48***
**4501 W. Augusta Blvd., Chicago 51, Ill.**
Motorola Military Electronics Division will show: Typical unclassified items of equipment indicating our experience in communications equipment, beacons etc. Transistor applications and their effect on new designs will also be illustrated.

► **See ad on page 41** ◄

***Mycalex Corp. of America*** ***Booth #18***
**125 Clifton Blvd., Clifton, N. J.**
Supramica 555 ceramoplastic for components operating at 500 deg C.; Supramica ceramoplastics and Mycalex glass-bonded mica insulation; Synthamica synthetic mica; Mycalex TM commutation switches for telemetering and similar applications.

► **See ad on page 115** ◄

***Nems-Clarke, Inc.*** ***Booth #73***
**919 Jesup-Blair Dr., Silver Spring, Md.**
Exhibit highlights the Nems-Clarke line of special purpose receivers operating in the frequency range of 55-260 MCs and a special telemetry receiving rack; new spectrum display unit, preamplifier, and multicouplers; TV rebroadcast receivers; field intensity meters; cam keyers; shield mounts.

► **See ad on page 88** ◄

***Northern Radio Co., Inc.*** ***Booths #77, 78***
**143 - 9 W. 22nd St., N. Y. 11, N. Y.**
New regenerative repeater: Embodies such features as "floating" input and output circuits—neutral or polar operation—acceptance of 47% mark or space distortion. Other advanced frequency shift communications equipment on display will be frequency shift keyers, converters, twinplex units, dual diversity receivers and tone telegraph terminals.

► **See ad on page 121** ◄

***Panoramic Radio Products, Inc.*** ***Booth #107***
**10 So. 2nd Ave., Mt. Vernon, N. Y.**
New spectral power density analyzer, synchronous frequency analyzer, telemetering indicator and frequency calibrators, sweep generators and subsonic through microwave spectrum analyzers.

► **See ad on page 74** ◄

***Park Nameplate Co., Inc.*** ***Booth #143***
**34 - 10 Linden Place, Flushing 54, N.Y.**
Exhibit shows anodized aluminum foil nameplates with special adhesive backing. Also demonstrates special application machines and methods for the different Park Nameplate adhesives.

***Phelps Dodge Copper Products Corp.*** ***Booth #7***
**300 Park Ave., N. Y. 22, N. Y.**
Foamflex coaxial cable, lightweight, low loss; copper center conductor, foamed polyethylene dielectric, tubular aluminum outer conductor. Also styroflex, spirafil coaxial cables and fitting accessories.

***Philco Corp., Lansdale Tube Div.*** ***Booth #112***
**Lansdale, Penna.**
Complete line of Philco transistors, including the new Micro-Alloy transistor. Also a special display of military type and special-purpose type tubes.

► **See ad on page 77** ◄

***Pic Design Corp.*** ***Booth #4***
**477 Atlantic Ave., East Rockaway, N. Y.**
New issue catalogue — featuring over 4000 items for immediate delivery: all precision gears, shafts, couplings, hangers, speed reducers, differentials, bearings, dials, and out precision kits for laboratory, university and research development.

***Production Research Corp.*** ***Booth #130***
**Thornwood, N. Y.**
Research, development and production facilities in electronics, electromechanics and optics. Featured will be "Magic Mike," a successful wireless microphone.

***Radio Corporation of America, Defense Electronic Products Div.*** ***Booths #34, 35, 36***
**Front & Cooper Sts., Camden 2, N. J.**
Leader in electronics for the Armed Forces—airborne fire control systems, guided missile systems, communications, radar, navigation and television systems.

► **See ad on page 125** ◄

***Ramo-Wooldridge Corp.*** ***Booth #43***
**5730 Arbor Vitae St., Los Angeles 24, Calif.**
The Ramo-Wooldridge Corporation conducts research, development and manufacture of electronic systems.

***Raytheon Mfg. Co.*** ***Booths #103, 104***
**103 River St., Waltham 54, Mass.**
Raytheon will be showing the latest developments in communications equipment, magnetrons, klystrons, the new amplitron and many things recently declassified.

► **See ad on 4th cover** ◄

***Rixon Electronics, Inc.*** ***Booth #96***
**2414 Reedie Dr., Silver Spring, Md.**
One recent development is a binary systems error counter. Unit will be in operation at show utilizing simulated radio circuit to evaluate circuit performance with various signal to noise ratios.

► **See ad on page 136** ◄

***Science Electronics, Inc.*** ***Booth #131***
**195 Mass. Ave., Cambridge, Mass.**
The complete line of EREC-TRONIC Training and Development devices, new pre-employment training kits BE-3 and BE-4; two research and development tools, the E-5 and the E-10 to aid development engineers.

***Skydyne, Inc.*** ***Booth #52***
**River Rd., Port Jervis, N. Y.**
Standard stock size molded fiberglas mobile instrument case, design development and production in sandwich material or molded fiberglas of specially designed electronic instrument transit cases, instrument cases, reusable containers and spare parts cases, test stands.

► **See ad on page 138** ◄

***The SoundScriber Corp.*** ***Booth #66***
**146 Munson St., New Haven, Conn.**
New in the field of long-time recording of voice communication circuits is the S-124 Magnetic Tape Recorder/Reproducer. Records continuously, unattended for 24 hours without tape change—24 hours of recording stored on tape

# EXHIBITS—continued

reels 2" wide, 3¾" in diameter. Also displayed are SoundScriber's disc dictating and recording equipment.

*Sperry Gyroscope Co.*
*Booths #58, 59, 60*
**Great Neck, L. I., N. Y.**
From Microwave Electronics Division: Microline(R) subsystems and equipment, ranging from single miniaturized components to complete microwave systems—plus complex antennas, microwave circuitry, precision test equipment, and checkout instrumentation. From Electronic Tube Division: High-power traveling wave tubes, klystron amplifiers and oscillators for radar transmitters, communication, telemetering and guidance systems. Also metal traveling wave tubes for special applications.

► See ad on pages 70, 71 ◄

*Star Expansion Products Co.*
*Booth #2*
**142 Liberty St., New York 6, N. Y.**
JE-31 (27-hole) tube pin straightener and JE-24 (26-pin) wiring plug for use in straightening special tubes. Also inline straighteners for printed circuit connectors.

*Stelma, Inc* *Booth #33*
**190 Henry St., Stamford, Conn.**
New transistorized telegraph communications equipment will be demonstrated. Telegraph signal generators, automatic distortion monitors, tone keyers, electronic relays, telegraph distortion analyzers, regenerative repeaters and inline electronic repeaters. Recent developments in transistorized voice frequency telegraph systems will be exhibited.

► See ad on page 92 ◄

*Stewart-Warner Electronics*
*Booth #144*
**1300 No. Kostner Ave., Chicago 51, Ill.**
Datafax is a modern facsimile communication system providing instantaneous transmission of any printed material from point to point by means of land lines, radio, or microwave facilities. Copy is electrically recorded and is permanent, error-free, and unalterable.

*Stromberg-Carlson, a division of General Dynamics Corp.*
*Booths #71, 72*
**100 Carlson Rd., Rochester 3, N. Y.**
AN/ARN-21 tactical air navigation equipment; AN/SPA-23 radar indicator; electron beam pick-up featuring D-C response from magnetic tape; automation display showing automatic electronic equipment assembly; AN/GRC-65 mobile communication equipment.

► See ad on page 135 ◄

*Superior Electric Co.* *Booths #8, 9*
**83 Laurel St., Bristol, Conn.**
Superior Electric features POWERSTAT variable transformers and STABILINE automatic voltage regulators.

► See ad on page 143 ◄

*Sweet Mfg. Co.* *Booth #154*
**84 Dunham St., Attleboro, Mass.**
Wide range of precision miniature parts, various metals (special, precious and common alloys). Sizes, shapes will be shown; complete production and fabricating facilities explained. Product applications in communications, missiles, vacuum tubes, transistors, instruments, radio, radar, computers, fire control, electronics, automotive, and others.

*Sylvania Electric Products, Inc.*
*Booth #145*
**Waltham, Mass.**
Sylvania's Electronic Systems Division is engaged in multi-million-dollar projects for all the Armed Services involving research, development and production activities in the fields of guided missile systems, digital computers, operations research, product engineering, electronic components, electronic countermeasure systems, radar, communications, reconnaissance, and navigation systems. As one of its major activities, Sylvania developed the passive defense system for the Air Force's B-58 Hustler, America's first supersonic bomber.

*Technical Materiel Corp., The*
*Booths #23, 24*
**700 Fenimore Rd., Mamaroneck, N. Y.**
Communication equipment, both transmitting and receiving, SSB equipment, remote control equipment, antenna couplers, terminal units, and transmission line equipment.

*Teletype Corp.* *Booths #75, 76*
**4100 Fullerton Ave., Chicago 39, Ill.**
Teletype 60 character per second punched tape system demonstrates operations of certain Teletype units of interest in automation and data processing. Also new transistorized time-division multiplex set for combining up to 4 Teletype communication channels and transmitting them simultaneously.

*Times Facsimile Corp.* *Booth #102*
**540 W. 58th St., N. Y. 19, N. Y.**
**Washington office: 1523 L St., N.W., Washington 5, D. C.**
New Faxwriter message facsimile equipment; Weatherfax facsimile communications equipment for weather maps and charts; new portable precision chronometer, accuracy 1 second/12 days, many other features.

► See ad on page 58 ◄

*Universal Transistor Products Corp.*
*(Formerly Universal Atomics Corp.)*
*Booth #147*
**143 E. 49th St., N. Y. 17, N. Y.**
Tiny transistorized electronic DC to DC power supplies for military electronics. Any practical combination of voltage and current to 125 watts from inputs up to 28 volts, in lightweight units that fit in the hand. Also rackmounted versatile units, and transistorized circuitry and devices for military applications.

► See ad on page 140 ◄

*Western Electric Co.*
*Booths #15, 16, 17*
**120 Broadway, N. Y. 5, N. Y.**
Mechanical precision in electronics, an operative demonstration of waveguide bending used in the manufacture of complex military electronic systems; precision manufacture of gyroscopes, printed circuits, and gears.

► See ad on page 55 ◄

*Western Union Telegraph Co.*
*Booths #81, 82*
**60 Hudson St., N. Y. 13, N. Y.**
Demonstration of new application of integrated data processing to payroll processing by Western Union private wire system. Intrafax (facsimile) equipment will be displayed and demonstrated.

► See ad on page 67 ◄

*Westinghouse Electric Corp., Electronics Division* *Booths #105, 106*
**Friendship International Airport, Baltimore 3, Md.**
Radar and communications equipment for military applications is featured.

► See ad on pages 106, 107 ◄

*Westrex Corp.* *Booth #70*
**111 8th Ave., N. Y. 11, N. Y.**
Airborne radio teletype, point to point radio transmitter and Divatel radio teletype receiving equipment.

*Zoomar, Inc.* *Booths #5, 6*
**55 Sea Cliff Ave., Glen Cove, L. I., N. Y.**
Live demonstrations of remote controlled Zoomar ITV lenses, 360° panoramic cameras using standard 70 mm film, special optics for long range photography, boresight camera assembly for radar.

*Bell & Gossett Co.,* *Booth #118*
*Dualex Division*
**8200 N. Austin, Morton Grove, Ill.**
Entirely new Dualex ground-to-air selective calling system with functional control system.

→ *Cargo Packers Inc., Booth #119*

*Radio Engineering Products. Booth #139* ←

★ ★ ★

# *service communicators send greetings*

**Maj. Gen. James D. O'Connell, USA**
***Chief Signal Officer***

Any evaluation of the forward strides made in the field of military electronics during the past decade cannot but consider the part which the Armed Forces Communications and Electronics Association has played. It is a world-wide organization with a closely-knit industrial-military affiliation. From this bond of unity has come not only progress but from it has also sprung a strong feeling of tradition and a solid foundation of support for communications and electronics in the military services. The theme, "Marconi to Mars," is symbolic of AFCEA's aggressive and forward-looking program—one which assures its own steady growth and that of the Military-Industry Team.

JDOConnell

★ ★ ★ ★

The 1957 AFCEA Convention theme, "Marconi to Mars," has particular gnificance to those of us who have been associated with naval communiations-electronics. There are some now living who can recall Marconi's rst wireless transmission for the U. S. Navy; all may well be aware of e recently announced first reception of electromagnetic signals from he planet Mars by the Naval Research Laboratory.

These pioneer achievements exemplify the remarkable advances through he intervening years in the related fields of communications and elecronics by the partnership of American industry and the Armed Forces. purred on by the requirement to meet new problems and by the chalenge to excel, this effective industry-military team, I am confident, ill continue to produce valuable and startling results and open wider he window of knowledge, to the mutual benefit of both partners and o the Nation as a whole.

The importance of communications and electronics grows daily. Our ssociation has a responsibility to see that this increasing importance is ecognized, and that new developments, as they occur, are made known nd utilized in the best national interest.

HCBruton

**RAdm. Henry C. Bruton, USN**
***Director of Naval Communications***

★ ★ ★ ★

**Maj. Gen. Alvin L. Pachynski, USAF**
***Director, Communications-Electronics***

Just as the Armed Forces Communications-Electronics Association this year is marking, through its theme, "Marconi to Mars," a half century of achievements in communications-electronics, the growth of military aviation is being recognized by a "Golden Anniversary" program.

Fifty years ago the aeronautical and communications-electronics fields were considered completely unrelated insofar as their application to warfare was concerned. Only an insignificant handful of people really had the imagination to visualize that either would have any significant impact on the nature or conduct of warfare. History has proven the validity of their thinking. But more significantly, time brought with it a gradual appreciation which accelerated, with the lessons of World War II, the interdependence of both fields, one upon the other, until today military air power as we know it represents an inextricable fusion of both. This, from my point of view, is what is most significant about the AFCEA's 1957 theme—"Marconi to Mars."

Alvin L. Pachynski

# New IRC® Metal Film Resistors

Type MEF

Type MEC

## FEATURES

**• Available in 1/2 and 1 watt ratings • Metallic resistive film accurately controlled and applied to special high quality ceramic cores • Designed to surpass characteristic A of specification MIL-R-10509B • Low noise level independent of range • Voltage coefficient can be disregarded**

Here are molded metal film resistors that set new standards of performance—units that will withstand full load at 125° C. ambient to zero at 175° C. In addition to high initial accuracy, these new MIL type units combine a stability on load and a low, controlled temperature coefficient never before available in film resistors. They also provide low inductance and shunt capacitance plus excellent high frequency characteristics.

Small in size and weight, IRC precision metal film resistors can replace precision wire wound resistors in many applications. They are available in five temperature coefficient spans for maintaining or controlling resistance over wide temperature ranges. They can be used where high stability must be obtained under difficult load and humidity conditions. You'll also want to investigate them for high frequency applications. Send for complete details.

**Insulated Composition Resistors • Deposited and Boron Carbon Precistors • Power Resistors • Voltmeter Multipliers • Ultra HF and Hi-Voltage Resistors**

*Wherever the Circuit Says*— IRC

**Low Wattage Wire Wounds • Resistance Strips and Discs • Selenium Rectifiers and Diodes • Hermetic Sealing Terminals • Insulated Chokes • Precision Wire Wounds • Potentiometers**

**SEND TODAY FOR COMPLETE DETAILS**

**INTERNATIONAL RESISTANCE CO.** Dept. 543, 401 N. Broad St., Philadelphia 8, Pa.; *In Canada:* International Resistance Co., Ltd., Toronto, Licensee

# NEWS COMMUNICATIONS

# PIGEONS to FACSIMILE

**By Fred E. Meinholtz**

**Director of Communications**
**New York Times**

COMMUNICATION MEDIA USED BY NEWSPAPERS TODAY has progressed an incredibly long way from the methods Julius Reuter used for getting his start in Germany in 1849. Today, we have multiple channel cables—the most recent of which provides 31 voice and 12 telegraph channels—multiple high frequency radio, telephone recording devices, facsimile, and other fast and modern forms of communication which we employ regularly and almost without a thought. Julius Reuter—you may remember—used homing pigeons to get his early start.

In the year 1849—not so different from 1957, may I sadly add—there was a great deal of trouble abroad on the continent of Europe. Revolutions and minor insurrections were breaking out continuously. In the streets of the three great continental monarchies there were barricades to be seen, and not a little desultory shooting to be heard. The governments of Paris, Vienna and Berlin were all assailed by popular movements. Against this turbulent background Julius Reuter began to move.

### *Pigeons Fill Gap*

He was interested in the science of telegraphy from its start. He watched the opening of Germany's first public telegraph line between Aachen—a name made world famous in World War II—and Berlin with an eagle eye. His astute mind noted that there was a gap between the terminus of the German system at Aachen and the terminus of the French and Belgian systems at Verviers. It was a short gap, not over thirty miles to be exact, but it meant a good deal to Julius Reuter and, through him, to the world. For he saw that if the gap could be bridged, there would be a profit for the bridger.

Julius Reuter organized news gathering agencies at both Verviers and Aachen and bridged the thirty-mile gap with a pigeon post. His busy homing pigeons, winging their way across the gap, paid rich dividends. They also brought Mr. Reuter an intangible thing—prestige. Reuter's reports, at that time, dealing only with economic and commercial matters, began to be quoted with authority on the stock exchanges of France and Germany.

Perhaps Mr. Reuter had a special way with pigeons, for I have been reliably informed that on the first occasion when homing pigeons were employed in the last World War, they were a failure.

That was at a place called Sened Station in Tunisia, where American and Axis tanks and infantry were locked in one of the early battles of the war. It was before teletypes were employed for transmission directly from the front fighting lines. Army public relations officers, in combination with the Signal Corps, decided to test the use of homing pigeons in flying news flashes on the result of the battle from Sened Station to a place several hours back by jeep, called Feriena, where more effective communications facilities were available.

Brought to the advanced posts where the correspondents were crouched in fox holes at Sened Station, the three homing pigeons became the subject of controversy. It was decided to draw lots to see in what order the pigeons assigned to the Associated Press, the United Press and the International News Service would be released. The AP man won, the United Press man was second and the INS man last.

Amidst a flurry of bombing by German stukas, the pigeons—in the decided order—were released just after American infantry took Sened Station.

What happened was that the INS pigeon, the last to leave, arrived first, but I am sorry to relate, he took longer than the jeeps did over rutty, bumpy desert roads. The AP pigeon turned up at base almost twenty-four hours later, obviously proud of himself. The bitter deduction of the AP correspondent involved was that the

*(Continued on page 29)*

### The Author

F. E. Meinholtz is now Director of Communications and Manager, Syndicate News Department, for *The New York Times*, and Director of Press Wireless, Inc. Active in the field for many years, he is one of the most distinguished men in communications today. He is a veteran, member of the American Legion, VWOA, and many clubs.

"All the News That's Fit to Print"

The New York Times.

FACSIMILE EDITION

August 20, 1956

VOL. CV. No. 36,003.

NEW YORK, MONDAY, AUGUST 20, 1956.

DULLES SUEZ PLAN EXPECTED TO WIN EARLY APPROVAL

15 or More Nations Are Said to Favor Establishing International Control

TALKS IN FINAL STAGE

Turning Point May Come Today—New Opposition Is Shown by Soviet

By HAROLD CALLENDER

PROTESTS: Charles Poletti, who objected to application by State Power Authority for license to develop Niagara power project.

MOROCCAN REGIME CHIDED BY PARTY

Major Political Group Says Coalition in Rabat Spurns Goals of Nationalists

STATE UNIT ASKS NIAGARA LICENSE; POLETTI OBJECTS

Harriman Supports Protest on Form of Request to Build Power Plant

By ALEXANDER FEINBERG

4 U. S. NEWSMEN AWAITED IN CHINA FOR 30-DAY TOUR

Red Agent Reports They Will Visit Despite the Objection of State Department

WITHDRAWS: Millard E. Tydings, who announced his withdrawal yesterday as Maryland's Democratic candidate in the Senate race.

STEVENSON TO USE TRUMAN SERVICES

Finnegan Says Advice Will Be 'Utilized All the Way Down the Line'

By WILLIAM M. BLAIR

TYDINGS GIVES UP RACE TO REGAIN HIS SENATE SEAT

Maryland Democrat, Target of McCarthy in '50 Bid, Heeds Doctor's Advice

G.O.P. CONVENTION TO START TODAY; UNITY STRESSED

*Southerners Gaining Headway on Rights*

By ALLEN DRURY

PROPOSED PLANK SUPPORTS ISRAEL

G.O.P.'s Tentative Platform Offers Help Against Attack But Is Silent on Arms Aid

PARTY CONFID

Nixon and Civil R Are the Only Iss Imperiling Accord

Pictured above is the facsimile edition of New York Times; pictured below is the Times' regular city edition.

"All the News That's Fit to Print"

The New York Times.

LATE CITY EDITION

VOL. CV...No. 36,003.

NEW YORK, MONDAY, AUGUST 20, 1956.

FIVE CENTS

DULLES SUEZ PLAN EXPECTED TO WIN EARLY APPROVAL

15 or More Nations Are Said to Favor Establishing International Control

TALKS IN FINAL STAGE

Turning Point May Come Today—New Opposition Is Shown by Soviet

By HAROLD CALLENDER

PROTESTS: Charles Poletti, who objected to application by State Power Authority for license to develop Niagara power project.

MOROCCAN REGIME CHIDED BY PARTY

Major Political Group Says Coalition in Rabat Spurns Goals of Nationalists

STATE UNIT ASKS NIAGARA LICENSE; POLETTI OBJECTS

Harriman Supports Protest on Form of Request to Build Power Plant

By ALEXANDER FEINBERG

POLICE HUNT WAY TO COMBAT GANGS; POLL 254 CITIES

Juvenile Delinquency Study Covering Nation May Bring Change in Method Here

WITHDRAWS: Millard E. Tydings, who announced his withdrawal yesterday as Maryland's Democratic candidate in the Senate race.

THUG IS SHOT DEAD IN PARK AVE. DUEL

Two Confederates Seized—Policeman Injured as Cafe Hold-Up Effort Is Foiled

TYDINGS GIVES UP RACE TO REGAIN HIS SENATE SEAT

Maryland Democrat, Target of McCarthy in '50 Bid, Heeds Doctor's Advice

G.O.P. CONVENTION TO START TODAY; UNITY STRESSED

*Southerners Gaining Headway on Rights*

By ALLEN DRURY

PROPOSED PLANK SUPPORTS ISRAEL

G.O.P.'s Tentative Platform Offers Help Against Attack But Is Silent on Arms Aid

PARTY CONFID

Nixon and Civil R Are the Only Iss Imperiling Accord

geon had met a lady friend and spent the evening with r. The UP pigeon never turned up. Another bitter rrespondent—faced with the alternative that his pigeon as a war casualty—took the position in a heated argument that it was most likely that it had landed on some rab's farm and become a squab.

Hampered—as we sometimes are even in this day of e "Iron Curtain"—by European restrictions on press se of telegraph, Mr. Reuter moved to London and beame a naturalized British subject. He had trusted agents all the capitals of Europe and these agents occasionally ere asked to supply pieces of political information or clear up some diplomatic obscurity.

Realizing that there should be a broader outlet for his eports than financial and commercial houses, he tried o sell Fleet Street (still today the great London press enter) on taking his reports. The Press, still translating ts reports from editions of European newspapers, was olite but unimpressed.

It took eight years and a news-beat, made possible by lever use of fast communications, to change Fleet Street's nind. At that time Paris was still the only continental ity in direct communication with London. Over the Paris-London telegraph, Reuter's agent reported the ominous words used by the Emperor Napoleon III to the Austrian Minister to France at the New Year's Day reception at the Tuileries Gardens. This foreshadowed the Italian campaign and the long struggle for the union of Italy.

The Emperor's remarks, when printed in Mr. John Walter's *Times*, alarmed Europe, set stock exchange prices tumbling and assured the success of the first international news service.

### *Canister Communications*

When the American Civil War—or shall we say the war between the States—broke out, there was no cable to America. Mr. Reuter worked out a system whereby the latest dispatches from the war front were placed aboard ship in tin canisters at the last possible moment at New York. They were thrown overboard to be picked up by Mr. Reuter's swift cutters waiting off Crookshaven, at the southwestern tip of Ireland. If they were tossed off a ship at night they burned a blue flare.

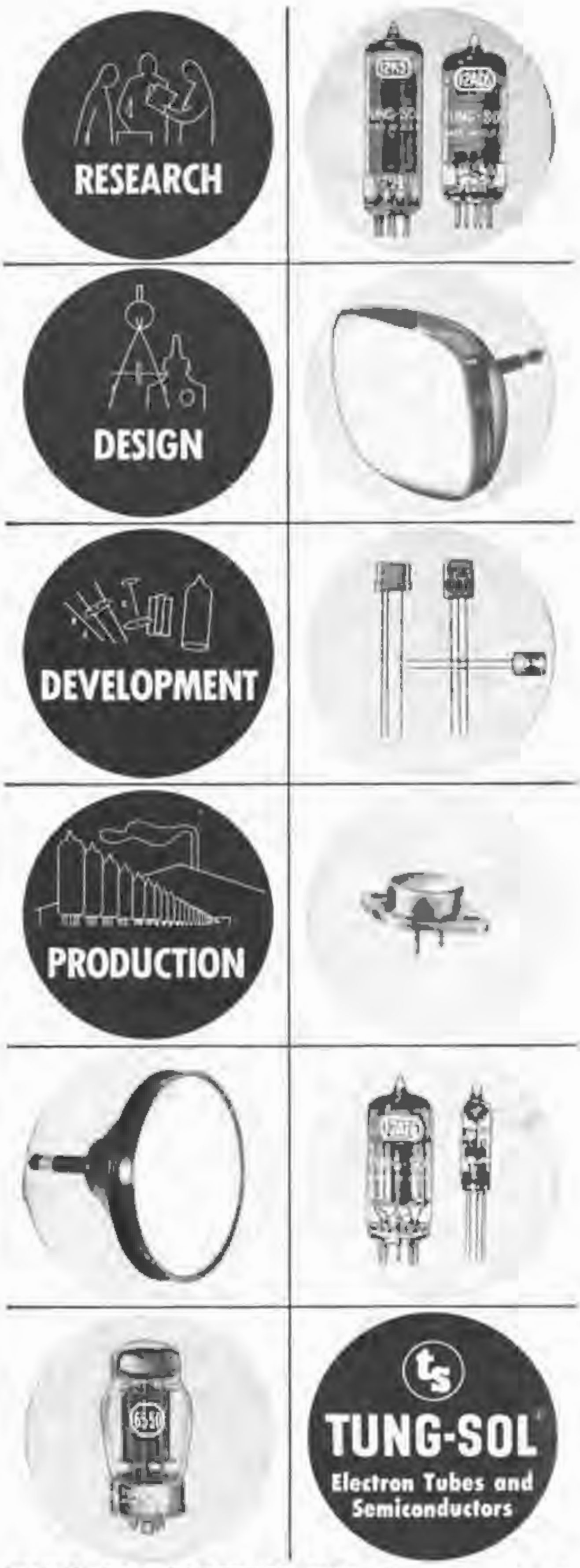
Across miles of wild southern Irish country from Crookshaven to Cork—where the message could be retransmitted to London—a special telegraph line was constructed.

One of the most dramatic of the many news beats this system made possible for the people of Britain and Europe (avid for news of what was going on) came at the end of the war.

Reuter's New York correspondent received a vital report. He chartered a special boat and took off with a canister after a mail packet that had just left port. He caught the ship and tossed the canister aboard. Off Ireland, it was tossed to another Reuter's man, who went rapidly ashore in a small boat.

Thus for a full week, before another ship arrived in Britain, the British and the European world knew only through Reuter's that President Lincoln had been assassinated at Ford's Theatre in Washington. And Reuter's had a full report. Another example of how important fast communications are in news gathering and dissemination.

I have mentioned Reuter's so much in the early part of this narrative only because Julius Reuter was the first man to recognize this fact and apply it. He was the first to see that faster and faster communications were coming



and that the world was to grow smaller and smalle Today, great newspapers, such as (and I hope you wi not mind my taking pardonable pride in this) *The Ne York Times*, and a number of world-wide press as ciations, are bringing a mass of reports on vital matte to the public quicker and in greater volume than ev before.

I cannot emphasize too much, however, that the backbone of the whole process is quicker and cheaper communications. There is a saying among newspaper correspondents that no story, no matter how important, is any good unless you can get it to the office.

We all remember the tale of the correspondent in the Crimean War. In those days, once a reporter was filing a story, no other correspondent could cut in on the cable line until it was completely filed. This man reached the office first and filed pages of the Bible to his paper until he had his story written, thus holding open the one line available for his copy alone.

There is another side, however, to this story.

I was acquainted with Floyd Gibbons, the fast-talking newspaper correspondent and radio commentator, who was one of the most colorful of several generations of correspondents. The fact that he wore a black patch over an eye he had lost in World War I as a result of German machine-gun fire near Chateau-Thierry, added to his distinctive personality. Old-timers will remember his staccato, rapid-fire delivery once he took to broadcasting.

His correspondence to the news organizations he represented at various times was as verbose as it often was pithy. He went out to cover the Japanese invasion of Manchuria for INS and he sent back long—in fact extremely lengthy—dispatches at the cost of no less than 22 cents a word. The copy flowed into the INS office in reams.

On March 1, 1932, INS headquarters in New York received a dispatch from Floyd which read simply:

> "Biggest story of the war. Japanese advance on all fronts. Lindbergh baby kidnapped. What the Hell? Gibbons."

Not another word came through. Gibbons learned the hardest lesson for any correspondent—WHEN not to go to the cable office. A story certain to swamp his had broken and he knew enough to act accordingly.

### *No Communications, No Story*

You readers are all aware that, during the European campaign in the last war, communications were so highly organized that correspondents not only had the teleprinter facilities at corps headquarters, but, in many cases, down to division levels. I believe that one division, the Eighty-Second, had a rule in its public relations set-up that a jeep would be available to take back one piece of copy, if necessary, at any time of the night, as well as the day.

The final excellent communications effect, however, was due to the first difficulties and experimentation that the correspondents, the Army communications people—and those in charge of purely press communications—went through in the early part of the war, starting with the African campaign.

In the Pacific, where jumps of hundreds of miles forward from one Army base to another were being made, usually with no communications that could be repaired and utilized on arrival, the situation was more difficult and complicated.

For instance, the correspondents who went ashore at Saipan at considerable danger to themselves, had made what they—and the Navy Public Relations people for

(*Continued on page* 32)

# close support

by Reeves
INSTRUMENT CORPORATION

## helps USAF BOMBING CHAMPIONS set new record

Strategic Air Command's annual Bombing-Navigational competitions are the "World Series" of bombing tests. B-47 teams from Strategic Air Command bases throughout the country, flying thousands of miles in simulated bombing runs, performed remarkable feats of navigation and precision bombing. The culmination of long months of ground and air training, the bomb scoring results obtained were the best in the history of the competition. SAC teamwork, highly trained crews, and the most advanced navigational and bombing equipment all contributed to the gratifying results obtained.

Data for determining the accuracy of the bombing runs was computed by the MSQ type of Command Guidance System, designed and built by Reeves Instrument Corporation. Tracking by radar, the system provides a continuous plot of the plane's ground position. The point of bomb release is plotted, and from it the point of impact determined to a very high degree of accuracy. The MSQ type of system can also be adapted to Command Guidance of fighter bombers for close support bombing and strafing of enemy positions.

Reeves has designed and manufactured guidance and control systems for all branches of the Armed Services. We invite inquiries on projects where our experienced engineering and production facilities in the fields of missile guidance, radar, gunfire control and computing systems can be of service.

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EEVES INSTRUMENT CORP. A SUBSIDIARY OF DYNAMICS CORP. OF AMERICA, 215 East 91st ST., New York 28, N. Y.

that matter—thought were excellent arrangements to have their copy carried to a communications ship and sent home quickly by high speed transmitters. The Japanese fleet, however, came out to take one of the several major lacings to which it was submitted. To the consternation of the correspondents, their pockets jammed with copy and notes, the Fleet just moved off, to meet the enemy, of course, and they were left as high and dry and isolated as Robinson Crusoe. The story was no good without communications.

Again, when MacArthur made his return to the Philippines, it was a story not only of importance, but, after Bataan and Corregidor, replete with the drama from which General MacArthur was never completely disconnected.

In that case, the Army somehow or other obtained an old icebreaker. I think it had been built in 1887 for the Atlantic iceberg control. It was taken to Sydney, Australia, and fitted to make possible transmission from the beachhead at Leyte Island direct to San Francisco. To assure its arrival on time, the old icebreaker, which travelled slowly, was sent with one of the first convoys to leave Dutch New Guinea for the Philippines.

The landings were made very early in the morning. *The New York Times* had two men there, and one of them filed a story at 10:30 A.M. aboard the communications ship. It was one of the first stories filed by anyone. All day, under hectic conditions and amidst enemy bombings, the operators on the communications craft transmitted copy. It was not, however, until 10:30 in the evening, Leyte time, that the first story of the landing was received in San Francisco. Atmospherics had been bad, and all copy filed for the first twelve hours was lost, including one of our major stories. Again—no communications, no story.

My job on *The New York Times* is to see that our communications are arranged on the most rapid, and at the same time, the most inexpensive basis. Any newspaper or press association can afford to spend just so much for communications and the cheaper the price per word, the more words we can obtain to better serve our readers.

### *Transmitters Cut Costs*

A long time ago, in order to beat down cable and radio costs which were very high, we formed Press Wireless, a company designed to provide facilities to the press at a cheap cost per word. I do not want to go into the details of that operation now. We were, however, not only able to provide economical transmission, but cable and radio companies, facing this competition, cut filing costs from Europe, Asia and South America—from all over the world in fact—to a fraction of what they had been.

In addition to establishing cheap toll service, Press Wireless pioneered in the organization of transmission of press to multiple destinations. Radio is an ideal medium for this method of news dissemination.

Today, the AP, UP and the International News Service, leasing transmitters on a fixed-time basis, transmit simultaneously to hundreds of clients throughout Central and South America, Europe, Africa and Asia. The transmission cost probably averages much less than a cent a word, and this small cost is assessed against the many clients subscribing to the service.

To operate not only intelligently, but economically and successfully, the Press has kept abreast with the most modern technological developments in the field of electronics and transmission facilities generally. It is about some of these developments, and particularly telephone recording and facsimile, that I want to record a few serious words.

During World War II, as early as the African campaign, we handled a large amount of war news by telephone recording. In order to provide enough circuits for the press to move the large volume of news in which the public was interested, Eisenhower's staff allotted part of the voice broadcast time at Radio Algiers to the newspaper reporters. This provided the fastest way to hand late news and our own, and other pressmen used it great deal.

The Associated Press and the United Press, as well *The New York Times,* had to catch these spoken wor The OWI helped out on numerous occasions, but w not staffed to do this always. To do the job accurat and expeditiously it was, of course, necessary to emplo recording machines.

In the late stages of the Pacific War, a considerable amount of press copy also was telephoned from the Far East to San Francisco, where RCA caught it and transmitted it on to New York.

### *Telephone Recordings*

On at least one major occasion, the use of voice transmission was highly important to us. One of our men obtained the first post-war interview with Emperor Hirohito, seeing him even before General MacArthur did and getting an expression of the Emperor's views on the postwar situation and his desire to cooperate with the Americans.

Our man arranged to have the interview an hour and a half before our edition time in New York. That did not give him much leeway, but he did not want others to hear of the interview until it was published at home.

When he arrived at Radio-Tokyo to write, he found that the circuits were out between downtown Tokyo and the transmission station outside of that capital, as far as radio message transmission was concerned. The voice circuit was operating, however, and a PRO officer stepped into the breach. He "voiced" the story to RCA in San Francisco which rushed it on to us. We had a world beat.

As a matter of fact, telephone recording was widely employed by newspapers and press associations for specific purposes beginning in the early 1930's, so this war use was no novelty to us.

*The New York Times* and the *Chicago Daily News*, for instance, were telephoning almost all copy from continental capitals to Paris, during the Thirties. After the German invasion of Paris, *The New York Times* transferred its telephone recording system to Berne, Switzerland.

It was worth its weight in gold to us several times, especially the night the Germans invaded Yugoslavia. There were only two special correspondents of American outfits in Belgrade at the time—Ray Brock of *The New York Times* and Cecil Brown of the *Columbia Broadcasting System*.

With German bombs screaming down and exploding on Belgrade, they worked in relays to collect information. That night, Brock telephoned 17,000 words, under most dangerous conditions, to our office in Berne where it was recorded, transcribed and re-telephoned to New York. I may not be modest about this, but it gave *The New York Times* another great beat.

The reason for having correspondents telephone from continental capitals to Paris and London before the war was the high transatlantic cable and radio rates then in effect. To transmit direct from the Balkan States to New York at that time cost 17 cents to 25 cents a word. From

*(Continued on page 34)*

*The AN/MPQ-4 is a mobile radar mortar locator which accurately determines the location of enemy mortars in a matter of seconds.*

# PEACE POWER

## ...thru Electronic Systems

Today's U. S. Army Signal Corps is vital to an army whose *power for peace* is based upon unprecedented firepower, mobility, and control.

Fulfilling a combat and technical role, the Army Signal Corps is exploiting scientific know-how in this Age of Electronics to provide and operate communication systems, radar systems, computers, mortar and artillery locators for the field commander. These electronic systems are indispensable to the commander's *control* of field forces in the nuclear age.

The Signal Corps' dual capability as a technical force and a fighting force offers tremendous opportunity for the young man desiring a career packed with challenge, action and advancement.

The young Signal Corps fighting man uses and helps develop such advance electronic systems as the AN/MPQ-4 mortar locator, which was designed for *front line battle operations* and makes possible the location and destruction of the aggressor's firepower. The highly effective AN/MPQ-4 was developed by the Signal Corps in close cooperation with the HMEE Department of General Electric.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

HEAVY MILITARY ELECTRONIC EQUIPMENT DEPARTMENT • SYRACUSE, N.Y.

Paris, however, ordinary press rate was but five cents a word and, for the larger news enterprises which had a high word volume, special rates were obtainable running as low as one cent a word.

The telephone rates from all over Europe to Paris were comparatively cheap and the service fast. The latter could not be said, in most cases, of the telegraph and radio services.

### *Recording Equipment*

Since the war, the telephoning of copy to the United States has fallen into disuse by most organizations as a result of an action by the Federal Communications Commission and the American communication companies in reducing press rates from all European points to this country to approximately the same level. The only exception to this rule is London, from which press copy moves at two cents a word to New York City and at one pence sterling to Canadian cities. That rate is still low enough to justify a considerable amount of copy from the Continent, and from British owned and mandated territories, to be forwarded to London for teletype transmission to New York.

Several types of telephone recording equipment are available. The one used by the Paris Office of *The New York Times* before the War was developed by a German and known as the Dailygraph. It was based on the Pulson invention and contained about 5,000 feet of fine gauge steel wire. The recorders contained two sets of magnets through which the wire passed. When set in a recording position the first magnet through which the wire passed demagnetized that section of the wire completely erasing the previous voice recordings. The second set of magnets recorded the voice modulations. The same recording instrument was used for transcribing. In transcription the first set of demagnetizing magnets is neutralized so the voice recording remains unaffected. The second set of magnets works in reverse, passing the audible voice modulations through the amplifiers, thence, to the transcribing operator's headset.

Recording and transcribing are at the same rate of speed. When the transcription speed is not synchronized at the recording speed, the pitch of the recorded voice modulations is changed, making the recording unintelligible.

Since the transcribing operator cannot operate a typewriter at dictating speeds, a sentence or phrase is typed and the recorder stopped by means of a pedal until the operator catches up. A tap or two on the foot treadle also backspaces the recorder—permitting the operator to listen time and again to the same word or phrase until he deciphers it.

*The New York Times* in New York started using a recorder based on the same principle manufactured by the Bell Laboratories. These recorders used a narrow steel tape rather than a steel wire and passed through the magnets at a greatly reduced speed. Other American counterparts of the Dailygraph are available under various trade names. Sensitized paper tapes have largely replaced steel wire. Speech recorders were widely used by the Army during the War for dictating orders, recording speeches to be broadcast and like matters. In some cases, wire reels were flown by plane many hundreds of miles from the scene of action to the nearest reproduction center hundreds of miles away.

There are also cylinder and disc recorders, employing aluminum, celluloid, plastic, paper, film and acetate discs. Many correspondents can easily dictate at 125 to 150 words a minute. The over-all speed is about 100 words a minute, counting interruptions in which the operator listening in at the receiving end asks for repeats on words or phrases which are not clear.

The Ediphone and the Dictaphone, the first widely-used recording devices, were still being employed on a large scale during the past war. The Germans, for their part, used sensitized paper tape, on which magnetic recordings were made. *The New York Times* now uses Gray Audographs which employ plastic discs to record the voice modulations.

An operator listens in on our machines as a correspondent dictates and he calls for a repeat on any part of the message he thinks the machine may not have caught. The machine plays back at the same speed at which the correspondent spoke and the operator transcribes the message in copy form. He can play back as many times as he wants and thus assure accuracy.

During the San Francisco Conference of 1945, at which the United Nations Charter was drafted, a facsimile edition of *The New York Times* was printed for the delegates and press representatives at the Conference. The four-page facsimile edition was transmitted across the continent every day without a single failure. Those receiving the paper found it under their hotel doors every morning when they arose for breakfast. A format was made up in New York and it was transmitted by AP Telephoto to San Francisco, one-half page at a time. Each half-page film, approximately 5 x 7 inches, required fifteen minutes for transmission. At San Francisco the two films were joined and blown up to full page size by rephotographing. The photographed format was rushed by motor to a newspaper plant where an etching was made, a matrix taken therefrom and a stereotype struck off and then affixed to the cylinders of the presses for printing.

### *Covering Republican Convention*

Eleven years later, August 20 through 24, 1956, for the duration of the Republican National Convention, *The New York Times* again published a facsimile edition at San Francisco. In contrast to the speed and size of the 1956 facsimile transmissions, the transmitting and receiving drums of the 1956 apparatus were fast and large enough to handle two full sized newspaper pages in one transmission. The transmission time for the two pages required four minutes. Because of modern improvements in equipment and full size page transmissions the definition of the reader's copy was four times greater than the 1945 results. Ten full pages were printed nightly and for transmission the microwave relay system or coaxial cable of the American Telephone & Telegraph Company normally employed for television programs was utilized.

San Francisco readers, in congratulating *The New York Times* on its ingenuity and enterprise, made no comment at all on the quality of engraving and printing in the finished facsimile product. The casual observer did not seem to notice any great difference between the original product and the facsimile copy. The paper was fully legible even to the small type in the stock tables.

Moreover, probably not a single reader realized that in the transmission of the copy across the continent the electric eye of the facsimile transmitter examined only 1/200 inch square area of the newspaper page at a given time nor that the speed of scanning was so rapid that 120,000 such scans were examined each second of transmission.

Surely news communications have gone a long way toward perfection since the canister and homing pigeon days of Julius Reuter.

* * *

# WESTERN ELECTRONICS LOOKS AHEAD

**By H. Leslie Hoffman**
**President, Hoffman Electronics Corporation**

ELECTRONICS IN THE WEST, like Spring, is busting out all over. This is self-evident from the statistics (see box on page 39). A comprehensive story of the history, present status and future of West Coast electronics would take several volumes; however, I will attempt to boil down what I feel to be the significant phases—past, present and future—particularly as they pertain to military electronics.

### The Beginning

This growth of electronics in the West is part of the new America, with its new products and its new population movements to Suburbia. It reflects the dynamics of America on the move both technologically and and geographically.

It has been a unique and exciting experience to be in the middle of this growth of electronics on the West Coast in the last 15 years. The tempo has been fast and promises to accelerate. The challenges have been many and the problems of growth exacting, but the opportunities of the future are most stimulating.

The growth of West Coast electronics can be divided into six phases. During Phase 1, or the pre-Pearl Harbor era, the radio industry, as it was then known, consisted of three radio manufacturers in the Los Angeles area, together with several small component companies. We made 2% of the Nation's radios and consumed 16% in the West. We concentrated on price and smaller sets, on one hand, and on the deluxe high quality sets on the other.

In San Francisco during the pre-Pearl Harbor era the industry was built around special purpose tubes. Very few companies existed in the Seattle-Portland area or in the San Diego area.

This was the beginning of our industry as we know it today. Western electronics, like most Western industry, has had to rely on new ideas and new concepts and the adventurous spirit of Western people to thrive.

### World War II Period

At the beginning of Phase 2, or the World War II period, all military radio and communications systems in the country were manufactured by a few companies on the Atlantic Coast. One of the Government's first moves was to expand activity in the East. Later the aid of radio set and component manufacturers in the Middle West was enlisted. But the far West was designated an invasion area. In addition, the strategy was to channel all available manpower into the aircraft and shipbuilding industries.

### Collective Approach

Placing contracts with Western electronics firms was actually looked upon with disfavor. This problem was common with all West Coast manufacturers. After considerable discussion and several meetings, it was decided to try the collective approach. This envisioned a cooperative effort of pooling facilities and know-how and expanding the component phase inasmuch as it was lack of components rather than final assemblers that was the restrictive factor in the production of military equipment at that time. The West Coast Electronics Manufacturers Association was formed to harness this collective effort and I was privileged, in 1943, to become its first president.

### Contract Channeling

Our West Coast companies began to supplement their individual efforts with data on the locations, capabilities and facilities of the entire industry as well as their own. It is interesting to note that the first major contract secured on this basis, which incidentally was awarded to our company, stipulated that we produce or procure at least 90% of the dollar content in the West. This requirement was met. This established the

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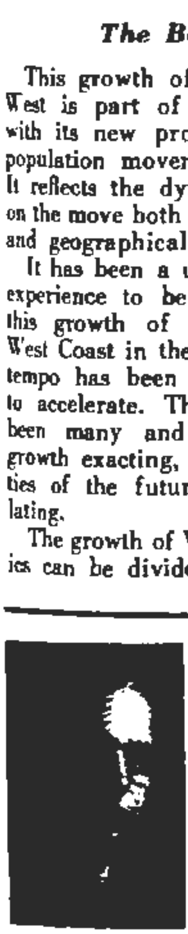


### The Author

H. Leslie Hoffman, the founder and first president of West Coast Electronics Manufacturers Association, is a major spokesman for and sponsor of the West's electronics activity. He is a past president of RETMA and is now head of the Electronics Committee for the Chamber of Commerce and a Trustee of the University of Southern California.

leader-follower concept which will be touched upon later.

Additional contracts were channeled to other end equipment companies and, by the end of World War II, the Western segment of the industry was firmly established. Annual billings in California alone had increased from $25 million per year in 1942 to more than $400 million in 1945.

During this period there were several other significant developments.

### *Military Moves West*

One was that the industry developed a close association with the scientists of Western universities and colleges that has constantly grown.

Another was that the Military began to recognize the West as an engineering center. The Navy started a program that eventually resulted in the expansion of its own engineering activities in San Diego, Invokern, Point Mugu, and Pasadena. The Air Force established large Western testing facilities and moved its overall long-range planning group to Santa Monica. The Signal Corps established West Coast offices for close coordination with its contractors and, more recently, a large testing base at Fort Huachuca, Arizona. This movement of the Military in turn sparked a new spiral of growth for West Coast Companies.

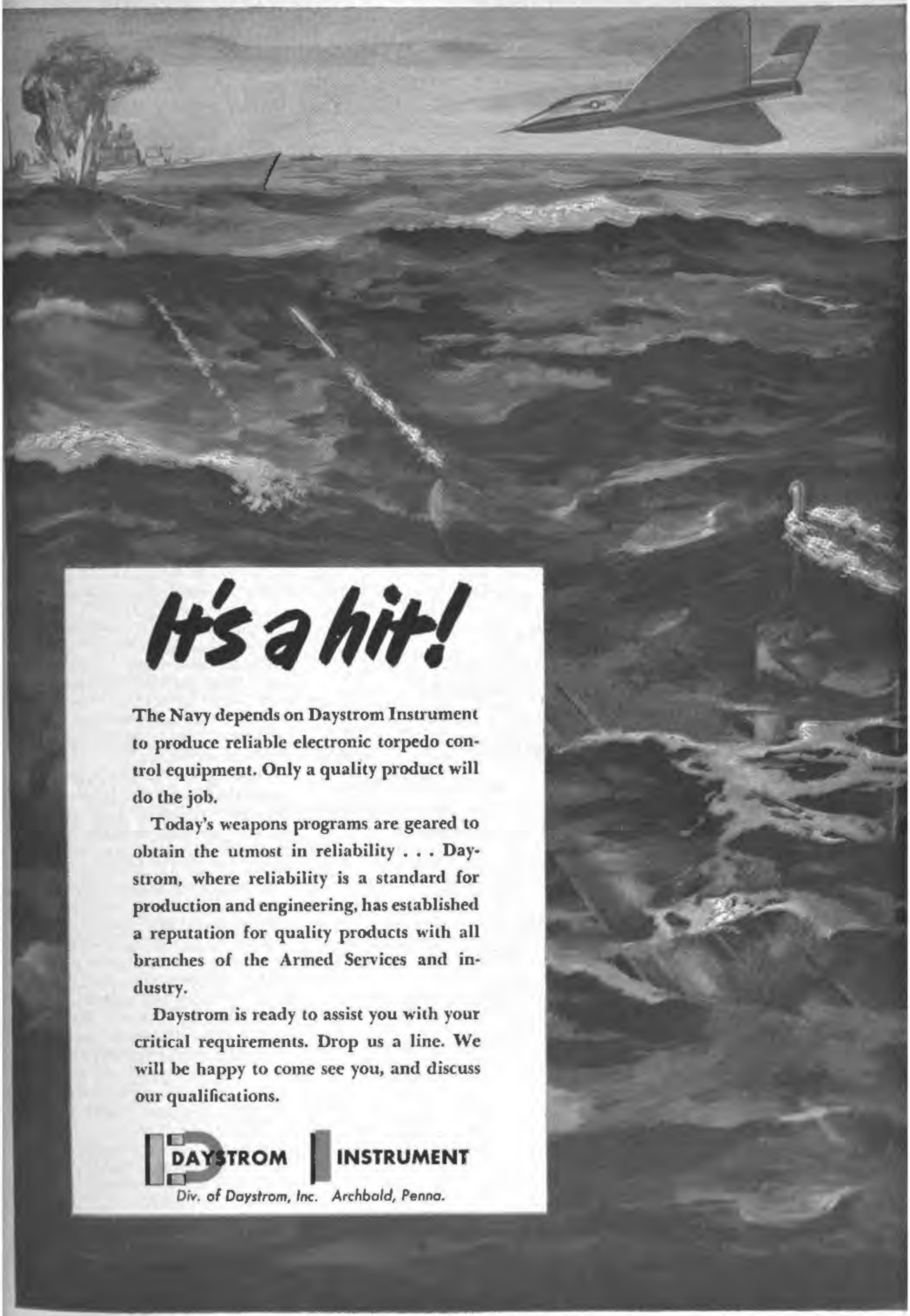
### *Post-War Years*

During Phase 3, or the post-war years (1946-50), the emphasis changed rapidly. Industrial companies tried to establish or re-establish their products in consumer and commercial markets. The military emphasis in the meantime was on disposing of war goods surplus. But the nucleus of national defense know-how remained. Some companies, such as our own, seeking to break new scientific barriers, continued to maintain their military electronics departments. Significant developments of the late war months—such as rockets, nuclear energy electronic activities and guided missiles—were carried forward on a research and development basis.

### *Research Expansion*

It was during this period that today's concepts of Systems Management were first introduced to the Military by West Coast people—an

(*Continued on page 38*)



outgrowth of our earlier cooperative approach.

It was also during this period that the airframe manufacturers began to recognize the significance of electronics to both guided and manned aircraft.

The general level of manufacturing output at this time only slightly exceeded the level at the end of the war. But the character of goods and services, both military and commercial, had changed radically.

Significant research activities in the San Francisco area again centered around tube developments, and the expansion of research and development centered around both universities and industrial research departments.

### *Mobilization Plan*

Phase 4, or the Korean War period, found West Coast electronics on a priority par with other sections of the country for the first time.

During the period from 1946 to 1949, a committee from RETMA, on which I had the privilege of serving, developed a mobilization plan to be used on an if-and-when basis. Many significant phases of this plan were utilized in the basic mobilization plan adopted by the Military. It encompassed a philosophy of establishing a strong electronics industry on the East Coast, in the Middle West, and on the West Coast so that the country would not be dependent on any given area at time of emergency in the future. At the time of Korea, West Coast companies, as a result, were called upon to expand materially their military engineering and production capacity.

### *Industry Doubles*

Another significant phase of this mobilization plan utilized the so-called leader-follower concept that was used so successfully on the West Coast during the early part of World War II.

Equipment produced during this period was largely the next generation of that produced during World War II. But even as it was being produced, research spawned still a third generation. This new plateau of accomplishment gave increased consideration to the rapidly accelerating speeds, reliability, temperature requirements, miniaturization, and mobility required of the nuclear and thermo weapons of today.

During this time (1950-54) our industry doubled in volume each year. It was the period of our greatest percentage growth.

Recruitment of engineers and scientists began on a grand scale. The Military, recognizing this expanded capability, increased its dependence on West Coast firms. New concepts, ideas, products and services initiated here won wider and wider acceptance.

### *Burst of Activity*

It was during this period that a new company started business every week. In the Los Angeles area the new components, products and services they offered centered around airborne equipment, both manned and unmanned, data processing, instrumentation, communication and navigation.

In the San Francisco area the new burst of activity centered around research in the universities and on expanded use of new specialized tubes and components.

In the Seattle-Portland and San Diego areas new services, components, sub-assembly and instrumentation activity blossomed around the growing airframe companies. The West also made substantial contributions to Sandia and other nuclear activities.

### *New Plateau Reached*

Today we are in Phase 5 of Western electronics growth and development. We have reached a new plateau.

The statistical box referred to earlier shows the 11 Western states with 641 of the Nation's approximately 4200 electronics firms. Last year they grossed $1,690,000,000 of the total $9,700,000,000 national electronics product. Western electronics now accounts for 15% of the number of companies, 16% of sales, and 18% of employment in the industry nationally.

But these statistics, again, do not tell the whole story. They do not tell us, for example, that the West now has the greatest concentration of electronic engineering talent of any area. In Southern California, and in the San Francisco Bay Area, the ratio of engineers to total population is the highest of any locale in the country. In Southern California electronics is second only to airframe manufacturing in employment and manufacturing significance. Approximately 12% of all persons employed in manufacturing plants in the area are in some phase of electronics work.

Today the West is a combination of both old and new companies—some just building reputations, some with nationally established reputations—engaged in a wide variety of electronic activities, from large Weapon Systems Management teams and Weapon Systems manufacturers through the entire spectrum to small specialized component or sub-assembly suppliers.

The West has become a major research and development center. Practically every engineering symposium or meeting finds representatives from Western companies presenting papers covering new approaches or new ideas in electronics. There have been many outstanding achievements in data processing, missiles, instrumentation, communications, navigation, countermeasures, semi-conductors, magnetic amplifiers, and a whole host of specialized components, and significant new products and services are coming to light almost daily. And, as reflected by the statistical table, electronics is in the forefront in every area as far as new manufacturing facilities are concerned.

### *Still Growing*

Such spectacular growth cannot occur, of course, without raising many new problems. And, of course, the future growth of the industry, like the growth of individual companies, will be measured by the competency with which we handle these problems.

It is significant that many people with highly developed know-how in the electronics arts have elected to live in the West, and the movement to the West is continuing at a rapid rate.

Historically, the greatest growth occurs where the greatest know-how exists, particularly in a highly technical art such as ours which is not dependent completely on the immediate adjacency of a market.

As long as the people in these companies here in the West recognize that they have the challenge of competing with other companies who have similar products or services to sell within the area and outside the area, and as long as they continue to come up with a higher creative content per dollar or per pound in the product or services that they are rendering their customers, this growth will continue.

### *Competition*

Another problem that must be faced is the migratory engineer. The game of musical chairs being played by our engineers today is hardly conducive to industry growth and stability. Substantial steps are being taken individually and collectively to correct this situation and the results indicate that this situation can be corrected.

Leaders in the engineering profession should accelerate their efforts to remind their people of their responsibility to their country, community and their companies as well as to themselves in this over-all program, and call a halt to the opportunist approach of too large a segment of their group at the present time.

### *Survival*

Based on the record of the past, only one out of four of the newer companies in electronics will survive in its present form. The other three will merge, be absorbed, consolidate, or go out of business. This represents a challenge to electronics industry management that has yet to be met by many.

Many of the smaller companies are beginning to face the basic problem of making money in order to continue to grow and survive. Fiscal success is not always assured the entrepreneur whose lifetime has been spent solving technical problems.

### *Technological Challenge*

Ninety percent of the growth of Western electronics has been built on the military dollar. We are still in a technological race with Russia. Electronics is playing a vital role in this race and will continue to do so but already there are rumblings that there is a limit to the price we can pay for technological supremacy. Here again the challenge confronts us that we must get a higher productivity from our management, engineering, and manufacturing teams per dollar, both in concept and end equipment, because this is one race in which we just can't afford to come in second.

### *Diversification*

In many areas the community, through the teaming together of its Chamber of Commerce, universities and industry, is working out constructive programs to increase, both quantitatively and qualitatively, the flow of technical manpower into our industry and also to supplement individual company efforts in both on-

## *Box Score of Electronic Industry Statistics on the West Coast*
## 1956

**San Diego County:**

| | |
|---|---|
| 1. No. of Electronic firms | 26 |
| 2. Employment | 2,300 |
| 3. Sales | $ 30,000,000 |

**Phoenix-Tucson Areas:**

| | |
|---|---|
| 1. No. of Electronic firms | 13 |
| 2. Employment | 6,000 |
| 3. Sales | $ 55,000,000 |

**Portland-Seattle (does not include Boeing activity):**

| | |
|---|---|
| 1. No. of Electronic firms | 12 |
| 2. Employment | 6,000 |
| 3. Sales | $ 12,750,000 |

**Los Angeles & Orange Counties:**

| | |
|---|---|
| 1. No. of Electronic firms | 470 |
| 2. Employment | 73,000 |
| 3. Sales | $1,000,000,000 |

**San Francisco-Oakland & Peninsula:**

| | |
|---|---|
| 1. No. of Electronic Firms | 75 |
| 2. Employment | 20,000 |
| 3. Sales | $ 260,000,000 |
| 4. Annual payroll | $ 80,000,000 |

**Balance 11 Western States:**

| | |
|---|---|
| 1. No. of Electronic Firms | 45 |
| 2. Employment | 9,500 |
| 3. Sales | $ 192,000,000 |

***TOTAL—Electronics Industry—11 Western States, 1956:***

| | |
|---|---|
| 1. No. of Electronic Firms | 641 |
| 2. Employment | 112,000 |
| 3. Sales | $1,690,000,000 |

***TOTAL—Electronics Industry—USA, 1956:***

| | |
|---|---|
| 1. No. of Electronic Firms | 4,200 |
| 2. Employment | 610,000 |
| 3. Sales | $9,700,000,000 |

***11 Western States as a percent of National Electronics Industry:***

1. 15% of electronic firms
2. 18% of employment
3. 16% of sales

### *Principal Growth Areas*

***San Francisco-Peninsula Area***

Expect the value of their electronic facilities to expand roughly 30%.

| | |
|---|---|
| Value Electronics Facilities — 1956 | $89,000,000 |
| New Facilities — 1957 | $32,000,000 |
| Sales — 1956 | $260,000,000 |
| Projected — 1957 | $321,000,000 |
| Sq. Feet of Plant Facilities — 1956 | 3,500,000 |
| Projected — 1957 | 1,700,000 (an increase of 49%) |

***Los Angeles and Orange Counties***

| | New No. Units | Capital Investment | Expanded No. Units | Capital Investment | Total No. Units | Capital Investment |
|---|---|---|---|---|---|---|
| 1956 | 24 | $7,500,000 | 35 | $31,200,000 | 59 | $39,000,000 |
| 1955 | 20 | 8,796,000 | 51 | 24,469,000 | 71 | 33,265,000 |

Total capital investment for one year (1956) was roughly 40% of San Francisco area's total value of electronic facilities in 1956.

Box score is an estimate compiled by the Chamber of Commerce.

job and off-job training. This program should be accelerated and expanded.

Our dependence on the Military is necessary but coupled with the lack of diversification into other fields, it also represents a weakness. Increased emphasis on extending techniques, know-how, new products, and new ideas into products and services for industrial and consumer usage is indicated. The more forward looking companies are recognizing this challenge and are acting to meet it. Up to this time, however, such activity has been on too limited a scale for the welfare of Western electronics as a whole.

### *Area For Concern*

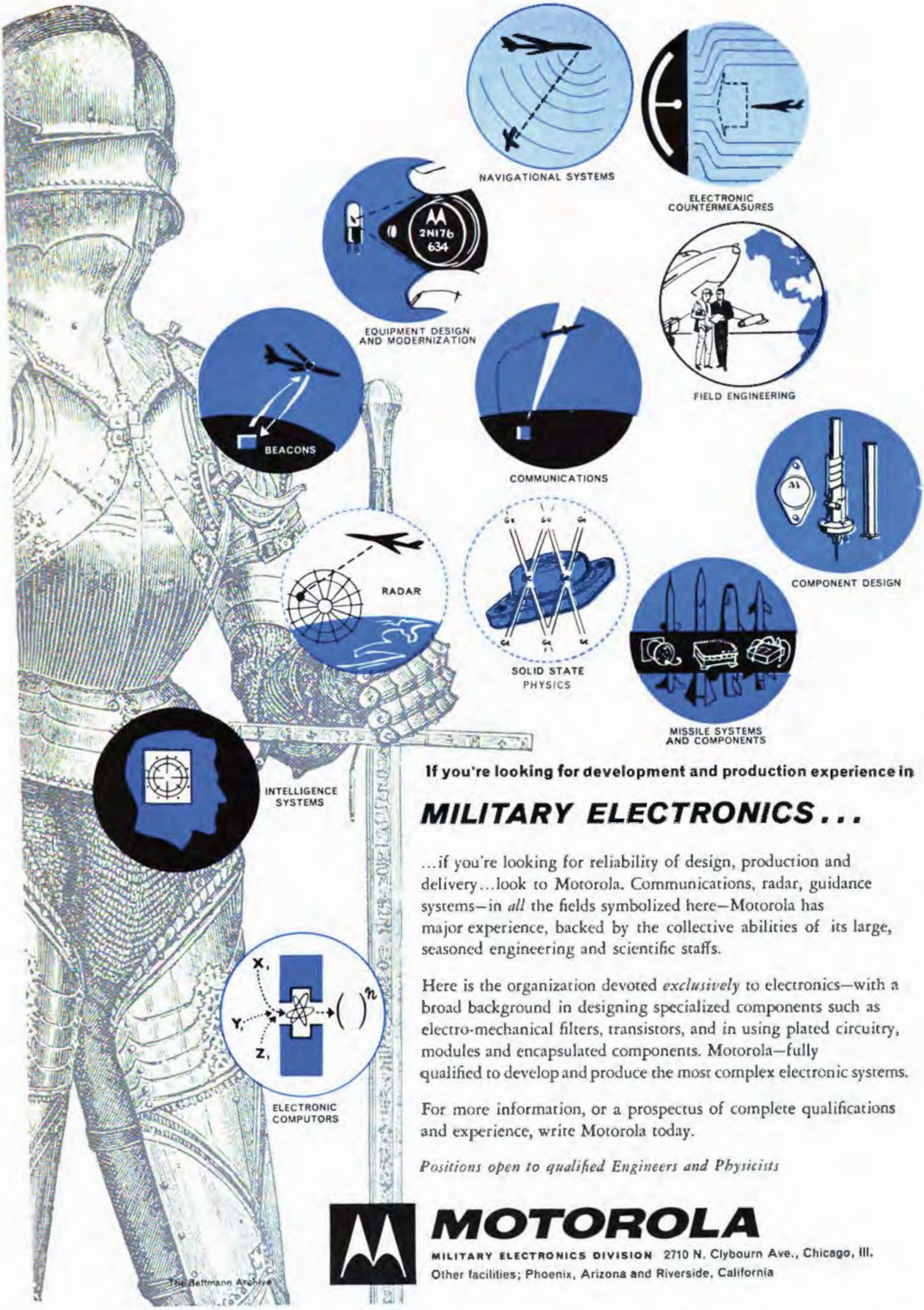
Another area for concern is the indication that many of the large projects now going through research and development on the Pacific Coast will result in manufacturing activity in some other area. This raises several important questions. One involves the challenge to various communities in maintaining manufacturers' employment. Another involves the challenge that will confront the Military in coordinating engineering and manufacturing—and make no mistake about this problem as the complexity of our weapons increases.

The very number of companies in electronics indicates the highly competitive nature of virtually every phase of the industry. Only those who can go forward on a balanced basis will survive even though the market is growing at an accelerated rate. The same aggressive attitude and fresh concepts that were instrumental in starting and building our industry must be applied to the future as well.

### *Growing Future*

Our market analysis people tell us that we will have a $15 billion electronics industry nationally by 1965. If they are correct, and our Western segment of the industry faces its future realistically, its rate of growth should continue to be higher than the rest of the country. By 1965 the West's percentage of output should increase from 16% to 20% and its dollar volume increase by more than one-third. On this basis we can look forward to a $3 billion Western electronics industry within eight years.

Western electronics is young, vital and flexible. Its approach is as fresh as it is vigorous and its contribution to military electronics will continue to expand.



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# marconi to MARS

by Maj. Gen. James D. O'Connell
**CHIEF SIGNAL OFFICER, USA**

***The Author***

*Maj. Gen. O'Connell, Chief Signal Officer, USA, has been in the Signal Corps since 1928. He served in England, France and Germany during World War II, and became Signal Officer of the 8th Army in Japan in 1947. General O'Connell is widely known throughout the communications field and recently was elected to honorary membership in the VWOA. He is a member of the Executive Committee of AFCEA.*

TODAY'S COMBAT COMMANDER MUST have control of his force. Without such control he is powerless. The destiny of every man in his unit and the outcome of a battle is not always within his grasp. In this Age of Electronics, he can strengthen his chances to gain this control and insure his probability of maintaining it.

Since the dawn of time, man has continuously sought to learn and keep within limits the physical forces about him so as to control better his own destiny.

### *Man and Mars*

Two thousand years ago, man gazed in fear at a red star in the heavens. We know the star today as Mars, and we know no terror of it, for we have plumbed many of its secrets. But ancient man trembled, for he saw it as an unknown and powerful influence upon his destiny—one over which he had not the slightest measure of control. Such is the ultimate destiny of Man, however, that in less than twenty centuries, two guided missile experts of this era—Wernher von Braun and Willy Ley—basing their plans on astronomical realities and sticking strictly to engineering knowledge available today, could have outlined a master blueprint for Man's first exploring trip to Mars.

In the year 1900—a date within memory of many who are today members of AFCEA — an Italian named Marconi employed wireless telegraphy for the first time in reporting the presidential election of that year. And in the last few years of a life which ended only two decades ago, this prodigious scientist devoted himself to experiments with short waves and with microwaves, which he believed held the secret of television.

### *The New Era*

What would Marconi have thought if he could have participated in the presidential election of 1956 and have seen the combined communications and electronics systems which brought to the eyes and ears of millions of Americans an instantaneous record of the proceedings?

Today's combat commander is more directly affected by Marconi's early spark-gap transmitter than by early Man's fear of a blood-red star in the firmament.

Yet he cannot be completely remote nor unsympathetic. For his future and those of his men and indeed the future of all free men hinge upon how clearly he understands and how effectively he is prepared to resist a new Red Star. Moving through a giant orbit, it has left in its wake death and corruption. Its nature was revealed finally and completely in Hungary: a nature predatory and treacherous, with an unyielding determination to control the destiny of all mankind.

Today's combat commander is in the vanguard of those of the free world who have banded together to oppose the threat. As you read this, Army troops are stationed in more than 73 countries, helping these allies to build up their own strength for resistance, and in demonstration of America's determination to deter or to overcome any aggressive move by an enemy.

In an era marked by the virtual annihilation of time and distance, new concepts of military operations have had to be developed. New organizations and new techniques have evolved. Today's Army is in dynamic transition from cannons to missiles, from trucks to helicopters, from shoe leather to flying platforms, from field glasses to battlefield television. Along with new and unprecedented responsibilities, the Army has already developed new and unprecedented capabilities.

### *Command Control*

Greatly increased firepower and mobility are part of a nerve system which insures a fast reaction time—a means for beating an enemy to the punch and dodging before he can strike back.

But firepower and mobility together do not insure victory. There is a third major requirement — Command Control. It is information about the battle situation. It is the means by which firepower and mobility can be coordinated and accurately directed. It is the element which enables an Army field commander to convert men, weapons, supplies and transportation into firepower, mobility and teamwork.

It is Communications and Electronics—rapid, reliable and responsive.

And these are but a few of the things which we in the Army and you in industry, university and laboratory are doing to improve Command Control.

### *Reconnaissance Drone*

In the extremely important area of Combat Surveillance, the commander will have a radio-controlled reconnaissance drone. Directed by a controller while within sight and carrying a camera over enemy positions, it takes pictures and brings back target information. Out of sight of the controller, radar takes over and plots the drone's location. Returning home, the drone parachutes to the ground, the exposed film is retrieved, and within ten minutes the finished pictures are delivered to the commander.

### *Surveillance Tools and Communications*

The new portable television camera constitutes an extension of the eyes of the commander far beyond his command post. Carried by a soldier in a forward area or installed in an Army aircraft covering an amphibious assault, the camera transmits essential and instantaneous information to the commander. This gives him a capability for decision based upon up-to-the-minute information of the battle and of the movements of enemy men or armor.

Ground combat photography is still an important surveillance tool. The new 100" camera has an effective range of up to 30 miles. By means of this device, distant terrain and enemy assembly points can be made available for close observation.

Added to these means for surveillance of the combat area are infra-red and other sensory devices.

For communication, the Army is considering a program of re-equipping its men at every echelon: the individual soldier to be provided with a helmet radio set; transistorized radio equipment to replace the Handie-Talkie and Walkie-Talkie for the forward combat units, and the new vehicular radio equipment, new radio relay, and new scatter communication equipment for the higher echelons in the Field Army.

Electronic Data Processing has already gone beyond the great promise predicted for these systems. It is today being applied to antiaircraft operations in air defense. The Army's Missile Master, in current production, is a data-processing communication system that ties in with the Air Force's SAGE system. Data from SAGE is fed into the system as well as data from the organic long-range radar of the Missile Master and the radar of the NIKE batteries. Information is fed out to the battery commanders to orient their radars on incoming targets and advise them of which targets to engage. The complete status of targets and the NIKE batteries are presented to the tactical controller at the Antiaircraft Operations Center.

### *Computers Employed*

This is an automation system which, as a tool in the hands of the Antiaircraft Commander and his staff, provides at least ten times the capability of any group of human processors!

In the logistical field, the Army's Technical Services are placing high priority on use of computers for inventories, stocks and requirements control at major supply and stock control points. The U. S. Army Signal Supply Agency in Philadelphia has in service a large commercial high-speed computer. It will eventually operate in a system using punch-card transceiver communication together with medium capacity computers at the four Signal Corps Branch depots.

It used to take up to six months to compile the stock status of the 150,000 different items in stock. Now it can be done in a single day.

### *New Equipment*

With the Army having to rely upon increasing numbers of organic aircraft for reconnaissance and resupply, there is a need for navigational aids and traffic control equipment. In developing these equipments, we are using everything the Air Force and Navy have which is applicable to Army purposes. Our requirements for aircraft are, however, fundamentally different from those of our sister services with respect to size, weight and operational performance. Substantial numbers of new types of electronic equipment will therefore have to be developed and procured for use in Army aircraft. A new basic aircraft radio set is now being introduced, and we are testing ground-controlled navigational and landing devices such as omnirange and quad radar. We are accelerating development of self-contained navigational systems for Army aircraft, including doppler and inertial guidance.

### *Speed and Reliability*

I have enumerated but a very few of the devices and systems which the commander will have available to him, and which the Army considers indispensable to the exercise of rapid and correct judgment by a field commander. The nature of modern warfare has placed a premium upon speed and reliability. In past wars, small margins for human errors were permissible. In future warfare, the margin for error and allowance for mistakes are sharply reduced, for speed of movement and the destructive effects of modern weapons are such that mistakes which used to have only marginal effects can now be catastrophic.

### *Desires and Realities*

Human reaction time is too slow to cope with the realities of today's combat operations. The breach can only be filled by the products of the dynamic technology which the professional members of the Armed Forces Communications and Electronics Association represent.

It can in truth be said that Marconi did as much as any man in history to stimulate free man's imagination, his hopes and his confidence in the future. Marconi himself would never have tried to link his name symbolically with that of Mars.

Yet, we can link the two. For Marconi can well be the symbol of man's insatiable ambition to ferret out the secrets of the universe, and Mars has ever been the symbol of man's aggressiveness, his soaring ambitions, his endless quest for greater — and now perhaps wiser—control over his own destiny.

### *Mars Awaits Man*

Our children are about to become spectators of mankind's first tentative stabs at uncovering the secrets of outer space. What new additions to the reservoir of human knowledge and wisdom and to the ultimate betterment of humanity will come of it?

Mars, the age-old symbol of the God of War, sails serenely on his infinite path, and waits for puny man to cross the threshold.

It is a threshold over which—one day—we will pass.

# Message from Melbourne

A recent short-wave broadcast from Melbourne, Australia . . . received in Syracuse, N. Y. (over 10,000 air miles) **with no perceptible flutter or fading** . . . is further proof that General Electric's new radio technique . . . Synchronous Amplitude Modulation* . . . is the solution to the problems of long-range radio operations. Its concept and operation are uniquely simple . . . SAM* is compatible with all present forms of radio equipment . . . its operators need no further specialized training . . . yet it preserves complex wave forms even while handling the Doppler effect. Its suppressed-carrier, double-sideband transmission and synchronous reception promise significant savings in weight and cost. Of paramount importance is SAM's* resistance to jamming and interference. Here again, is a vivid example of LMEE's invaluable contribution to progress... in furthering new uses for electronics. For the very latest information on SAM* . . . write Section B

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## — GOVERNMENT —

THE WORLD'S NORTHERNMOST CITY Since 1951, millions of U. S. dollars have been spent in the development of a protective cluster of air bases and radar stations at the top of the world. The northernmost airbase in the world is Thule, located only 800 miles from the North Pole in Greenland. Its' architect, Garnett Herwig, said recently that it is assuming the title of the world's northernmost city. Located in a valley between two mountain ranges on the edge of Greenland's huge ice cap with a steady wind and permanently frozen ground, techniques of construction are just the reverse of those usually devised. Pioneering work at Thule has provided architects and engineers with the ability to cope with other Arctic and Antarctic bases where the same rigorous conditions exist.

BRIDGES "FLY" AT FORT BELVOIR Bridges are literally flying at Fort Belvoir, Va., the U. S. Army's Engineering Center. The Engineer Research and Development Laboratories are conducting tests in an effort to give the Army the capability of moving bridge and stream crossing equipment to distant sites by helicopter. In test demonstrations, the H-21c helicopter, a light cargo carrier with a lifting capacity of 3,400 pounds, carried boats and bridges. A heavier helicopter furnished by the U. S. Marine Corps Base at Quantico, Va., demonstrated the capability of delivering a 5,600-pound assembled float. It then placed a 6,600-pound aluminum deck on it to form a complete bay.

CONTRACT AWARDS: The ARMY has awarded the following contracts: Texas Instruments, Inc., transistor frequency modulated oscillator, $35,111; Hycon Manufacturing Co., modified camera KA-20, $227,450; Brooklyn Polytechnic Institute, microwave instruments study, $44,275; Raytheon Manufacturing Co., electron tubes, $40,000; Varian Associates, electron accelerator, $625,000. The NAVY recently announced contract awards to: Elgin National Watch Co., timing mechanisms, $1,240,000; Bath Iron Works, missile carrying destroyers, $44,045,600; Westinghouse Electric Corp., cooling system for naval vessel, $7,513,000; Western Union Telegraph Co., modifying telegraph facilities, $2,181,790; U. S. Hoffman Machinery Corp., ammunition, $3,355,000; Allison division of General Motors Corp., reconditioning jet aircraft engines, $7,776,661; Stavid Engineering Co., missile guidance system for submarine launching, $6,000,000. AIR FORCE grants include: Sikorsky Aircraft, Division of United Aircraft Corp., H-19D helicopters and spare parts, $2,717,000; Glenn L. Martin Co., flight testing of Matador missile, $1,527,981; Convair, Division of General Dynamics Corp., research and development, $1,474,950; Ray Aeronautical Co., aerial target drone and spare parts, $9,225,849; Boeing Airplane Co., reorientation of the WS 110A program, $3,250,000; E. I. Du Pont De Nemours & Co., methanol, $1,623,430; Avco Manufacturing Corp., T-53 engine development, $2,080,460; Standard Oil Co., starter cartridges for B-57 bomber engines, $3,412,593; Aeroil Products Co., Inc., spray outfits for cleaning, de-icing and decontaminating, $1,916,438; Lockheed Aircraft Corp., additional facilities for final assembly end production flight testing site for jet aircraft, $2,314,000.

## — INDUSTRY —

I.R.E. CONVENTION HUGE SUCCESS SIGNAL extends congratulations to the Institute of Radio Engineers on its 45th national convention in New York City, March 18-21. A populace of 54,000 visited the giant New York Coliseum where remarkable achievements in the world of electronics and communications were displayed in 846 exhibits and discussed in some 250 technical papers. The Waldorf Astoria, where some of the technical papers were read, became home ground for many of the visitors. The four days unfolded, before the public, the story of electronic progress.

BORESCOPE APPLIED TO INDUSTRY The instruments with which doctors peer into patients' bodies now have been adapted by industry to probe for defects hidden in machinery and to read gauges inside atomic reactors. The long needle-like instrument known as the borescope—in effect periscopes with built-in flashlights—has become industry's newest tool. It is being used also to examine the interiors of airplane propeller blades, boiler tubes, and engine cylinders, according to the National Electric Instrument Co. of Elmhurst, N. Y., which manufactures them for the medical profession and industry. It has just developed a special lens system for them called the "Fontar" which enables all objects and areas within view to be always in focus, regardless of distance from the end of the instrument.

RCA MAKES THE CONGO TEST As a vehicle to test and subsequently advertise test results of 24 various products, RCA went on a "Safari" to the Belgian Congo. An RCA Victor Pocket Sized Transistor Radio (Model 8BT7) and a 7 Band Strato-World II Radio (Model 7BX10) were among the products subjected to the heaviest duty in the jungle. On land and in canoe, the transistor radio "operated perfectly," RCA reports. The Strato-World II served as a "calling card" at native communities in the Congo, bringing music from all over the world. All sets are said to have withstood the rigors of the 26,000 mile trip, exhibiting good reception and excellent performance and tone in this high humidity area.

ELECTRONIC TUBE GOLDEN ANNIVERSARY Control of the infinitesimal electron has made it possible for mankind to hear, see, feel, smell, calculate, and even talk. The history of electronics, commemorating the 50th anniversary of the patenting of the original electron tube, was shown in an exhibit at the I.R.E. National Convention in New York City recently. Known as the Princeton Tube Collection, probably the most comprehensive of its kind in the world, it consists of more than 6,000 tubes ranging from examples of the earliest "Edison Effect" to the most modern 600,000 watt tube. Included were samples of more than 40,000 different types of tubes that have been developed and their contributions to unlocking the mysteries of radar, television, x-ray and other electronic equipment.

## — GENERAL —

"TOMORROW THINKERS" STUDY AVIATION The Republic Aviation Corporation now has an ultra-specialized staff of "tomorrow thinkers," organized after an international talent hunt, working on the problems of flight at speeds of thousands of miles an hour at altitudes 50 miles above the earth. The group, called the Scientific Research Staff, is primarily concerned with fundamental research vital to continued growth of aviation. It is maintained on a semi-academic basis so that it is free to explore developments in such fields as mathematics, general physics, nuclear physics, supersonics and thermodynamics.

COMPUTER TRANSLATES RUSSIAN INTO ENGLISH Developed at the University of Michigan is the Michigan Digital Automatic Computer (MIDAC) which deals strictly with the language of theoretical or experimental physics. It was noted that MIDAC translates Russian scientific fact into English but it won't translate the Russian fairy tales. The researchers predict, however, that it will even translate the fiction eventually. The magnetic drums of the machine have 64,000 Russian words and their English equivalents on record. As an operator types off a Russian scientific paper, the machine automatically types out the English equivalent.

FREQUENCY CONTROL SYMPOSIUM Attending the 11th Annual Frequency Control Symposium sponsored by the U. S. Army Signal Engineering Laboratories in Asbury Park, N. J., last week, were representatives from government, industry and educational institutions. Visitors from most of the free world nations were present. The purpose of the Symposium was to promote a better understanding and wider dissemination of technical information related to frequency control which was obtained during the past year. Technical papers were presented by outstanding scientists and engineers in their respective fields. Nobel prize winner in Physics, Professor Kusch presented a paper on "Precision Atomic Beam Techniques."

JAPAN SEES U. S. COLOR TV A million-dollar color television caravan of the Radio Corporation of America is now in Tokyo at an American exhibit in the International Trade Fair. The equipment includes full color TV studio facilities, two camera chains, lighting and testing apparatus, film transmitting facilities and two fully equipped, specially built mobile units. Japan was the first country in Asia to introduce black and white television.

**COMMUNICATIONS -- *Half the Battle!***

Will today's communications help win tomorrow's battles? For a good answer, take a look at how the U. S. Army Signal Corps is keeping ahead of the fast-changing techniques of military operations — by providing tomorrow's communications systems *today*.

Look, for example, at the Signal Corps' completely miniaturized, all-transistor carrier system for cable or microwave communication in the field. It is fully portable, takes up less than a cubic foot of space, weighs only 65 pounds (compared to 500 for comparable World War II equipment). It provides 4 separate channels, offers highly reliable operation under severe conditions ranging from Arctic cold to tropic sun.

Lenkurt, selected as prime contractor for the development of this carrier, has facilities uniquely oriented to research, development, and precision production for vital defense projects. As a leading specialist in telecommunications, Lenkurt works directly with government agencies and with other manufacturers in providing equipment either "off-the-shelf" or specially designed, to meet the highest standards and most exacting requirements of the military.

***See the Lenkurt exhibit, Booth 51, at the AFCEA show, May 20-22.***

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# SCIENTIFIC EDUCATION . . . . the NEW CHALLENGE

RCA Fellow studying at the New York University College of Eng neering is shown verifying transistor equivalent circuits on th University's electronic analogue computer.

***By Brig. Gen. David Sarnoff***

**Chairman of the Board of Directors**
**Radio Corporation of America**

When the Armed Forces Communications and Electronics Association was organized in 1946, its main objective was to encourage a firm and lasting partnership between the military and industry. In its eleven years of operation, AFCEA has successfully accomplished that mission, and time has broadened its objectives and extended its opportunities.

As the first president of the AFCEA, I congratulate its members who have built and strengthened the organization with enthusiasm and patriotic devotion.

Today the influence of AFCEA as a vital link between the Armed Forces and industry extends through forty-eight chapters, across the United States and overseas. Its roster of more than 200 professional organizations, corporations and manufacturing divisions contains many of the most distinguished American names in science and engineering.

Through its interest and activities in communications, electronics and photography, the AFCEA has established a timely relationship between the military and industry. It has helped to keep this country in the vanguard of the latest developments in every phase of technology.

David Sarnoff, head of RCA, recently celebrated his 45th anniversary in the radio field. He helped originate the present-day radio receiving set and was mainly responsible for the creation of NBC.

### *Shortage of Skills*

Today a new situation—a crisis in scientific education—has arisen and with it a new opportunity for AFCEA to extend its tradition of service to our national security. The solution to this critical problem may well be the challenge and the dedication of AFCEA in its second decade.

The crux of the matter is that in a period of growing dependence on increasingly complex electronic systems and scientific devices for national defense, this Nation faces a serious shortage of essential scientific skills. There is a decline in the number of students in science and engineering, and there are indications that the downward trend may continue. Unless the situation is quickly reversed, the balance in scientific superiority may ultimately swing away from the free world.

### *Safety and Strength*

Should the day ever come when we yield our scientific and engineering mastery to an enemy, we will have surrendered a key bastion to the fortress of liberty. In the final analysis, our safety and the safety of the free world rests on the deterrent capacity of America's armed might. Strength, however, will deter only so long as it is based on continuing supremacy in all areas of technology. And this supremacy is assured only as long as we have the finest scientific and engineering talents available to our laboratories and industrial plants.

*(Continued on page 50)*

In the electrical engineering laboratory of Howard University, this RCA scholar checks circuits on the distribution panel for an experiment.

RCA scholar at the University of Washington checks a dynamic demonstrator used to demonstrate adjustment of radio receivers.

The crisis caused by the shortage of skilled technical manpower exists on three levels, all of which are directly related. It is painfully apparent in the fields of creative industry. It exists in the colleges and universities, and extends into the high schools. It permeates the teaching of sciences in colleges as well as in secondary school classrooms.

A glance at current advertisements for scientists, engineers and technicians should be sufficient to convince anybody of the shortage of skilled personnel in industry. Competition to entice the existing cadre of technical talent away from one organization to another has reached a new peak of intensity.

### *Surveys*

According to figures prepared by the Department of the Navy, one defense firm, for example, spent $907,560 to gain 59 employees at a net cost per employee gained of $15,328. Another firm spent $100,674 and had a net loss of four employees; a third spent $40,722 and had a net loss of 14 employees. Such methods not only are wasteful; in the final analysis they are self-defeating.

The picture is even more unsatisfactory on the university and college level. Surveys reveal that to fulfill peacetime industrial requirements, the United States needs 35,000 to 50,000 new engineers each year. And we are told that despite increasing dependence on their services, the number of graduates in science and engineering has decreased by 52 percent since 1950.

Today we read that the Soviet Union has approximately 175 modern schools which offer engineering training exclusively to an enrollment of about 300,000 students. Although some 210 colleges in the United States offer engineering courses, their over-all enrollment totals approximately 194,000 students.

As for the secondary schools, the decline in the number of students receiving adequate training in the sciences and mathematics is both marked and urgent.

In addition to the shortage of students in science and engineering, there is, finally, a shortage of teachers. Inadequate pay, absence of incentives, and brighter opportunities in industry have served to siphon off many of those best qualified to carry on the training of new scientific generations. Thus, the picture shows an inadequate harvest for the present, the prospect of diminishing returns for the future and the depletion of the seed grain. It is a situation which calls for prompt and energetic corrective efforts.

### *Solution*

The immediate task is to see to it that young people with the necessary aptitudes in the sciences and technologies are given every chance to develop their talents and enter a career in these fields. This includes provision for adequate instruction. Secondly, we must provide a climate in which youth will be fired by the tremendous challenge which science offers and the broad opportunities it presents.

The responsibility for securing these goals is total. It cannot be assigned exclusively to education, or to government or industry. It must be shared by all three and with equal awareness of the need and the urgency.

Since the membership of the Armed Forces Communications & Electronics Association and its thirty-six chapters throughout the country represents both industry and the Armed Services, it is in a unique position to lend prestige and authority to the drive for increased scientific manpower and teachers.

### *National Educational Reserve*

Through the support of school activities and its participation in educational programs, AFCEA can help to stimulate and increase the flow of youth into the scientific studies and ultimately into research, engineering and industry. The opportunities are as extensive as they are important.

Some time ago, for example, I proposed the establishment of a "National Educational Reserve," comprising qualified teachers in mathematics, physics, chemistry, engineering and related subjects to be drawn from the technological ranks of industry.

This would involve the release—with full pay for at least a year—of a reasonable number of men and women for teaching assignments in their local schools. It could also mobilize those who have reached the retirement age in the military services and in industry, but whose knowledge and experience would ake them inspiring teachers. Addiionally, it could include qualified eople willing to volunteer their ervices to teach in night schools ithout giving up their industry obs.

The number of teachers recruited rom any single organization would e too small to entail hardship for ny one—but the total number comrising the corps could be drawn rom such an extensive list of organzations that it would be large nough to give new impetus to teachng of the sciences in our school sysem, especially at the junior and high chool level.

### *Encouragement From Experienced People*

In some degree too, such a plan vould amount to the restitution by usiness of personnel it has siphoned ff from the school system. Men and women who normally would have become teachers of the sciences have instead gone into industry where the rewards are more enticing. Because of their practical experience, such people could become even more valuable to education in that they would bring the breath of reality into the schoolroom and restore the sense of adventure to technical careers.

There are other areas in which AFCEA can make a notable contribution to the campaign for skilled technical personnel.

Far too many young people are lost to science for lack of encouragement from experienced elders or through inadequate information about the many opportunities it offers. By the support of such activities as student chapters of AFCEA or through individual student enrollment in chapters already existing, much can be done in this direction by AFCEA to further an interest in the technologies.

### *Contributions From Industry*

There are many members of AFCEA who can provide lecturers or lecture material and stage scientific or technical demonstrations. They may even be able to lend some simple equipment for use in schools. The novelty of an outsider coming to speak, the opportunity to see science at work for progress, the chance to finger equipment in industrial use would help open the classrooms to the living vitality of science and inspire many a young student to take up its challenge.

Industry has shown that it is prepared to contribute generously to the advancement of education. Its donations have run as high as $100 million a year. Yet it has been estimated that the Nation's colleges and universities will require an additional $800 million a year over the coming decade to carry out their training mission. The bulk of this must come from individuals and corporations if the need is to be met without the Federalization of education.

A senior, studying under an RCA Scholarship at Wellesley College, conducts research tests on an infrared spectrometer.

### *Toward A Long Range Objective*

If industry can spend tens of thousands of dollars to attract young men getting out of college, it seems that it might invest even larger sums to get them into college and to help them complete their studies.

Recently, the Radio Corporation of America established thirty college and university scholarships for students who are preparing for the science teaching professions.

It was done because we recognized that the supply of creative scientific and engineering personnel depends upon the quality and number of secondary school teachers who will instruct our young people in such courses as physics, chemistry and mathematics. Through such programs which contribute to the supply of science teachers, we believe that progress can be made toward achieving the long range objective of maintaining America's technological superiority.

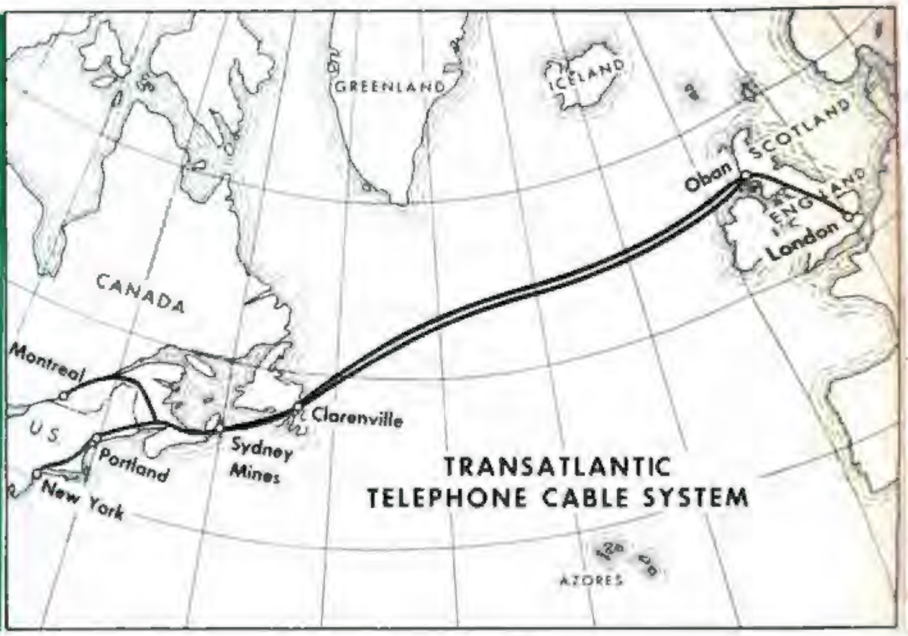
The struggle for scientific supremacy in the day of the electron and the atom will not be of limited duration. It is a conflict which may extend over decades, and to retain our Nation's present leadership in technology will call for undeviating tenacity of purpose. In the educational aspect of the conflict, the purpose must be to assure a steady inflow of scientific creativeness into our industrial and military establishments. Since we do not wish to "commandeer" the brainpower of our young people, we must seek out all ways of stimulating their interests and engaging their enthusiasms.

### *Publicizing Science*

We must not neglect a single opportunity or means to inform them of what science is accomplishing and what it means to America's progress and security. We must utilize all means to see that this message reaches them at a time when they are beginning to develop their basic concepts and we must remain with them long after they embark on their careers.

The AFCEA can help to achieve these goals with persuasiveness and authority. This is the challenge and the opportunity. Its importance is matched only by its urgency in the interests of national defense and peace.

The route of the transatlantic telephone cable system is shown on the map (right). It stretches 3,205 miles from Portland, Me., to Oban, Scotland. Various domestic circuits carry the messages to the New York City area, Montreal and London. The 2,250 miles from Clarenville to Oban are spanned by twin repeatered cables, while a single repeatered cable extends from Clarenville to Sydney Mines, Nova Scotia, a distance of 300 miles. The cable system is operated by the A.T.&T. Long Lines Department, and British and Canadian telephone interests.



# International Telephonic Operations

## UNITED STATES PHASE OF OPERATION

By

**W. G. THOMPSON**

**ASST. VICE PRESIDENT**

**AMERICAN TELEPHONE & TELEGRAPH CO.**

William G. Thompson, Director of the Overseas Services of the Bell Telephone System, has been responsible for coordinating activities in connection with new underseas telephone systems.

COMMUNICATIONS HISTORY WILL, I believe, mark September 25, 1956, as the beginning of a new era in voice communication between continents. The Transatlantic Cable system, which was opened for public service on that date, has demonstrated that peoples separated by ocean barriers can talk with one another as naturally, as clearly, and as conveniently as neighbors do in a local telephone conversation.

Although this new cable has been in service only a little over five months at this writing, the stimulus to telephone traffic between the United Kingdom and this country exceeds the most optimistic forecasts. The increase in daily telephone messages over the pre-cable level of messages averages over 75 per cent. On Sundays, the increase averages approximately 65 per cent. The volume of messages on Christmas Day 1956 was 1200, compared with 450, the highest previous Christmas volume which was reached in 1953.

Several of the cable circuits were extended through England to the European continent. One channel was terminated in each of five European countries and two in another. Even with these few cable circuits available, overall service between the United States and these countries has increased substantially, being up 20 per cent. Naturally, this development has led to a desire by the countries concerned for more cable circuits.

Although the increase in the transatlantic volume is greater than anticipated, it is not surprising when one reflects upon the progress of long distance telephony within the United States. It has been demonstrated over the years that as the Nation progresses, its need—commercially, industrially, and socially—for more extensive and better long distance communications grows likewise. The present vast, national network of long distance telephone lines and the continually increasing use of long distance by the public are substantial proof of the impact of communications on the economic and social relationships of the United States.

Despite the differences in time, customs, and often in language between the countries of the "Neighborhood of Nations," it appears that the potential basic requirements for communication of one country with another follow our domestic pattern. The world of today, with its strains and stresses and with the interdependence of its people upon one another, needs clear and speedy communications more than ever before. For example, the social value of the new transatlantic cable was demonstrated by the recent tremendous surge in Christmas calls, previously mentioned.

It is well-nigh impossible to calculate or analyze the impact of the new international telephone facility on our Nation's economy as a whole. Users of transatlantic telephone service come from a cross-section of American industry. Particularly active, of course, are organizations and persons engaged in foreign commerce. They range from large companies devoted to oil and shipping operations to individuals, such as diamond buyers, fur merchants, foreign exchange dealers and lawyers. Emergencies, like the Suez situation, undoubtedly create new and important users of the telephone service for businesses and for governments. In the latter connection, our experience has been that such uses, stimulated by specific events, continue after the crisis has passed.

In summary, I believe there is a substantial, undeveloped potential of telephone messages between the United States and other nations, and that as clear, fast, and reliable service is provided by the installation of adequate facilities along the major world routes, the public will respond with continuing increased usage.

## CANADIAN PHASE OF OPERATION

By

D. F. BOWIE

PRESIDENT

CANADIAN OVERSEAS TELECOMMUNICATIONS CORP.

Douglas F. Bowie has been a pioneer in the communications field and has been responsible for organizing the Canadian operational phase of the Transatlantic Cable.

THE MOST ILLUSTRATIVE COMMENT that can be offered to describe the importance to Canada of the new Transatlantic Telephone Cable is that overnight we experienced an increase of almost 500% in transatlantic telephoning and the new level has been maintained ever since. Obviously, we had filled a long-felt want and public, business and official reaction has been overwhelming.

It is our feeling that in thus providing, in collaboration with our British and American friends, high quality service on this route, we have achieved the goal of every communications enterprise, namely, that of giving the customer the latest and best in telecommunications facilities, which he is entitled to expect in return for his money. The response of Canadians, as indicated above, certainly seems to prove the correctness of that theory and the 1956 project was, as a result, an outstanding success. It is a continuing obligation for us to look to the future and to utilize all technological improvements and developments so that the industry can keep apace with the ever increasing public demand for ample and economic means of communication during a rapidly expanding economy.

It is our view that the planning and laying of this Transatlantic Telephone Cable was an outstanding example of international co-operation. Major undertakings—such as this was—frequently fall behind schedule. When there are several partners, the questions of rights and privileges may perhaps tend to slow up general progress but when sovereign rights, pride of craft and such other intangibles are also thrown into the pot, the results could be serious. The Transatlantic Telephone Cable project encountered those problems and overcame them. It was completed and in use almost three months ahead of the original target date. The unanimity of purpose of all concerned brought about that satisfactory result and it was an outstanding demonstration of what our three countries can do when determination to get the joh done is the overriding factor.

This development is, I am confident, only the forerunner of greater things to come which will provide more and more means of communication and, I helieve, ultimately at reduced cost to the user so that he will be provided with every facility for correspondence in the broadest sense —whether by the spoken or by the written word. The first Transatlantic Telephone Cable, and those which will surely follow, can only help to produce improvement in cultural and commercial relationships between the countries they serve, and the greater development of ample direct communications between nations must surely, in the long run, produce greater understanding between people. From the point of view of security, there can be no doubt that the continuity and secrecy of cable operations will be important factors contributing to the defence of the free nations of the world.

It is our belief that in providing such high quality service on the Transatlantic Telephone Cable, we jointly achieved the goal of every communications enterprise, namely, that of truly serving the public by the provision of the best possible facilities at the lowest possihle cost. That happened in 1956. Now we must look ahead and provide for the years to come.

Pictured here is the Telegraph Test position of the Transatlantic Telephone Cable.

**As we go to press, we learn that officials of the governments of Canada and the United Kingdom, together with representatives of Cable and Wireless, Ltd., and Canadian Overseas Telecommunications Corporation, met in Ottawa recently to consider arrangements for the development of a new transatlantic sixty channel cable for telephone and telex services across the Atlantic.**

**Pictured on the left is the International Exchange in London where all North American Telephone Cable Services are performed. Since the beginning of this service, total paid minutes have increased by 125 per cent.**

Below: The author, Sir Gordon, as Deputy Director General had technical responsibility for Britain's contribution to the transatlantic cable. Together with Dr. M. J. Kelly, he received the international Christopher Columbus prize for his work on the cable in 1955.

# UNITED KINGDOM PHASE OF OPERATION

By

## Sir GORDON RADLEY

### THE DIRECTOR GENERAL, GENERAL POST OFFICE UNITED KINGDOM

By THE BEGINNING OF FEBRUARY 1957, the transatlantic telephone cable had been in service for some 30,000 hours. Through service between London and New York and Montreal was interrupted for a few hours in January, but that was due to a fault in one of the unattended radio-relay stations in Nova Scotia. It was quickly cleared by an engineer who arrived at the snow surrounded station in a helicopter.

The 400 electron tubes and 7000 other electronic components which operate in the submerged repeaters on the bed of the Atlantic between Newfoundland and Scotland and between Newfoundland and Nova Scotia have so far given no cause for concern. Nor have the transmission characteristics of the submarine cable system changed to any serious extent. That, I suggest, is an important measure of the technical success of the cable. But the ultimate measure is the way the public, especially the business public, is making use of it. The records show that calls between Great Britain and the United States have risen by about 80 per cent, and are now running at about 4,000 a week. Calls between London and Montreal have risen even more, by 150 per cent over the daily average—about 500—before the cable was opened on September 28th. Further, the total paid minutes increased by 125 per cent, while the average paid duration of calls had also increased considerably.

British listeners to broadcasts from America, as well as those using the telephone service, are experiencing the incomparable increase in clarity since they began to come over the new cables, and we can now hear such broadcasters as Alistair Cooke as clearly as if he were speaking in one of the B.B.C. studios. The Cable was also used very successfully on January 24th for a joint meeting between three professional engineering Institutions—The Institution of Electrical Engineers in London, the American Institute of Electrical Engineers in New York and the Engineering Institute of Canada in Montreal. Public address systems in the three halls linked together by the cable enabled engineers in the three cities to join together in a discussion of technical papers.

The cable is also carrying leased services and customer-to-customer services with Canada; the latter, known in Britain as "Telex", have increased considerably and we are expecting a heavy traffic build-up.

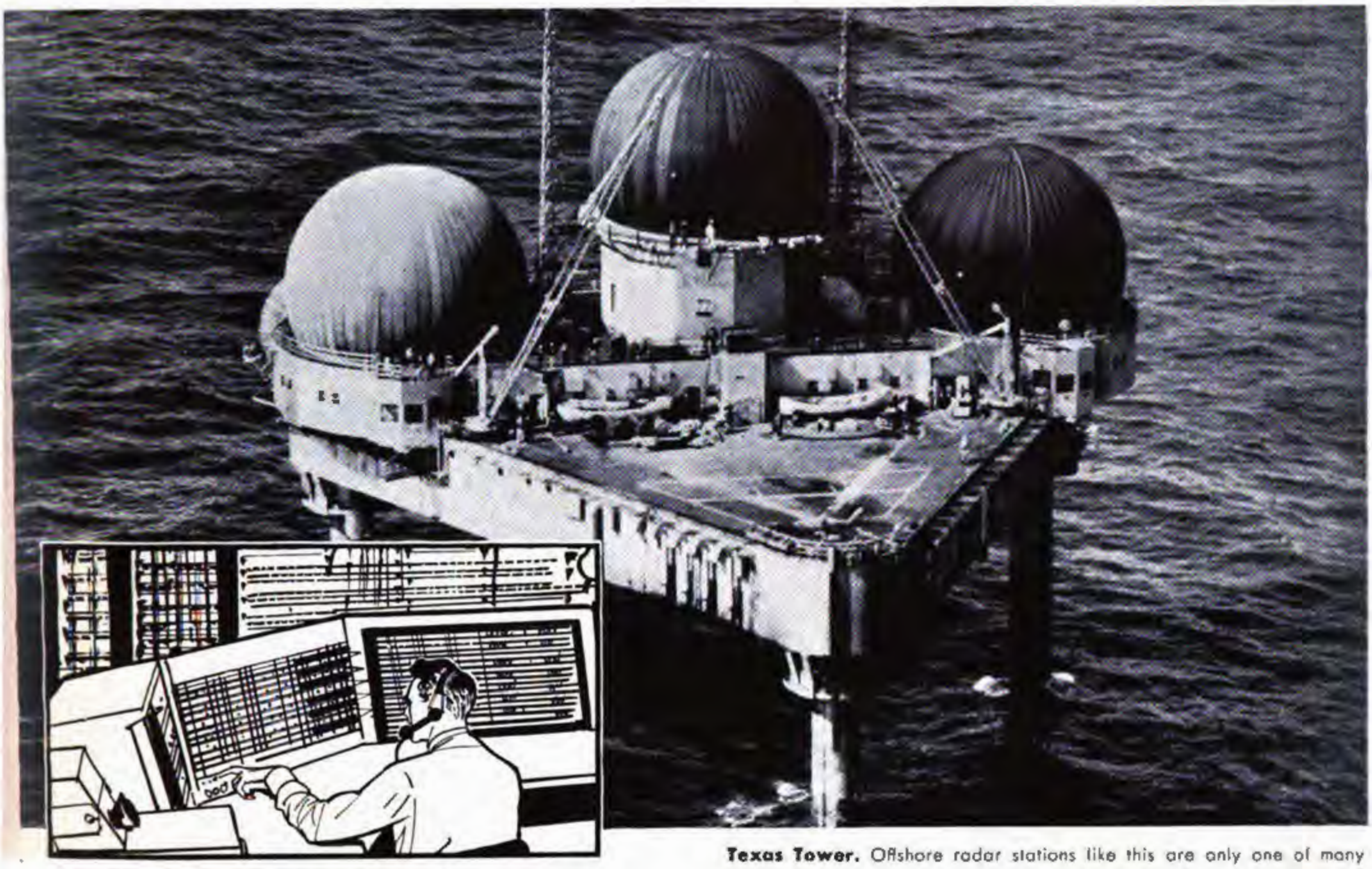
Readers of SIGNAL will naturally be interested most in the cable's contribution to the maintenance, by close contact, of the Western Alliance. This is largely a governmental matter and, although much of the communication is secret, it can be said that the telephone cable has added greatly to the stability and security of Government exchanges.

We in Britain are proud to know that most of the cable was made in our country and that it was laid by Her Majesty's Telegraph Ship *Monarch*. But the project was only possible because we made use of technical developments from both sides of the Atlantic, in particular, the flexible repeater housing from the Bell Telephone Laboratories. Throughout, our American and Canadian friends worked in the closest intimacy with us, freely exchanging all ideas and collaborating down to every detail.

We share your view that the new cable service, one of the finest examples of peace-time co-operation between nations, is the forerunner of great developments in the telecommunications world. Only three years ago it was little more than a dream: today, thanks to Anglo-American-Canadian co-operation, it is a living reality.

# Help test SAGE

## – the new Air Defense System



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E. H. RIETZKE, President CREI
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• *One of a series of institutional messages.*

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"I wish to say at this time that this is the first time in a good number of years that I have found a course in leadership which was written for people like me who really do need the help; most courses are just a bunch of ideas; this course anyone can understand. I think I have learned much and hope I can put into practice what I have learned."

**Name on file*

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The impetus of military research programs has generated important progress in this quest. Recent Avco research achievements—in thermodynamics, metallurgy, advanced electronics and inertial guidance, in all the sciences that figure prominently in "re-entry"—create hope for a prompt, decisive solution.

Through such experiments as these, America stands to gain over and over again from its investment in defense. For as science forges defense strength, it lays the groundwork for a nation prosperous in peace.

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"DEFENSE DOLLARS DELIVER TWICE," *says* Lt. Gen. James M. Gavin, *Chief, Army Research and Development* "For each military application of new scientific discoveries there are many parallel developments for peaceful use to improve the health, comfort and well-being of present and future generations."

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RJ3

# THE AIR FORCE C-E PROGRAM PROGRESS and CHALLENGE

During World War II, Gen. Pachynski served as Signal Officer, 5th Air Force, Southwest Pacific, and as Air Communications Officer, Far East Forces. He was named Director of Communications-Electronics for the U.S. Air Force in June, 1956.

By Maj. Gen. Alvin L. Pachynski, USAF

**DIRECTOR OF COMMUNICATIONS-ELECTRONICS, USAF**

THE AFCEA CONVENTION theme this year is "Marconi to Mars" which implies the astounding progress that has been made in the communications-electronics field within the last half century. In this era science, industry and the Armed Forces have marched together to achieve, in the light of yesterday's technological capabilities, what would have been considered near miracles in translating ideas into realities.

No small part of the significant advances made have, since World War II, been applied to meeting the requirements of the Air Force. Our needs for communications-electronics equipment in the Air Force have been expanding tremendously within the last few years.

### *Equipment Expenditures*

The size of appropriations is a pretty good index of this growth. Back in Fiscal Year 1952, the Air Force budget provided approximately $150 million for communications-electronics equipment. A portion of this bought us equipment for installation in aircraft but the bulk of this total covered procurement of equipment required for the Air Force communications-electronics ground environment. In Fiscal Year 1957 funds appropriated for procurement of ground equipment alone totaled in excess of $450 million. Thus, within a span of five years, our rate of expenditures for procurement of ground communications-electronics equipment alone increased more than threefold. The communications-electronics equipment procured and installed as integral parts of our air weapons systems represents, as you know, a sizable additional cost. Much of this airborne equipment operates within the systems comprising the overall communications-electronics environment of the Air Force.

### *Additional Costs*

The dollar figures I have quoted buy us only the equipment called for by the time-phased requirements of our communications-electronics program. To put this equipment into operation, we must at the same time program funds to cover other capital costs such as construction of buildings and other structures and for installation, maintenance and operation of the equipment once it is delivered. As we increase dollar-wise the scope of our equipment procurement costs in these other areas also increase. Thus each successive year sees our communications-electronics program absorbing an increasing share of the over-all Air Force budget. Briefly, why is this so?

### *Yesterday and Today*

Looking back at the past, it wasn't so long ago when a combat aircraft was quite capable of discharging its mission, once airborne, without further communication with, or direction or control from the ground. In World War I, air combat, such as it was, took place without benefit of any such ties. World War II saw the beginning of a significant change. But during that time and for some years afterwards, the measure of Air Force effectiveness remained primarily the number of modern aircraft in the inventory and the personnel necessary to operate and maintain them. The communications-electronics equipment and systems provided to support the Air Force served as an adjunct, an assist, if you will, to our air combat forces.

The coming of the jet and missile age and the introduction of nuclear weapons changed all this. Today we are dealing with air weapons moving at the speed of sound and tomorrow these will operate at velocities unheard of a few years ago. Concurrently, the effective employment of our air weapons in combat is geared to the use of nuclear armament which must find its targets.

### *SAGE*

The qualitative performance capabilities of today's weapons generate demands for communications-electronics means of command, warning, control and direction of unprecedented scope and complexity. These demands increase inversely as the rate at which the gap, in terms of time, between action and reaction in air warfare continues to close. The practical effect of this trend is that today Air Force effectiveness must be measured both in terms of the quantity and quality of the air weapons in our inventory and the communications-electronics environment required to operate our air weapons effectively in combat. The sum total of these represents the measure of our air power.

Let me cite a few examples. I have already referred to World War II. At that time and for a number of years afterwards, our air defense was designed to cope with aircraft moving toward their targets at speeds of less than three hundred miles an hour.

Under such conditions our ground radar stations could operate effectively in the dual role of early warning stations and ground control intercept centers. Manual methods of handling data and control of our intercept aircraft by voice communications were quite adequate for the purpose. As speeds of aircraft increased it became apparent that the target band-over problem between control centers and the manual transmission and processing of data associated therewith were too slow and cumbersome to permit effective intercept of enemy aircraft. To correct these deficiencies the Air Force adopted the concept of the semi-automatic ground environment or SAGE which primarily fills two specific needs. The first of these solves the hand-over problem generated by higher speed aircraft flying too rapidly through the control area of each radar station. The SAGE concept groups a number of such radar stations together into one area. Each such area has a single intercept control center into which data from the radar stations is fed automatically rather than manually. The second need filled by SAGE solves the command and control problem. This requires rapid assimilation of, and action on, the mass of data flowing into the centralized control center. The SAGE digital computer is designed for this purpose. As most of you know, SAGE is now in the process of implementation. We estimate the capital investment for SAGE may total in excess of $1.5 billion and the annual operating maintenance cost will approximate $400 million annually. This does not include the cost of radar stations feeding data into the system.

### *The DEW Line*

The threat of air weapons operating at supersonic speeds and equipped with atomic and nuclear explosives has made it necessary—for effective reaction by our forces — to push our air attack warning zones further away from vital target areas. The DEW Line, which was described to you earlier this year (January issue of SIGNAL), is such a warning zone. This project represents a capital investment, in terms of equipment and construction, in excess of $400 million dollars. To maintain and operate it will cost the Air Force annually an estimated twenty per cent of this amount.

These two projects alone account for a significant share of funds being applied to the growing Air Force communications-electronics program. Rapid advances in weapon capabilities also have an impact on other functional areas. With air weapon operating ceilings pushing higher and higher, we must keep in step by providing our air defense radars with an equivalent capability to detect enemy targets and control our own weapons. The speed and ceiling performance factors of new weapons also generate requirements for improved air navigation and air traffic control radars.

### *Strategic Air Command*

Our Strategic Air Command operations, based on constantly advancing air weapon capabilities, generate requirements for improved and new communications-electronics systems needed for quick reaction, split second control and effective operation of our retaliatory forces. Continuing air weapon modernization of our Tactical Air Forces likewise results in similar program demands that must be satisfied.

### *Technological Milestones*

Our Air Force communications program is designed to meet all of these requirements. Obviously, the emphasis today is on the application of funds to increasing costs in the Air Defense area where the greatest demands exist for equipment and systems to meet a variety of pressing operational needs. The DEW Line and SAGE projects are outstanding examples of major costs in this area.

Based on recognized operational needs to which our Air Force communications-electronics program is geared, we can expect that the requirements of this program in terms of capital investment, operation and maintenance in the next few years will continue to absorb an increasing share of the Air Force budget.

The maintenance of effective air power requires that we continue to press forward in the communications-electronics area as rapidly as we can to achieve our programmed objectives. Teamed with the scientific and technological competence of the Nation, we have made and continue to make significant forward strides in translating our Air Force program into reality. The development of the digital computer for SAGE and its application to our air defense system is an example. Another is the DEW Line. Still another is the widespread installation and operation by the Air Force of both tropospheric and ionospheric scatter circuitry through and within the Arctic regions. These represent real technological milestones in our march forward to achieve the kind of operational capability the Air Force requires. But in the long-range view there are areas which bear examination from the standpoint of current state-of-the-art capabilities as set against future requirements.

### *Radar*

Let's consider several examples. The modern radar, operating on the principle of a reflected pulse, utilizes basically the same technique invented in the 1930's and used with such telling effectiveness in the Battle of Britain early in World War II. True. today's radar, used for air defense and traffic control has been vastly improved and refined. It will, with further known state-of-the-art improvements, continue to do an effective job for us in the future. But in order to cope with tomorrow's targets we continue to increase its power. By doing so we further emphasize one of the inherent limitations of radar, the line of sight characteristic. which keeps us from seeing targets below the horizon. Thus, in order to maintain the lower altitude coverage required for effective air defense in a given area, we must maintain substantially the same density of radars regardless of the addition of higher powered radars to the inventory. As this trend continues into the future. complexity and costs will necessarily increase correspondingly.

### *Scatter Techniques*

I have mentioned the application of forward scatter techniques to fulfill Air Force operational requirements. These represent significant advances in the state-of-the-art of communications. But these scatter propagation techniques are still used for transmission of signals which have remained virtually unchanged since the telephone, the teletypewriter and the facsimile device were invented. The tempo of today's air operations is generating requirements for ever increasing capacity, speed, versatility and reliability in communications. To satisfy the requirements for greater capacity, speed and versatility, we must multiply the number and types of channels operated over a given radio circuit.

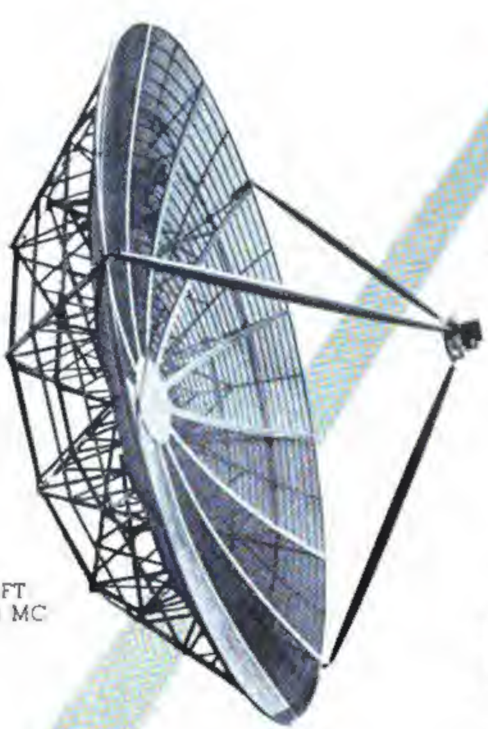
The scatter techniques we have adopted provide us with the means for maintaining continuity in our point-to-point communications despite dverse propagation conditions and ıey are a significant improvement ver the high frequency mode of adio communications with respect to ccidental or deliberate interference. lowever, this problem is not comletely solved. We are searching for technique that will guarantee posive communications between ground nd air, particularly at distances beond the line of sight. Much effort being applied toward developing ıore rapid and reliable means of ommunications. But for the most art the state-of-the-art advances eing accomplished will, as in the ase of radar, move us forward techıologically in relatively small steps vhereas our requirements for the uture appear to call for seven league ıoots.

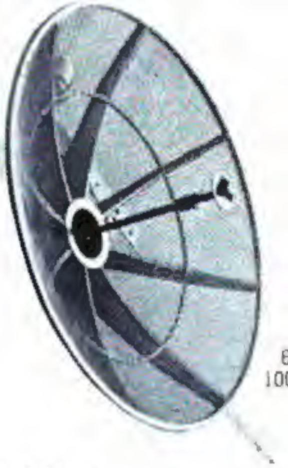
### *Rapid Advances*

The types of problems just described, with which we are coping in Air Force communications-electronics today, have been generated by the rapid qualitative advances made in our air weapons. These advances are direct results of a significant technological breakthrough in each of two fields of science. One is the mastering of aeronautical science of the problems of flight at supersonic speeds. The other is the development of a hydrogen bomb following hard on the heels of our success in producing the atomic bomb. The outstanding successes in these two fields were considered, not so long ago, as unattainable. That they were achieved is a great credit to our Nation's research facilities and technology.

### *The Challenge*

It is my view—first, that a major technological breakthrough in communications-electronics equivalent to those achieved in the nuclear and aeronautical fields, is required if we are to solve, in this area, the real problems of the foreseeable future; and — second, that this Nation has amassed enough scientific and technological competence to effect dramatic solutions to these problems. The requirements for such a breakthrough constitutes a real challenge to all of us. Our survival in the world of today can be attributed to the ingenuity and energy with which we have effectively solved yesterday's problems. Our future could very well depend upon how effectively we can apply these national attributes to the challenge which confronts us.





A senior Engineering Assistant of Western Union's Radio Transmission Division adjusts large "forward scatter" microwave antenna atop the telegraph company's building in New York City. The antenna is used for beyond-line-of-sight tropospheric radio signal propagation tests between New York and Philadelphia.

# Western Union Expands with Microwave

by Walter P. Marshall PRESIDENT
WESTERN UNION TELEGRAPH CO.

WESTERN UNION PLANS TO MAKE increasing use of microwave radio to keep pace with national defense requirements and to provide added common carrier facilities in the private wire, facsimile, data processing and television fields. Our expansion comprehends a nationwide network of microwave facilities that will link important cities and defense areas. It is expected that 90 percent of the added facilities to be derived from beam extensions now under way will be used for governmental and industrial private wire systems.

Walter P. Marshall is also a director and member of the executive committees of American Broadcasting-Paramount Theatres, Inc. and of the American Express Co., with wide experience in communications.

The leasing of "closed-circuit" telegraph systems for the fast, economical handling of volume communications has doubled in volume in the past five years and is increasing at a rapid rate. We have been meeting this demand through increased use of carrier equipment which creates a multiplicity of message circuits on a single pair of wires or radio beam. Carrier equipment now provides more than 2,750,000 miles, or over two-thirds of the four million telegraph channel miles, we use for message and private wire services.

### *New Circuits*

We expect to complete extensions of Western Union's microwave beam system to Cincinnati and Chicago by the end of the year, which will provide 1000 new duplex circuits in the heavily industrialized midwest area for general telegraph service and for leasing to industry and government. These extensions cover 556 airline miles and will flash through 20 towers in four states. Tower sites are being acquired for an additional westward route in excess of 1,000 miles which will reach from Indianapolis to Kansas City via St. Louis and from Cleveland to Chicago via Toledo and Detroit, and extensions to other key areas of the country to provide nationwide coverage are planned. National defense is, of course, an important consideration in our extensions and selection of tower sites so that main cities may be by-passed in the event of a national emergency.

### *Surveys*

In planning our present microwave extension it was found that topographical maps were lacking in certain areas and others were outdated or without essential detail, such as the location of high trees, high buildings and other man-made obstructions that might interfere with line-of-sight signal transmission. This problem was met by making aerial surveys of the new route at a time when the weather was clear, the und free of snow and trees bare foliage.

The aerial mapping was done by mes flying at 35,000 feet, and 350 otos were made of a five-mile-de path, which provided our en- eers with a complete, up-to-date ture of the terrain. As a result of is accurate survey it was possible eliminate several stations from the iginal plan with substantial savings construction, equipment, and an- al operating and maintenance sts.

Self-supporting towers of simpli- ed design using "fly-swatter" reflec- rs are being installed in the new stem. These reflectors catch the eam and direct it to receiving equip- ent at the bottom of the tower here the signal is amplified and ngled upward to another reflector nd on to the next station.

### *Monitoring System*

A unique monitoring system de- eloped by Western Union technic- ans automatically places an alternate eam circuit in operation when the egular circuit fails so that there is o service interruption. At the same ime, a Western Union facsimile ma- hine automatically records the nature and exact location of the failure.

Under our monitoring plan, each relay station is assigned an identifying code signal which registers on a master facsimile recorder at the terminal. Other code signals will show, for example, that the trouble is caused by a weak signal, that there is emergency generator operation because of commercial power failure, that tower warning lights are not on, or even that an unauthorized person is on the premises. When a fault occurs, the station affected sounds an alarm bell at the nearest monitoring center. The station then identifies itself and makes a report of its particular difficulty for which it will receive prompt maintenance attention.

### *Improvements*

Microwave transmission techniques are undergoing constant changes and improvements as the result of engineering research and development. For example, changes in air density, movements of warm and cold weather fronts and other meteorological factors cause radio signals to bend and fade. Such conditions occur most frequently in summer months, particularly at night and during early morning hours. To help overcome this problem, Western Union engineers experimented with an increase in radio transmission power above the one-tenth watt originally used.

### *New Tube*

The Sperry Gyroscope Company, developer of the Klystron tube, was asked to build a tube of greater power to meet Western Union's needs. The result was a new Klystron tube with a power of 10 watts, 100 times greater than the tube formerly in use.

An initial five-month transmission test of the new tube resulted in perfect operation while another radio beam channel, using the old tube with one-tenth watt power, suffered 17 interruptions from atmospheric disturbances totaling 23 hours during the five months. The new tube has reduced the effect of atmospheric difficulties in radio beam transmission outages to a remarkable degree and is now in use throughout Western Union's beam system.

### *A Radio Relay First*

Western Union played a pioneering role in the application of microwave radio for telegraph transmission. During World War II, thousands of scientists worked on the perfection of radar and microwave techniques including wave guides, cavities, and development of new tubes, such as the resonant cavity magnetron and the Klystron. Contributory effort in allied fields gave added impetus to the growth and advancement of a new communications art—microwave radio.

Recognizing the practicability and desirability of applying super-high-frequency radio to telegraph transmission, Western Union in August, 1944, applied to the Federal Communications Commission for a construction permit to build an experimental radio relay system connecting New York and Philadelphia. The New York-Philadelphia system was placed in operation in March, 1945, and began carrying commercial traffic in October, 1946. This was the first commercial use of microwave and also was the first use made of it for telegraphic transmission.

### *Experiments*

Our research engineers have been experimenting with new "forward scatter" microwave transmission techniques and rapid advances are being made with this revolutionary method of operation. Tests indicate that it is now possible to beam ultra-high frequency radio waves into the troposphere, where they are "reflected" to distances as great as 200 miles and even farther. This development offers considerable promise for some types of radio beam extensions, especially where difficult terrain is a factor, since great distances can be covered with fewer relay towers.

### *A Microwave Future*

Microwave radio has demonstrated its ability to carry telegraph, voice, facsimile and television signals fast and efficiently. Beam facilities are particularly suited for broadband transmission systems where many channels are required and have additional advantages over wire circuits. They are not subject to interruptions from wind storms, sleet, snow, ice, lightning, power induction and earth currents. As a new, challenging and rapidly expanding medium of communications, microwave is destined to play an increasingly important role in the future growth and expansion of the telegraph industry, and in strengthening our national defense.

Pictured above is a drawing of Western Union's new self-supporting microwave tower with "fly swatter" reflectors. A reflector catches the beam and directs it to receiving equipment at the bottom where the signal is amplified and angled upward to another reflector which flashes it on to the next station. This is the tower now being installed on W.U.'s microwave beam system extension to Cincinnati and Chicago.

# Application of Electronics to National Air Traffic Control

**By the Honorable Edward P. Curtis**

**Special Assistant to the President of the United States for Aviation Facilities Planning**

IT IS ESSENTIAL THAT THE NATIONAL AVIATION facilities System, that is required to provide the smooth and healthy growth of aviation, has a continuing program of modernization. Whatever future system and development program that is decided upon, electronics in all its phases will play an important part.

Those of you in the Armed Forces Communications and Electronics Association concentrating on work in the electronics field are more familiar than most people with the magnitude of the difficulties that exist. As increasingly large segments of our airspace become crowded, particularly in terminal areas, and as we put an ever-increasing load on two-way voice communication, it becomes more apparent daily that only a major effort on the part of Government and industry together can produce a system capable of carrying today's load in the air and provide for expanding demands in the future.

### *Progress and Facilities*

There are many reasons why we are in trouble today. but basically, I think, it is due to the fantastic development of our aviation, both civil and military, in recent years. All of us can well remember when a hundred miles on a motor was about the best you could expect Our airspace was relatively uninhabited and our pilots were certainly uninhibited by regulations and controls In the space of a few short years, all this has changed. Now we measure top speeds in Mach numbers instead of miles per hour and passenger miles flown in the tens of billions. Increasingly large portions of our airspace are becoming crowded and our traffic control system and airport facilities are becoming growing bottlenecks. For the first time in aviation history our forward progress is being threatened, not by the capabilities of our aircraft or the demands for their use, but by our own failure to provide adequate facilities to handle them.

### *Improvements*

Following the excellent report of the Harding Committee which highlighted some of the important deficiencies existing today, the Administration took vigorous action to look for both short- and long-term measures to improve the situation. One of the immediate results has been the very large increase in Civil Aeronautics Administration's budgets for purchase and installation of equipment and additional personnel to operate the Federal Airways System. Their program will result in a real improvement in our traffic control and communications set-up during the next two or three years. The program deserves, and I sincerely hope will get, the support of the Congress as well as of the Executive branch of our Government. With perhaps some additions and amendments, it represents the most effective action we can take for the immediate future.

In considering the longer term problem, the President has charged me with three major areas of responsibility.

*(Continued on page 66)*

### The Author

Edward P. Curtis has been with Eastman Kodak since 1920 and is now Vice President in charge of motion picture film business throughout the world and supervisor of general business abroad. During World War II, he served as Chief of Staff of the U.S. Strategic Air Force in Europe and attained the rank of Major General.

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First is the direction of a study of the Nation's long-range requirements for aviation facilities including airways, navigational aids, communications and airports; second, the development of a comprehensive plan to meet these requirements and finally, to recommend such organizational, legislative, and budgetary procedures as may be necessary to implement the plan.

### *Long-Range Requirements*

Our studies into the long-range requirements include the numbers of aircraft and the types which are likely to be in the system in the next twenty years. In terms of numbers, we expect that the scheduled air carrier figure of approximately 1,500 aircraft will increase very little if any during this period, but of course, larger and faster planes will generate a large increase in take-offs, landings and in passenger miles flown. Similarly, the numbers of manned military aircraft will show some slight increase in the near future and then begin to decrease as missiles are introduced into the tactical picture. It is in the field of general aviation, including everything outside of the airlines and the military, where we would expect the greatest increase to take place—something in the order of fifty percent from approximately 60,000 active aircraft in the inventory today to about 90,000 in 1975. So far as aircraft types are concerned, the period up to 1975 will be characterized by the completion of the transition to turbine driven aircraft in the military and likewise the conversion of perhaps 90 percent of the air carrier fleet to either turboprop or pure jet types. We would expect that even by 1975 the great bulk of the general aviation fleet will continue to be piston driven with perhaps 10 to 15 percent, represented by the executive type planes, to be turbine powered.

### *Major Traffic Areas Sampled*

In considering the requirements for aviation facilities in terms of traffic control, communications and airports—numbers and types of aircraft do not mean too much unless we know something about where and how they fly now and in the future. In this part of our investigations, our requirements team conducted extensive samplings over a four-day period from Friday through Monday in four of the major traffic hubs—New York, Chicago, Los Angeles and Washington—and four smaller hubs—Norfolk, St. Louis, Albuquerque and Oklahoma City. This was done by photographing radar scopes and actual counting to cover all traffic within a fifty mile radius of the principal airports and to break it down in terms of types of traffic, that is, civil and military by types and whether it was local or itinerant traffic. Counts were made on the basis of the number of take-offs and landings per peak hour at all airports in the area, which we felt gave the best measure of airport capacity demand, and also we counted the number of instantaneous airborne aircraft at a given moment of peak operations as a measure of the potential load on traffic control and communications.

### *Large Increases for 1975*

I will not attempt to go into any detail about these figures, but a few highlights may be interesting. W found, for example, that the Los Angeles area has b far the highest volume of bourly movements, over 50 during the peak hour sampled as compared with 345 fo the peak hour in New York and 300 in Chicago. A might be expected, the "mix" of traffic is very differen in the various areas. In Los Angeles the percentage o general aviation flying is very high compared to othe areas, whereas scheduled airlines activity is relativel low compared to New York. In the Norfolk area, military flying accounts for most of the air activity with ver little airline or general aviation operations. While w are not yet ready to give any firm forecasts for th increase in air traffic, it seems probable that overall w will have to expect between two and three times today' volume by 1975. The increase will vary in differen areas, of course, and we expect relatively a much greate increase in demand under IFR conditions as the capacit of the system is expanded and pilot proficiency and airborne instrumentation is improved, particularly in th general aviation field.

### *A Feasible Plan to Solve the Problem*

Based on the magnitude of the problem as indicated by our requirements investigations, my systems engineering team has prepared a plan which, if properly implemented, we believe will be capable of providing adequate facilities for the future without undue constraints or an intolerable burden of cost to either the users or the taxpayers. We do not claim it represents the only way the job can be done, but that it is one good way of doing it and also that it is of the utmost importance that one plan of action be decided upon and supported by all interested parties. Obviously, any system must be subject to constant review and continuing experimentation if we are to take advantage not only of existing technology, but important developments which are sure to lie ahead.

### *Primary Requisites*

Basically, any system must fulfill, as far as possible, certain policy concepts of which the following four points are of fundamental importance:

1. That a single National Aviation Facilities System be capable of meeting the needs of the users, both civil and military, on an equitable basis;

2. That the future facility system be compatible with existing systems in a technically and economically feasible manner;

3. That the air traffic control system and the air defense system assist each other to the maximum extent possible;

4. That an effective federal organization for keeping aviation facilities modern be an integral part of the National Aviation Facilities System.

### *The Operation of Two Modes*

The System, as envisioned by the Team, would utilize a division of the airspace for the operation of two modes. The first mode, called the all-weather mode, would apply ove certain specified altitudes and in dense terminal ies including designated runways. It would require ffic control at all times.

The second, called the dual-weather mode, will have ffic control regulations similar to present ones, but juiring speed limits and minimum cockpit visibility ndards.

### *Air Space Reservation Continues*

The airspaces assigned to each of these two modes uld not physically conflict, and each would have pro-lures and pilot proficiency requirements so chosen it each airspace user should be able to accomplish his sired trip while complying with the regulations of the ode that fits his capabilities. Extension of the all-ather mode should eventually cover enroute altitudes signated to meet the demands of users wishing traffic ntrol protection at all times. There appears to be space cover the requirements of the next two decades for -weather and "see and be seen" altitudes or lanes, d even a third mode involving positive separation for erators not possessing IFR flying capabilities.

The system should continue to use airspace reservation the basic procedure for separating aircraft, as con-asted to a system which would permit unrestricted flow traffic with only occasional intervention to prevent nflicts.

Study of the possibility of providing such an arrangement of airspace indicates that horizontal and vertical separations capable of being achieved by foreseeable navigational techniques would be adequate even in most heavily traveled enroute areas such as the one between New York and Washington. Parallel one-way airways, speed segregation on airways, non-conflicting crossing altitudes and radar vectoring for "fan out" and altitude change are some of the techniques which will increase the present capacity. In the multi-airport terminal areas, where the aircraft densities are greater, and climbing and descending are standard maneuvers, the System will utilize non-conflicting slant airways, if feasible, which will feed "path stretching" areas before final approach. These techniques will provide a high-capacity feeding system for the runways. Helicopter airways will generally exist only at low, non-conflicting altitudes. Long-range flights will use high altitude, flexible airways, based upon a fixed grid structure.

### *Successful Evolution in Ground and Air Necessary*

The airways system then would consist of fixed airways in dense enroute areas; non-conflicting entries and exits for multi-airport terminal areas; helicopter airways; flexible long-distance airways; using the concept of fixed, reserved airspace blocks, wherever possible, and paths for military air operations such as interceptor aircraft to climb and descend through traffic, and for efficient climbing profiles for strategic missions.

(*Continued on page 128*)

# BLACK BOXES
# and NAVY BLUE AIRPLANES

**By RAdm. James S. Russell, USN**
CHIEF, BUREAU OF AERONAUTICS

RECENTLY, A MEMBER OF THE Joint Chiefs of Staff stated that one of the few subjects which brought forth a divergence of opinion in that group was the future and the uncertainty of having the right answer.

Perhaps nobody can be completely authoritative about the future of aircraft electronics either, except to recognize its spiraling complexity and its snow-balling importance to all air weapon systems.

A good way to get a "reading" on future expectations for the electronics industry is a glance at the past. There have been rapid and exciting developments since 1945. The electronics equipment in a Navy World War II fighter was elementary and naive when compared with the electronic capabilities of today's aircraft. In the coin of the airplane designer, pounds avoirdupois, the World War II fighter carried about 220 pounds of electronic gear. Today's Navy fighter packs at least five times that by weight, and much more than a five-fold increase in diversity and versatility of performance.

Yet even with these unmistakable indicators of good progress in the airborne electronics art, we must assess the 1957 state of black box affairs as being on the threshold of greater things rather than as having already accomplished them.

We must also recognize the fact that military aircraft electronics requirements for the next ten years will place even greater pressures upon the industry than were experienced during the past ten. There are several specific reasons for this, from a Naval aviation viewpoint and as we are concerned with them in the Bureau of Aeronautics.

Naval air tactics seemed pretty well advanced and near perfection at the end of World War II after carrier aviation had been flame hardened in battle. Self satisfaction, though, was not long for the Naval airman. The post-war emergence of nuclear weapons, guided missiles, high performance aircraft, and high performance submarines, soon made sweeping changes in tactics and strategic concepts.

The tactical use of nuclear weapons literally broke the old concepts for naval task forces, and gave rise to new ship dispersal patterns—patterns which at once must provide security from nuclear bombardment

(*Continued on page 72*)

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## The Author

Commissioned Ensign at the U.S. Naval Academy in 1926, Rear Adm. Russell attained his present rank in 1953. He received numerous citations for his outstanding service in World War II, and he has been Chief of the Bureau of Aeronautics, Navy Dept., since 1955.

USS BOSTON (CAG-1) launching Terrier Missile.

Chief Aviation Electronics Technician T. R. McConnell, USN, tests radio equipment and establishes communication with remote commands in order to flash alert to carriers, bases and fighter airplanes over a wide area. Defensive measures are geared to swing into action within seconds from alert. Here he is using high frequency voice channel to communicate with Navy Early Warning Squadron One Headquarters, but he can switch to code transmission and reception as necessary.

## SPERRY ANNOUNCES

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C G Holschuh

**SAMUEL AGABIAN** has been appointed Manager of the Air Armament Division. Formerly works manager, Mr. Agabian is an Annapolis graduate and former Marine Corps officer. His work at Sperry has included responsibility for computing gunsights, bombsights, antiaircraft devices, radar and infrared developments.

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Aircraft fire control radars
Airborne inertial systems

**MYRON D. LOCKWOOD**, manager of the Surface Armament Division, was formerly a systems engineering director. A World War II Lt. Col. of Artillery, and military-technical advisor at M.I.T., Mr. Lockwood has been associated with Sperry projects in underwater torpedo fire controls, guidance computers for missiles, antiaircraft control systems and inertial navigation equipment.

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Computers
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and yet allow effective use of the ships as a force or fleet. Guided missiles have introduced new armaments for both air and surface elements. High performance aircraft with operational speeds above the sonic, and with great striking capabilities have given the total seapower potential of this country a new lease on life. Last, but not at all least, the high performance submarine is keeping the anti-submarine-warfare people awake nights trying to figure out a way to beat the unholy combination of nuclear propelled subs and guided missiles.

### *Superior Naval Operations Through Electronics*

These are just a few of the salient post war developments and what they mean to the Navy. If there is one single element that is both common and vital to all of these brilliant technological advances, it is electronics equipment and the electronics application to each. Ultimately, the "new Navy" may well come to be described as the "electronic Navy."

Since the Bureau of Aeronautics is responsible for providing the Fleet with the materials of Naval aviation, we run the gamut from research to procurement via development and pilot production. Consequently, we are in vantage point to see the full chain of events. We can observe, at first hand, the evolution of the modularization idea from its inception to production installation.

From such a vantage point is noted the fine progress made to date in the field of aircraft electronics. Some of the advances most meaningful to Naval air operations are: the development of inertial navigation systems which help solve over-water navigation problems; the appearance of automatic control systems which began as fire control systems and which with the new airborne digital computer will open the way to complete centralized control; improved communications systems which have increased the number of available channels as well as having added sensitivity and stability; and the development of the tactical navigation system known as TACAN.

### *Over The Horizon*

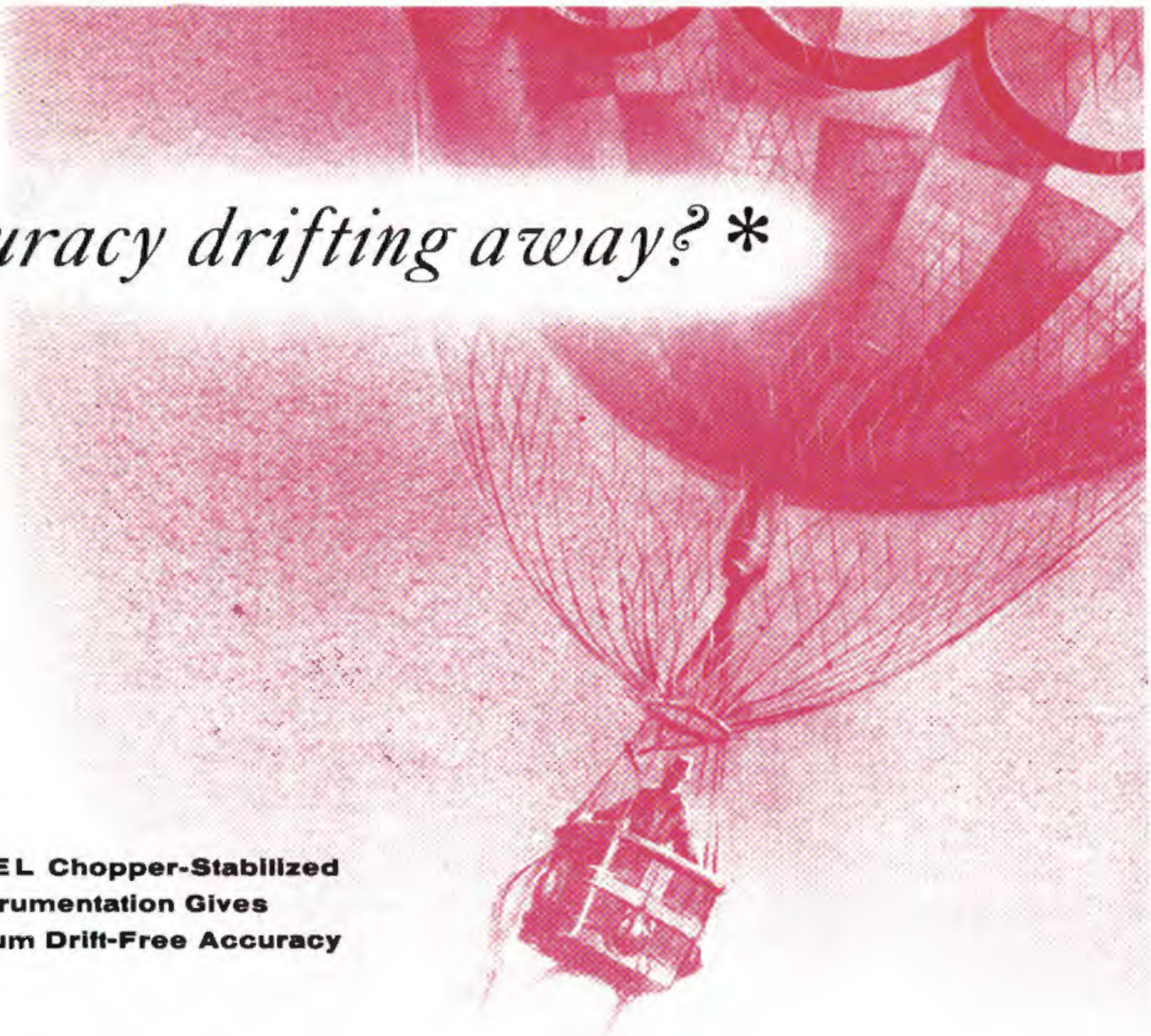
In the guided missile field, many kinds of guidance systems are now evident, active, passive, and semi-active, where a few short years ago the whole idea of the practicability of the guided missile was undetermined.

These improvements are instruments which have been produced and are in operational use. Today, they are in the airplanes and the guided missiles flown by the Fleet and this is important to the country and to the Fleet.

Also of importance to the country and to the Fleet are the things yet to be done—"the gear yet to be got." Again, it is in terms of hard-headed practicability, or what is useable and what will work, that we set our sights on Fleet needs.

In the area of manned aircraft, an urgent need is the means to facilitate and simplify the act of flying, per se. The complexity of today's high performance jet airplanes is such that

*(Continued on page 74)*



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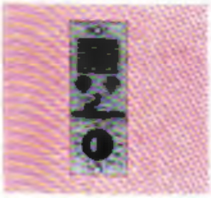

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**Panoramic Sonic Analyzer, Model LP-1a** for waveform analysis, 40 cps—20 kc log scan or 200, 1000 and 5000 cps lin scan segments centered anywhere between 0 to 20 kc; features direct reading, 60 db dynamic range, linear and log amplitude scales.

LP-1a

**Panoramic Ultrasonic Analyzer, Model SB-7aZ** for waveform analysis, 1 kc—300 kc, features continuously variable linear scanning widths and resolution, linear and log amplitude scales, exceptional sensitivity.

SB7aZ

**Panoramic Panalyzors and Panadaptors** for RF, VHF, and UHF spectrum analysis feature continuously variable sweepwidths, resolution and scan rates; long or short persistence displays, linear or log amplitude scales, and are unique in that they offer the advantages of wide scan display yet permit examination of closely adjacent signals. Special features, sweepwidth, scan rate and resolution vary with the model and type selected. 5 models in 21 different types fulfill almost every need from low-cost general purpose instruments to those for highly special applications.

SB-8b

**Panoramic Spectrum Analyzer, Model SPA-1** for microwave spectrum analysis, 50 mc—4000 mc, features two tuning heads (RF-2 from 50 mc to 250 mc; RF-3 from 220 mc to 4000 mc in five ranges), with a single tuning control dial having an accuracy of ±1%, continuously variable resolution, sweep rate and differential markers, —100 dbm sensitivities.

SPA-1

**Panoramic Sweep Generators, Models G-2 and G-3** convert the LP-1a and SB-7aZ, respectively, into single line response curve tracers, discriminate against noise and hum, show response to fundamental frequency only and assure accurate frequency response measurement.

G-2

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pilots must be quasi-engineers to get the most out of the airplane or to operate it properly. Some sort of electronic instrument display, together with more automatic flight control and navigation elements, may be the trend and the answer here. It is a big problem and it is a serious one

### *Two Important Fields*

In the guided missile area, two fields appear to be of prime importance. One is the vital need for breakthroughs in the art of electronic countermeasures; the other is the urgent requirement for detection and "anti" gear to cope with the ballistic missile from a defensive attitude.

Another specialization of great concern within defense electronics is improved equipment to locate and destroy hostile submarines. It is mandatory that we achieve a "transparency of the sea" if we are to hold our own defensively against teams of nuclear propelled submarines, the true submersibles.

In all the black box areas we need greater ranges, greater flexibility and interchangeability, higher reliability, more standardization, shorter lead times from inception to production, more fully automatic systems, and some effective brakes on the rising costs.

### *Confidence In Communications*

Indeed this is quite a package to ask of a young industry which has been so busy just growing up that it has multiplied its dollar size by a factor of ten over the past decade.

But the cooperative forces at work within the industry and the military establishment so well exemplified by the AFCEA will certainly insure the printed circuitry for getting the job done. In connection with this sort of teamwork, the theme of the 1957 AFCEA Convention, "Marconi to Mars," is noted with more than a passing interest. The feeling prevails that industry will always supply the "Marconis," and the Armed Forces will always define the "Mars."

It is this sort of working relationship that breathes into the Navy airman a confidence that his men will never report the failure of a mission due to the lack of proper black boxes. It is this sort of working understanding that allows Naval aviation to position its needs in the proper industrial channels with a minimum of static and with a clear reception.

• • • — • —

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# Telemetering . . .
# THE INTELLIGENCE LINK

By Martin V. Kiebert, Jr.

**Director of Electronic Development**
**MIAMI SHIPBUILDING CORPORATION**

WHEN CONSIDERING THIS ARTICLE ON "LONG RANGE Telemetry and Remote Control Systems," I was reminded of the subject matter contained in a paper I presented before a joint meeting of the Royal Aeronautical Society and the Institute of Aeronautical Sciences held in London in 1947. At that time the comment was made that the pilot, as we then knew him, was becoming obsolete. As a pilot talking to pilots, you will appreciate the raised eyebrows and red faces that greeted this statement. I pointed out that this obsolescence was coming about due to the larger control forces required in higher speed aircraft; the higher aerodynamic performance of the newer and higher speed aircraft which could not be manually controlled adequately as a result of the limiting, relatively slow perception and response of man; and due to the many, inter-related power plant and fuel management requirements which virtually required a relatively complex computer in order to solve these problems satisfactorily. Accordingly, and as predicted, the role of the pilot who was originally a navigator, a power source, the automatic pilot, and a power plant engineer, has already changed significantly with the advent of the DC–8 and 707. In the case of rocket powered aircraft, the change is even more drastic, and as such the pilot has become obsolete and will likely be only an executive in general charge of the flight.

### *Air Traffic Control Problem*

Telemetering techniques can provide and will be required to provide answers for the two most significant aspects of extra-atmosphere flight. These are:

A) What is the environment that space vehicles (and subsequently their occupants) will be required to survive and surmount?

B) What are the surface conditions and environment of the celestial body on which it is proposed to make a landing?

Some of the answers to the first question are now being obtained; many others will be learned as the International Geophysical Year (IGY) progresses, satellites are established, and environmental data is transmitted back to earth via the proposed telemetering links.

With answers to the first question and evolution of equipment and techniques which will permit survival of the spacecraft and crew, the next phase of controlled space travel must deal with the Space Traffic Control Problem. Telemetering and Remote Control techniques appear to be the keystone of this aspect of space flight—even as they may ultimately provide the most tenable and best solution to our present Air Traffic Control Problem.

### *Phases of Flight Path*

It is pointed out that there now appear to be three phases of the trajectory or flight path of a space craft. These are:

1. *Take-off* from the earth's surface which will probably refer to the earth's gravitational field and true north.
2. *The cruise portion* of the trajectory which will probably depend upon celestial navigation either by optical or radar means, with some small potentiality of receiving some guidance from the earth.
3. *The Landing Problems* of a Space Craft on a Celestial Surface. This imposes severe difficulties due to the fact that ground based facilities may not be available, initially or normally, and magnetic references will be of no significance while gravity considerations on another celestial body will probably be entirely different and will pose new stabilization problems. Telemetry will serve as an extremely important element in the landing of space craft on previously unexplored celestial bodies. It is visualized that suitable shock-protected landing drops of telemetering equipment could and should be made prior to actual landing of a space craft on an unexplored celestial area. Such equipment might include sensory instruments which could indicate the nature and density of the atmosphere: the gravity, magnetic orientation, the nature of the chemical content of the atmosphere, and the general superficial environmental conditions which will

be significant in the ultimate landing of extra-atmosphere space equipment and the power required for such descent.

4. *The return trajectory* will again have the take-off problem (from a celestial body); the return cruise problem will not be unlike that of the original cruise phase of the flight path, and the landing problem will again necessitate re-orientation of the space craft coordinates to the earth's coordinates. Instead of the pilot requesting his "altimeter setting," he will now request the information required to reset his gyro references to a particular point (coordinates) at a particular time.

Associated with the foregoing trajectory problems is the unique need for a precision, on-board time standard required for the solution of navigation problems. This will probably be a frequency standard based on nuclear resonance phenomena. I do not, however, care to go into the relativistic problems and philosophies that give rise to some intriguing ideas.

### *Fuel and Power Requirements*

The fuel and power requirements for space craft will necessitate accurate trajectory control. It is possible that telemetering and remote control techniques may help to minimize this problem. It is possible that nuclear fuels for take-off and landing may provide a material improvement over current payload to fuel ratios which are now formidably "stacked" against space travel. Once out of the earth's gravitational field, however, the use of photon emission, perhaps the use of electromagnetic fields and/or the gravitational fields of other celestial bodies, may help to speed the traveler on his way. The present state of the art, wherein twenty to forty tons of missile and fuel are required to place a twenty pound orbital vehicle in its flight path, is indicative of the technological breakthroughs which will be required not only to send manned craft "out of this world," but also to provide for deceleration to the surface of another body, subsequent take-off, re-entry and landing on the surface of the earth at a designated location—even if the time is unspecified.

### *Power Supply Problem*

The power supply problem for instrumentation and control, aside from propulsion problems, also requires careful consideration. The IGY studies and a current missile program have, however, indicated tenable feasibility of several approaches.

The relatively long time requirements for power must be considered carefully for space craft applications. In general, there are four types of power sources which may be used for various in-flight functions. All of these must have long life, the promise of simplicity, and minimization of the fuel problem. These particular power supply sources may be listed as follows: (1) Strontium 90 or Cobalt 60, in high impedance, low energy applications, (2) Direct sun conversion, for medium power and requirements, (3) Peltier effect, for medium power levels and, (4) Miniature reactors for high power levels.

The system components used in telemetry and remote control systems in space craft also necessitate special consideration.

Antenna designs may be derived from current jet and rocket aerodynamic and aeroballistic configurations. Semi-conductors with their low power requirements and high efficiency will probably be used for the majority of the voltage or power amplification requirements. Printed circuits will probably be essential. There is some question as to whether or not magnetic amplifiers will find much application; however, their lack of sensitivity to nominal levels of nuclear radiation and the use of lower density ferramics indicate some potential in the electronic system components. There will be problems of cosmic rays and nuclear energy shielding which, however, will not be too difficult to evaluate after the IGY findings are available and additional studies have been made.

### *Telemetering Functions*

Manned space craft will probably employ telemetering and remote control functions (as aided by both carried and ground based computer facilities) for the following functions:

(1) Telemetry can be used to fix a landing position provided previous facilities have been so established.

(2) Ground based radar and computers will be available for landing on the earth; however, the lack of these facilities on the celestial bodies now make it appear essential that the space craft must carry its own radar and high frequency response computer system.

(3) Telemetering may be required on the earth as an advisory means as to when and where landings may be made, and re-orientation of inertial references to the earth's coordinates.

(4) The role of telemetering in the landing of extra-atmosphere space craft on celestial bodies.
It appears that telemetry will serve as an extremely important element in the landing of space craft on previously unexplored celestial bodies as previously indicated. Knowledge of both the physical and chemical environment on a proposed celestial body will be essential for survival of both the craft and the crew.

The present re-entry problems necessary to afford the required deceleration appear to be formidable. Orbital trajectories have been considered, as having "bouncing" re-entry techniques. Neither of these appear to be very promising due to the time problems and the thermal shock problems.

It appears to be likely that retro-rocket techniques may be required which will be more readily capable of reducing the re-entry to approximately Mach 2, (twice the speed of sound) or lower. Use of this latter technique, however, necessitates expenditures of large amounts of kinetic energy, which with present chemical fuels, appears to be prohibitive. The use of nuclear fuels seems to provide a more tenable solution to this problem.

Considered review of the foregoing indicates that while evolutionary concepts are required, there is basically little that is revolutionary in the field of space navigation that will be required to permit practicable space navigation and travel.

* * *

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# THE SERVICES OF AERONAUTICAL RADIO INC.

by
John S. Anderson
**PRESIDENT
AERONAUTICAL RADIO, INC.**

IT WOULD HARDLY BE RIGHT TO say that Aeronautical Radio, Inc., long known as "ARINC", defies description, but it is in some respects unlike any other company. Fundamentally, it is a communications company specializing in air-ground-air aeronautical mobile service and point-to-point aeronautical fixed service. It serves its member companies also as a technical meeting center at which service requirements, equipment characteristics, and plans and programs generally are thrashed out. Also, it engages in research in a field that, like the weather, has heretofore been the subject of more conversation than action: reliability of electronic tubes, equipments, and systems.

The airline companies are the principal owners of ARINC, as well as the principal users. It follows, therefore, that there is no profit motive, no sales department, no advertising. Nevertheless, it is organized as a normal corporation—vintage 1929—under the laws of Delaware. The air carriers and other stockholders total some sixty in all. But ARINC services are not confined to its stockholders alone, its service roster numbers several hundreds and includes the CAA, the military, and many foreign flag interests.

### *A Kaleidoscopic Blanket of Radio Coverage*

The task assigned to the largest branch of ARINC is the administration, control and operation of the air-ground-air and point-to-point ground radio stations. These stations, which through the years the Federal Communications Commission has licensed ARINC to operate, may be considered in two general groups: (1) the lease-contract stations that are airline-owned, airline-staffed and are fitted to the needs of a single airline; and (2) the ARINC-owned, ARINC-staffed facilities that are patterned to meet broader requirements. Facilities leased from outside concerns may of course be found in either group. To portray the total domestic service furnished by all of these non-governmental ARINC stations would be simply to show the breadth and width of the United States densely populated with radio facilities producing a kaleidoscopic blanket of radio coverage. On the accompanying map, however, are outlined the services of ARINC's station operations—those that are patterned to the broader requirements and staffed by ARINC. The domestic air-ground-air communication service is predominantly on the very high frequencies (VHF) but high frequency (HF) services are an essential adjunct, and the overseas air-ground services each require one or more families of a selected series of high frequencies for each route area. Since this HF coverage cannot be well shown on the map, the services of each station are simply tabulated.

### *High Frequency Services*

The high frequency services are normally furnished through ground-to-air AM transmitters of 3-5 kilowatts power, and air-to-ground single-channel crystal-controlled receivers. Antenna design, governed by service requirements, includes the more elaborate directional arrays and spaced diversity, as well as just ordinarily good non-directional radiators. In the overseas point-to-point services, plant facilities follow the same general pattern. And in all of the plant engineering, exceptional attention is given to high speed, flexible, conven-

(*Continued on page 81*)

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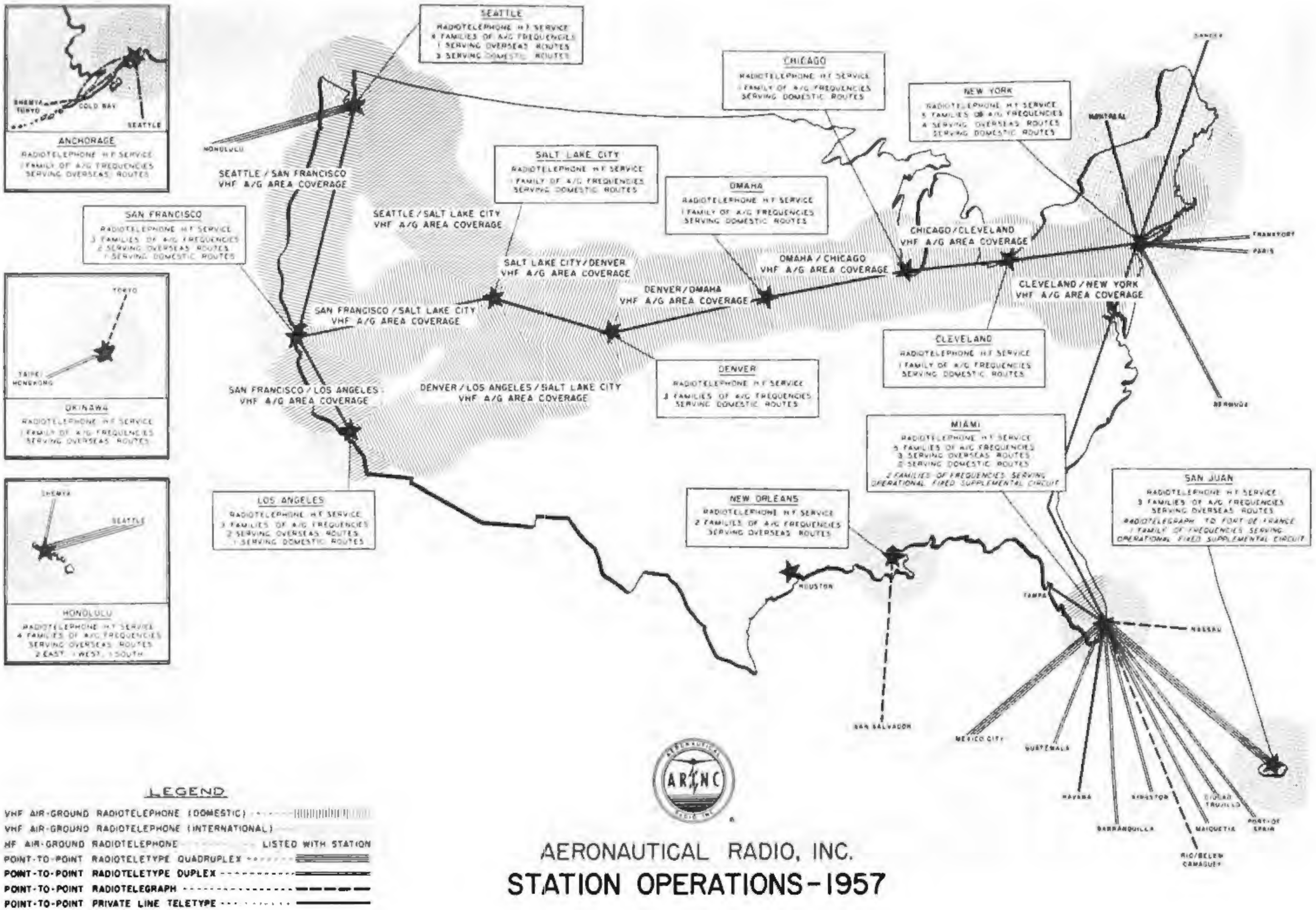
**The Author**

J. S. Anderson, President of Aeronautical Radio, Inc., since 1951, has been active in aeronautical communications for nearly 30 years, particularly in international communications. In World War II, he was promoted to Colonel and commanded the 6th AACS Wing.



AERONAUTICAL RADIO, INC.
STATION OPERATIONS - 1957

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ient control facilities which, through cable or special microwave equipment, connect the operating location and the remote transmitter and receiver sites. Significantly, the remote facilities are unlike those of many communication companies in that they are unattended, the installations having been engineered for automatic operation.

### *High-Gain Antennas Employed*

The line-of-sight, 127-132 megacycle, VHF-AM air-ground-air services employ high-gain antennas as required, but for more extended area-coverage, various combinations of favorably sited satellite stations (e.g., Mt. Washington, N. H.) and network area services are used, as shown on the map. In these networks the two or three operating locations receive simultaneously from several remotely located VHF facilities, and transmissions from each of those control points are made through the simultaneously operated remote transmitters, all on the same VHF channel. The remote facilities are of course closely spaced for solid coverage to low-altitude aircraft. Then, to avoid audible heterodynes at high altitude, transmitter frequencies are accurately displaced one from another beyond the audible range but within the band width of the standard aircraft receiver. Also, to provide good phase relationship, the voice circuits to the several transmitters are accurately synchronized.

### *The Important Triumvirate*

The millions upon millions of air-ground-air transmissions to and from ARINC stations provide data that is essential to each member of the important triumvirate—the captain of the aircraft, the aircraft operating company, and the government air traffic controller. To accommodate the ever-increasing flow of communication, this non-government ARINC communication system is undergoing constant improvement. Additionally, government facilities through which the traffic controller can be in direct communication with aircraft are being substantially extended from the heretofore local service areas. Also, selective calling devices along with automatic, visual, and record communication techniques coming into the systems can, in the years ahead, reasonably be expected to supplant much of the

(*Continued on page* 82)

voice communications of today.

The oldest function of ARINC—"oldest" in the sense that the function existed even before the company was chartered in 1929—is to serve as a technical meeting center. In recent years, the demands for coordination of complex systems and standards necessary to national and international aircraft operations, have brought into being a branch of ARINC which specializes in conducting the necessary committee and conference activities. It is this branch which provides the secretariat and general housekeeping services for the Airlines Communications Administrative Council, the Frequency Committee of that Council, and other special committees through which industry coordination is accomplished on a wide variety of communications requirements, plans, and programs. Here also, industry opinion is formulated for presentation to the Government Industry Radio Technical Commission for Aeronautics (RTCA), to Government committees, and to international conferences, as appropriate, such as the International Civil Aviation Organization (ICAO) and the International Telecommunications Union (ITU).

While these few paragraphs make no pretense of covering the subject of airborne electronics, the task of the Airlines Electronic Engineering Committee (AEEC) deserves more than a mention. The development of successful systems and sound standards, whether in RTCA, ICAO or elsewhere, depends greatly upon technical guidance, such as is offered through the work of this Committee. Also, in order that manufacturers might best meet common requirements, technical guidance is offered through conferences and the issuance of AEEC equipment "Performance Characteristics." Airline investment in airborne communication and navigation equipment serves as an interesting measure of the increasing magnitude and complexity of this equipment—about $10,000 in a 1946 aircraft as compared with $150,000 in each of the 1958-1959 models.

### *Related Organizations*

Throughout all these activities a day-to-day working relationship is maintained with a host of other organizations having related interests; from the closely linked Air Transport Association to those in distantly related fields, and even foreign countries. For, to keep abreast of the state of the art, to integrate the best engineering knowledge and skill for the purpose of meeting the burgeoning requirements, to find acceptance of one good solution in preference to another good solution, all requires coordinative activity of ever-increasing complexity.

### *Reliability Research*

Of the three functional branches of ARINC, the youngest is reliability research. Closer examination will disclose, however, that the search for a definition, a means of measuring, and a program for improvement of this evasive thing called "reliability," commenced as an airline "reliable tube program" some ten years ago. It was seen that so long as development was geared primarily to the home radio market, there was little incentive to give much attention to reliability (accurately predicted life, not just extended life). In consequence, a program was conceived that, on a continuing basis, would give the needed attention to greater reliability in tube types most useful in complex electronic equipment upon which the operation of multi-million dollar aircraft is so dependent. Initially, there were but two manufacturers sufficiently interested to establish production processes necessary to this program and its relatively small market. Fortunately, they were both highly respected and capable of contributing greatly to such an undertaking. The years have added substantial sophistication to the original concept, but it remains fundamentally and simply the application of technically sound field surveillance and analysis, designed to feed back to the manufacturer data that will enable him to introduce the "fix" required to overcome failure patterns as they are disclosed by the field observations. It is obviously a methodical program wherein spectacular advance verges on the impossible. But ten years have seen more than just steady progress. Under military sponsorship, initiated in 1951, the program has been greatly expanded and accelerated beyond all early expectations. Research into the much broader subject, or science, of reliability is now applied to complete electronic systems, and is prospectively applicable to other fields.

Throughout all activities of ARINC, there is the constant and common challenge that tomorrow's requirements will exceed the plans and advances of today.

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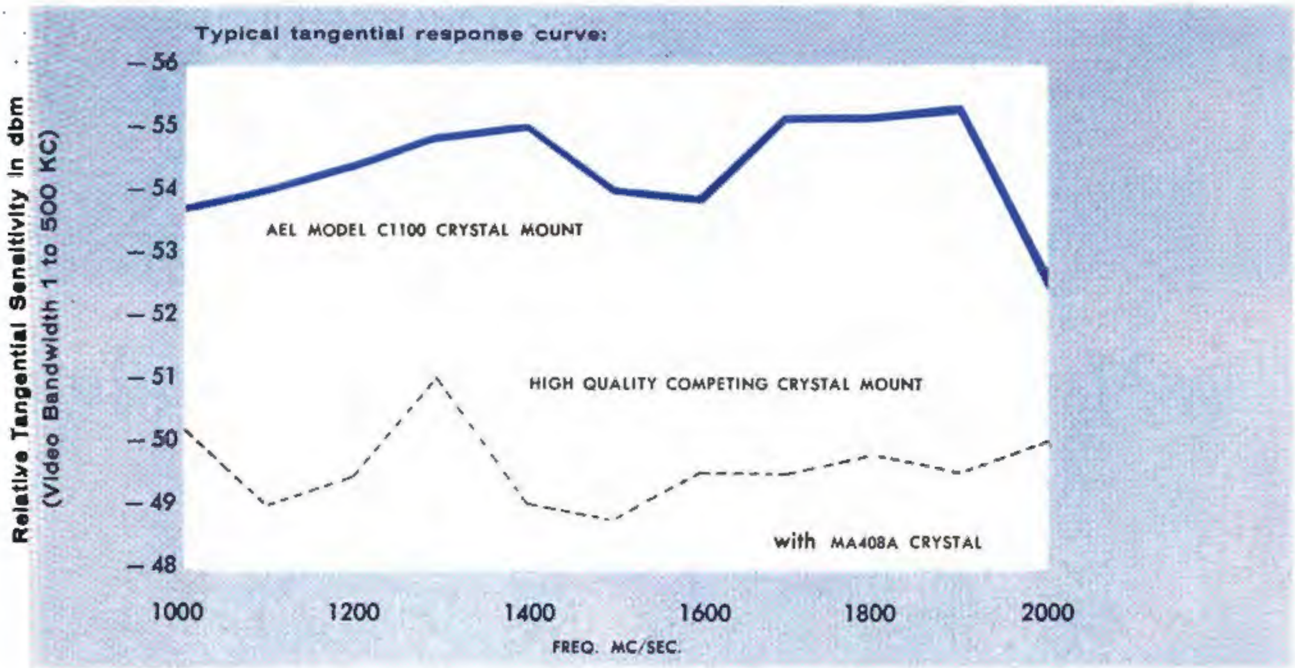
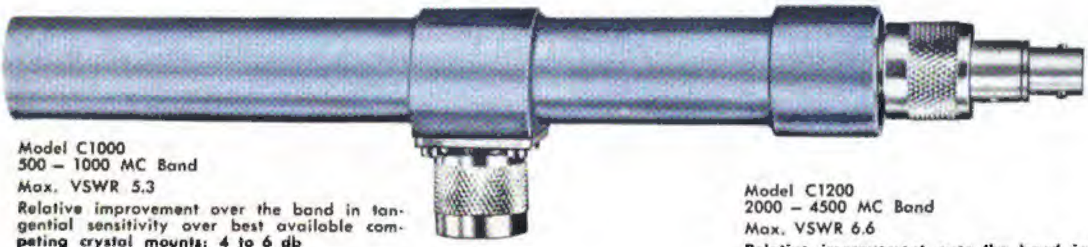


**NOTE:**

**Tangential sensitivity is defined as the power level of the incoming signal at which signal plus noise equals twice noise. "TS" is read when the bottom of the noise inside the pulse is tangential to the top of the noise outside the pulse. It is measured in − n dbm, where "n" is the power level of the signal in db below one milliwatt.**



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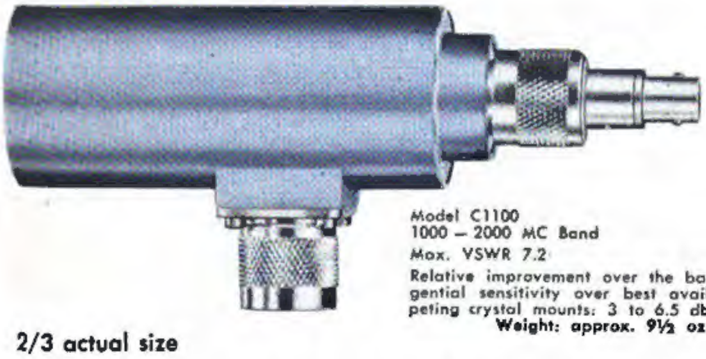

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Reliable operational range of the Marine Corps' new "team pack" radio communications equipment has increased from a former range of two to twenty miles to twenty to fifty miles, to support the new concept.

# New Marine Concept is an Invitation to Industry

by Maj. Gen. E. W. Snedeker, USMC
ASSISTANT CHIEF OF STAFF, G-3
HEADQUARTERS, U. S. MARINE CORPS

AMPHIBIOUS OPERATIONS OF THE future, dictated by the needs of the Atomic Age, place more difficult requirements on radio communications and electronics than have any previous types of warfare. Large-scale military operations of the type conducted in the Pacific Ocean area and at Normandy in World War II are a form of warfare that belongs to the past.

The Atomic Age has dictated the need for re-evaluation of many types and phases of warfare to insure dispersion, flexibility, mobility and self-sustenance of combat units. Consequently, new goals under study since World War II have resulted in the formulation of a Navy-Marine Corps concept for future amphibious operations adaptable to all types of wars, including those which do, or do not, use nuclear weapons.

**The Author**

Maj. Gen. E. W. Snedeker is a veteran of the Nicaraguan and Haitian campaigns, World War II combat and the Korean engagement.

The concept is *offensive*. It is designed to carry the war to the enemy homeland, *exploit* our own atomic or conventional weapons in offensive action, *exploit* the speed of the new Navy, *exploit* the teamwork of the Marine air-ground landing force, and *exploit* the helicopter in attaining a new tactical mobility by eliminating direct assault on enemy-defended beaches.

### *Major Role of Communications*

For the Marines, the basic structural essentials are speed, mobility and flexibility. Helicopters are being used in increasing numbers to speed the initial assault, provide tactical mobility for the initial assault and provide tactical mobility for the troops. The helicopter permits the launching of an initial assault while ships are still well out at sea; it enables the Marines to project naval power deeply ashore, and permits the Marines to concentrate and disperse rapidly, once ashore. The helicopter's speed and mobility facilitate the rapid concentration of Marines necessary to knock out enemy beach defenses and other strong points.

Basic needs for implementing this concept are for new equipment, new tactics, new techniques, and improved forms of signal communications. One of the major problems is to keep pace with the rapid developments of new weapons, equipment and electronics, and of adapting those developments which increase Marine fighting power without reducing mobility and flexibility.

While dispersed, Marine formations must be controlled, and their movements and actions fully coordinated and perfectly timed. Concentration must be fast and flexible, responsive to battlefield intelligence and, again, fully coordinated. Communications developments must keep pace with battle developments.

### *Increased Distance Poses Problems*

In the past, primary dependence for control was necessarily placed upon radio during ship-to-shore movement. Once troops were established ashore, radio became a secondary or standby means, and the primary means of communicating changed to wire circuits. This will not apply in future amphibious operation. Instead, radio and radio relay will continue to be the primary means of communications throughout the entire operation, because of the

The modern helicopter permits the launching of an initial Marine assault while ships are still well out at sea.

The new Marine Corps concept relegates "wire" to limited use within tactical localities and in rear areas. "Wire" will not be the Marines' primary means of communications in the future.

To support the new concept, "man-pack" radio equipment must be available which operates reliably over ranges of from ten to twenty miles. The old range requirement was five to ten miles.

need for dispersion and increased mobility. "Wire" will probably be possible only within tactical localities and in rear areas.

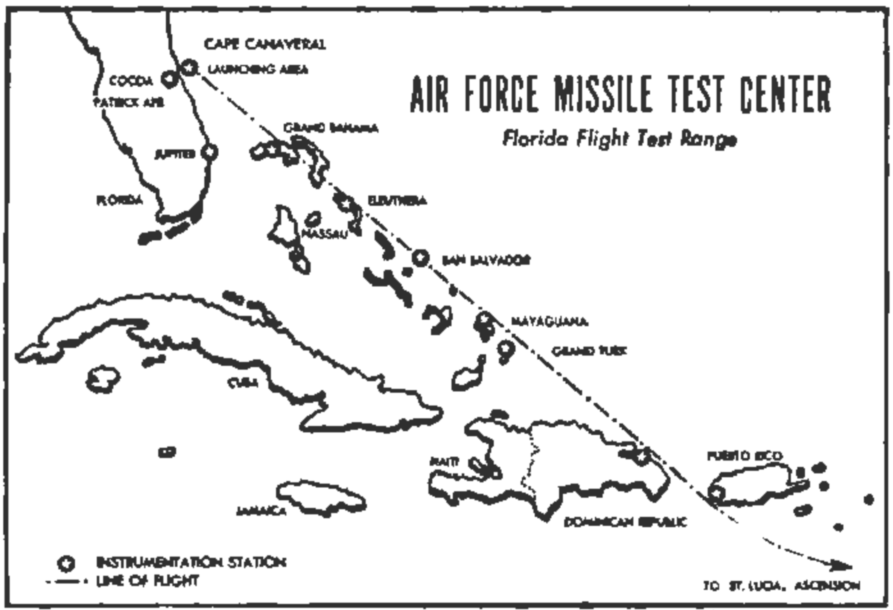
This increasing reliance upon radio is further aggravated by the new, increased distances between operating units. In the past, the Marine Corps concentrated upon lightweight, waterproof equipment with operating ranges of five to ten miles for "man-pack" radio equipment, and ten to twenty miles for "team-pack" equipment. To support the new concept, radio equipment must be available which will operate reliably over ranges of ten to twenty miles for "man-pack" equipment and twenty to fifty miles or more for "team-pack" equipment. Weight and waterproof requirements remain about the same.

This primary reliance on radio poses many urgent and demanding problems.

### *First Steps Toward Solution*

The first problem is overcrowding of the frequency spectrum. Currently, only a small portion of the frequency spectrum is usable for reliable communications. The Marine Corps has taken a step to move out of this overly-used portion of the spectrum from 2 to 100 megacycles, by sponsoring the development of radio relay equipment in the 5000-megacycle range. In addition, the use of single sideband techniques is being vigorously pursued. The plan is to use single sideband equipment instead of present amplitude modulated radio sets, and to determine the adequacy, acceptability and suitability of this technique over conventional or other known radio transmission techniques to meet the requirements of tactical communication and control.

Secondly, there is the problem of countermeasures. Any electronic device is subject to a counter-measure action and in this lies one of the great dangers in having primary re-



liance upon radio communication. Much more investigation and development are required in this field.

Equipment maintenance is a third problem. Maintaining complicated electronic equipment in reliable operating condition will be one of the prime problems in providing successful communication support for future Marine amphibious operations. Part of the problem may be solved, of course, by making the equipment as reliable, and as simple to operate, and as easy to repair, as possible.

### *Challenging Requirements*

Finally, range requirements must be considered. There are two means of increasing the range of radio equipment: one, by increasing the power output of the equipment, and, two, by increasing the effectiveness of antenna radiation. The same unsatisfactory antenna systems used in World War II are still being used today. Portable power supplies have not progressed much further than the antenna systems. Increased emphasis is being placed on these two important means of attaining increased range in portable equipment. Unfortunately, the problem of increased range, azimuth coverage and accuracy is compounded by helicopter lift limitations which restrict weight and size of equipment.

### *Invitation to Industry*

While helicopter assault forces will land whenever possible in unfortified areas not immediately defended by the enemy, enemy reaction can be expected to be rapid and violent. Assault forces must be prepared to counter enemy attacks from any direction; they must be equipped to obtain and control rapid and effective air, military, naval gunfire, guided missile and special weapons support anywhere around a 360-degree frontline perimeter. Requirements for electronic surveillance, recognition, and identification, both ground and air, become increasingly difficult.

However, the old, standard requirements for reliability, simplicity and ruggedness, coupled with small size and low weight, still remain.

The challenge of meeting the rigid requirements of new equipment for implementation with techniques proposed in the new concept, lies fundamentally with the Nation's electronics industry!

# Telephone Communications . . . *in Hawaii*

By J. Ballard Atherton

**President**

**Hawaiian Telephone Co.**

IN THE YEAR 1878, AN enterprising storekeeper on the island of Maui first introduced the telephone to the Hawaiian Islands. His purpose was to provide fast communication between his home and his store—a matter of a few hundred yards.

Four years later a group of Honolulu businessmen founded our company which was chartered by the Kingdom of Hawaii under the name of Mutual Telephone Company on August 1, 1883. The company existed under this name until January 29, 1954. On that day—with a view to better identifying the company with the islands it serves—the name was changed to Hawaiian Telephone Company. In the remainder of this article the Company is referred to as Hawaiian.

By 1894, Hawaiian had acquired control of a competing Honolulu company and was furnishing telephone service to the entire island of Oahu (on which Honolulu is located).

Around the turn of the century other independent telephone companies were organized on the islands of Hawaii, Kauai and Maui. Recognizing the advisability of having all telephone communications in the Territory operated by one company, Hawaiian in 1912 began a program of acquiring these other companies. By 1929, they had all been purchased and had become part of the Hawaiian Telephone System. In 1931 Hawaiian established a telephone system on the island of Molokai and in 1946, built a system on Lanai, the last of the major islands.

Throughout its 73 year history, Hawaiian has been a leader in the telephone industry. In 1910, the installation of an automatic Strowger system in Honolulu made that city one of the first major cities in the world to have dial service. In subsequent years, dial conversions were made throughout the islands until today the Company is 99.8% dial operated with only about 320 magneto telephones remaining in service. They will be converted to dial service in 1957.

### *Expanding Circuits*

Until 1931 communications between the islands was provided over a radiotelegraph system which was one of the earliest regular commercial overwater radiotelegraph systems in the world. In that year, as a direct result of pioneering work done by Hawaiian's engineers and technicians, an inter-island radiotelephone system was installed consisting of single circuits from Oahu to each of the islands of Hawaii, Maui and Kauai. The equipment, which was specially built for the system, operated in the 30-40 megacycle band and was the first of its kind in the world to operate commercially over water at these high frequencies. In the same year, Hawaii was connected to the mainland United States via a single radiotelephone circuit between Honolulu and San Francisco, California.

### *Changes and Improvements*

Many changes and improvements have occurred since that day, 79 years ago, when the first two telephones were brought to the island of Maui. Today the Company operates over 154,000 telephones on the six principal islands of Hawaii, Maui, Oahu, Kauai, Lanai and Molokai and these islands are inter-connected by an extensive network of radiotelephone and radioteletype circuits. A few years ago this network was completely renovated with the installation of modern equipment operating in the 76-110 megacycle band which, after extensive tests, the Company had proven to be most satisfactory for overwater radio transmission for the distances involved. Circuits from Honolulu to the mainland now number 14 and they handle an average of approximately 550 completed calls per day.

Of the Company's 154,000 telephones, approximately 125,000 are located on the island of Oahu. Of these, 103,000 serve Honolulu, a city of 275,000 people, where the principal offices of the Company are lo-

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J. B. Atherton, President of the Hawaiian Telephone Co. since 1950 and a member of AFCEA, has been active in Hawaiian communications since 1935. He is Director of many Hawaiian firms, including Welding & Industrial Products, Ltd. and The Hawaiian Electric Co., Ltd.

cated. It is also the main seaport and the center for all business and tourist activities in the territory. The five outer islands, where many of the large sugar and pineapple plantations are located, are strictly rural in nature, and thus do not have the high telephone development found on Oahu.

### *Serving the Military*

In addition to the telephones served by Hawaiian, there are approximately 18,000 telephones located on military installations. These are confined almost entirely to the island of Oahu which is the Headquarters of the Armed Forces in the Pacific. They include Pearl Harbor, headquarters of the Commander-in-Chief, Pacific, and his joint command; Fort Shafter, headquarters of the U. S. Army Pacific and the Hawaiian Defense Command; Hickam Air Force Base, headquarters for all Pacific and Far East Air Force operations and a transport wing of Military Transport Service's Pacific Division; Fort Ruger, headquarters for the Hawaii National Guard; Schofield Barracks; Fort Armstrong; Barber's Point Naval Air Station and Kaneohe Marine Corps Air Station. All of these installations are served by government owned and operated dial offices and are interconnected by an extensive network of government owned cables. Calls to and from these military installations and the civilian population throughout the islands and the continental United States are routed over connecting facilities between the military telephone system and Hawaiian's system.

### *In Peace and War*

The present extensive military system did not really begin to develop until the defense build-up period which took place just prior to World War II, and, of course, it was tremendously accelerated and expanded during the war years. Even in the pre-war period, however, Hawaiian was often called upon to provide special services and equipment and to assist in the engineering of outside plant and central office facilities. One of the early pre-war services provided was a system to remotely control night lighting facilities at the airports adjacent to Honolulu. Just prior to the outbreak of hostilities, Hawaiian was engaged in assisting the armed services in the establishment of an island-wide air raid alarm system.

It would take pages to fully cover the role that Hawaiian played during the war years in connection with our national defense and in meeting the needs of Hawaii's civilian population. Within hours after the first bombs fell at Pearl Harbor, company technicians, operators and engineers were hard at work providing equipment and services for the Army and Navy. Practically overnight a five position multiple switchboard was installed at Punahou School, a private school in the heart of Honolulu, which was taken over as Honolulu headquarters by the Army Corps of Engineers. To meet the needs of this and many other emergency installations, switchboards were removed from civilian business organizations and many miles of cable and wire were taken from our own supply and turned over to the Armed Forces. Because of the scarcity at the time of telephone engineering personnel in the armed services, company personnel were called upon to engineer and install censorship equipment on all transpacific and inter-island circuits and to assist in the design of facilities for the Army Traffic Control Center. In addition, an engineer was loaned to the Army for over six months to assist in the basic design of the telephone network required to meet their war-time needs. In the months following Pearl Harbor, assistance was also given in training service personnel in installation and maintenance procedures, and a special switching system was installed to permit military telephones located in downtown Honolulu to dial directly into the Army and Navy telephone networks.

### *Rapid Expansion*

Despite the unavailability of telephone equipment during the war years, except in limited quantities to primarily serve defense needs, the company added approximately 4000 stations between 1942 and 1945. This was done to serve high priority subscribers and was accomplished by overloading existing facilities and forcing lower grade four-party service. Consequently, Hawaiian entered the post-war period with an overloaded plant and a backlog of approximately 8,000 waiting applicants. At the end of 1945, the company had approximately 55,000 telephones in service.

### *High Post-War Demand*

Because of the tremendous government spending in Hawaii during the war years, an increase in the overall conomic health of the Territory, a apidly expanding tourist industry, nd the low ratio of telephones per 00 population, demand for telephone ervice in the post-war years has been xceptionally high. From 1946 to 956, the company sustained the reatest growth in its history. In a eriod of eleven years it gained 99,-79 telephones, representing an in-rease of 182% over the number of elephones in service at the end of 945. At the end of 1956, the ratio f telephones per 100 population was 9.2 as compared to 12.0 in 1945. ncidentally, held orders which in 948 were near the 11,000 mark were irtually eliminated by the end of 953.

### *Dial Service Extended*

During this period many improve-nents were made. In addition to onverting more and more areas to dial service, extended area dial service was introduced and toll charges eliminated wherever possible. This program has progressed to the point where four of the six principal islands now have completed island-wide toll free dialing service and the remaining two are scheduled for such service by the end of 1958. As early as 1948, as the result of experimental work done by the company's engineers, equipment was installed to permit direct operator dialing between the islands over the radio circuits. This proved so successful in speeding the completion of calls that engineering studies were soon undertaken for possible application of operator dialing on the transpacific radiotelephone circuits. By 1954 equipment was developed and tested for this purpose, and will be in regular use on these radio circuits by the end of 1957.

### *New Transpacific Cable*

In addition to the radio circuits, we will have 36 additional high quality voice channels in operation at the end of the year which will also be equipped for operator dialing. These circuits will be provided by the *new transpacific telephone cable* which will be installed between Hawaii and California during the summer of 1957 as a joint undertaking of the American Telephone and Telegraph Company and Hawaiian Telephone Company. While this cable had originally been contemplated for installation around 1960, national defense considerations advanced by the Office of Defense Mobilization made its earlier installation a necessity. Consequently, both American Telephone and Telegraph and Hawaiian agreed to advance the date for completing this project and the entire project was approved by the Federal Communications Commission. Actual work on the cable began in October, 1956, when the landing section at the Honolulu end was laid from the landing site to a point approximately two miles from shore. This portion will be joined to the deep sea section which will be laid this summer.

### *Increasing Significance*

Hawaii's location, as the meeting place and stopping off place between East and West, and as one of our country's most vital outposts in the Pacific, is constantly increasing in importance and significance. As a result there has been in the post war years a high level of military activity in the islands which has required close cooperation between the communications personnel of the Armed Forces and Hawaiian. This cooperation in general has been excellent as demonstrated by the manner in which contracts have been negotiated or arrangements made for the use of interconnecting and other plant facilities, the provision of telephone centers on military installations to assist servicemen with their local and overseas calls, and the furnishing of special trunking arrangements to permit civilian personnel living in residential areas adjacent to various military installations to dial directly into those installations. In addition, much time has been devoted by Hawaiian to the study of ways and means to provide communication facilities to meet both the normal and emergency needs of the armed services. Hawaiian has not only provided equipment and services for Civilian Defense but has encouraged its employees to assume key positions in the Territory's Civil Defense Organization. Many of its employees also belong to the Hawaii National Guard.

The recent activation of guided missile installations in the islands and the announcement by the Government of the military budget for the islands for the coming year assures the continuation of the present high level of military activity for some time to come. This activity, together with Hawaii's growing economy, means a continuing demand on the Hawaiian Telephone Company to meet both civilian and national defense communication requirements. We look forward to this challenge—confident that we can meet it as successfully in the future as we have in the past.

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Figure 1.

DIGITRON display equipment as applied to a console for the Missile-Master System. Console is joint development of The Glenn L. Martin Company and the Boston Electronics Division of American Machine & Foundry Company.

# a new concept in electronic display equipment

by Dr. W. B. Sell

**General Manager, Defense Products Group**
**Electronics Division**
**American Machine and Foundry Co.**

THE AMERICAN MACHINE & FOUNDRY COMPANY'S Electronics Division in Boston has just recently completed a development program culminating in electronic equipment to be known commercially as the "Digitron" display system. This system was demonstrated publicly for the first time for the industrial-military team at the 1957 AFCEA Convention.

The program which resulted in this equipment was originally conceived by the U.S. Army Signal Corps as

Dr. W. B. Sell is a 1940 graduate of the U.S. Military Academy and served in the Anti-Aircraft Artillery, U.S. Army, until 1954. Upon his resignation he joined Boeing Aircraft Co. as a Project Engineer on the Bomarc Missile and presently is General Manager of American Machine & Foundry Co.'s Electronics Division, Boston.

replacement for an optical projector in an early air efense data processing center and was awarded to MFED on a competitive bid development contract. Subequently another contract was received by AMFED from lenn L. Martin Co. to produce similar but advanced isplay Systems for what is now known as the Missile-laster Anti-aircraft Defense System. A typical display onsole for the Missile-Master System is shown in Figure . Reliability, ease of maintenance, economy of producion and human engineering factors were prime coniderations in this console design.

### *Character Generation*

In the Digitron System of Electronic Display illustrated n Figure 2, the characters or symbols are formed very imply by causing the electron beam to write out the esired character just as a person would form it with encil and paper. Flicker-free display is provided by regenerating each symbol at approximately a 20 cps ate. A major advantage of this scheme is the extreme implicity of the Cathode Ray Tube (CRT), a Dumont K1202, which this system employs. Target plan posiion (or character major position) is controlled by the magnetic deflection system and yoke. Character painting and symbol minor position are accomplished by the onventional electron gun and electrostatic deflection assembly. All CRT components are standard and the tube is considered a stock item by DuMont. A minimum of Cathode Ray circuits and adjustments is required.

ADVANCED ELECTRONIC DATA DISPLAY EQUIPMENT exhibited by the Electronics Division of American Machine & Foundry Company, Boston, Mass., at the 1957 National Conference of the Institute of Radio Engineers. An air-traffic control display is shown on the screen. Electronic data display systems are used whenever processed electronic information is presented to a human operator. Applications include radar, air and ship traffic control, defense systems, combat information centrals, and general purpose digital computer outputs. Figure 2.

A possible form of symbology available in the DIGITRON display equipment developed by the Electronics Division of American Machine & Foundry Company. Figure 3.

### *Advanced Developmental Effort*

Following the Missile-Master Development Program, AMFED's attention was devoted to discovering new design approaches which would significantly reduce equipment complexity and improve reliability. Out of this effort there evolved a new systems concept based on the application of digital techniques to the control and programming of symbol waveform generation. This new concept had the immediate benefit of reducing the required tube complement by 50% as well as opening the possibility of transistorization with the attendant economies in size, weight and power dissipation. The new concept also provided more flexibility in generating symbology. A possible form of symbology which has been developed is shown in Figure 3. Many other variations are obviously possible. A plug-in printed circuit board is used for generation of each character and is located in the common equipment display generator, thus giving the user complete freedom to select symbols desired. Transistorization of the deflection amplifiers is now under way and transistorization of the waveform generator and console display control circuits will begin in the near future.

### *Applications*

The Digitron display equipment is applicable to any data handling system in which processed information must be presented to a human operator for either (a) end use, or (b) human evaluation and re-insertion into the data handling system.

Typical examples include: (a) Defense Systems, Combat Information Controls (either land, shipboard or airborne), Battle Command Posts, etc., (b) Air Traffic Control, en route controller, approach controller, ground controller, etc., and (c) General Purpose Digital Computer Output; Temporary readout for program verification or permanent high speed readout in conjunction with a high speed camera.

### *Major Advantages of the Digitron Display System*

1. The Digitron employs a conventional Cathode Ray Tube which is a stock item.
2. The symbol forming mechanism is not built into each tube. It is a part of the common equipment which services all indicator tubes.
    (a) Changes in symbology can be effected without discarding existing display tubes.
    (b) Character selection outside the display tube eliminates the necessity for complex electron optics in the basic tube structure and the associated precisely regulated power supplies.
    (c) Display stability is enhanced and many critical display adjustments are eliminated.
    (d) Continuous symbol size control from an inch or more on the diagonal down to a dot is possible on the Digitron display equipment.
    (e) A shorter tube (25 inches over all) results, permitting more compact display console design.
3. The Digitron display is extremely bright, thus permitting operation at high ambien
4. Transistorization of virtually all of circuitry provides an extremely comp ficient equipment.
    (a) The common equipment can be in the display console or separa 30 cubic feet cabinet.
    (b) Low power dissipation (on the order o watts depending on the application) el ates the necessity for special cooling eq ment and enhances reliability.
5. Method of character selection employed mak the symbology extremely flexible. Letters, nun erals and geometric patterns may be provide The user may choose as few or as many as h requires. Moreover, the symbology may b changed after installation of the display equi ment by simply changing a single plug-in printe circuit card for each character.
6. The Digitron display equipment has a high sym bol painting speed. This may vary widely wit the functional requirements for each installa tion. A typical, conservative value is 20 micro seconds.

### *Summary*

Interest of both industry and the Defense Departmen in this new electronic display is considerable. The ap plication potential for the system appears to be unlimite where high speed display is required. Additional develop mental effort now in process will further enhance its po tential.

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# U. S. COAST GUARD COMMUNICATIONS

**By Captain G. Van A. Graves, USCG**
**Chief of Coast Guard Communications**

THROUGH THE EVER-INCREASING magic of electronics the Coast Guard is ever more effectively ON WATCH. All around the coasts of the United States, on the lakes and rivers, in the stormy wastes of the North Atlantic, on the broad reaches of the Pacific, in the Arctic and in the tropics, the Coast Guard is on watch to aid those in distress and to provide guide posts and information to prevent disaster in the air and on the sea. What is communications? What does it do? It provides information, coordination, control and, because of all these things, it provides help when things go wrong. Here is how the Coast Guard uses communications and, briefly, an indication of the equipment with which we work.

The mission of Coast Guard communications is to furnish an efficient communication service to operating and administrative units of the Coast Guard, provide for the receipt of distress information from all sources available, disseminate distress information with the utmost speed and accuracy to all agencies capable of rendering aid, and be so organized and equipped, and have personnel so trained, that amalgamation with the Navy in time of war, or when so directed by the President, may be accomplished with a minimum of operating change.

### *A Compatible System*

To carry out this mission the Coast Guard communications system must be compatible with civilian, military and Coast Guard requirements. Normal communications for Coast Guard operations would require a relatively simple system of communications, but when the compatibility requi
ment with military and civilian co
munications is applied, a compl
communications system is the resu
Coast Guard communications m
be prepared to handle traffic to a
from Ocean Station vessels as w
as ship to shore traffic from Co
Guard vessels operating in the
lantic and the far Pacific. Als
our communications must be pr
pared to handle ship-to-shore traf
from merchant vessels when they a
required to pass on information
interest to the Coast Guard; traff
to, from, and among Loran station
broadcast notice to mariners an
other marine information; traffi
with Coast Guard, civilian and mili
tary aircraft, and many other routin
services too numerous to mentio
here. Radio and landline circuits ar

(*Continued on page 96*)

In addition to his present post as Chief of Coast Guard Communications, Captain Graves has served as Commander, Naval Forces, Canadian Arctic from 1942 to 1943, and Commander, International Ice Patrol, from 1951 to 1954, as well as two previous assignments in Coast Guard communications.

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The coordination of rescues is the mission of the Rescue Coordination Center. The controller (second from left, seated) alerts and dispatches necessary Coast Guard search and rescue air and surface craft. He keeps participating SAR planes and vessels fully informed of the situation as it develops.

utilized for both administrative and operational traffic with the primary attention being placed on operational communications. There exist many types of circuits, namely: teletype, all forms of radio, specialized VHF radio link, and specialized control circuits for aids to navigation, to cover the majority. All of these are integrated into a common system for the rapid handling of messages.

### *Coast Guard Comes to Doria's Aid*

On the morning of 26 July 1956 at 3:10 GMT, the *SS Andrea Doria* and *MV Stockholm* collided 19 miles from Nantucket Lightship. At 3:22 GMT the Coast Guard Radio Station, New York at East Moriches, Long Island, alerted the East Coast Coast Guard SAR Control Net with the report that an auto-alarm signal was heard on 500 kcs followed by the *Stockholm's* call sign "SEJT." This alerted all the Coast Guard rescue coordination centers (RCC) from Massachusetts to Louisiana. New York Radio followed this report with another which said "SOS SOS DE ICEH," indicating it was receiving a distress message from the *SS Andrea Doria.*

### *Role of Communications*

These messages were the first notice of one of the largest marine disasters in recent years. The RCC in New York assumed the task of coordinating all vessels, aircraft, and other services involved in the rescue. For the next eleven hours there was a series of messages from ship-to-shore, ship-to-ship, and ship-to-plane involving Coast Guard, Navy and commercial forces. These messages were largely controlled by Coast Guard communications and were concerned with the involved operation of rescuing personnel and attempting to save the *SS Andrea Doria.* News reports had the man on the street spellbound until the *SS Andrea Doria* finally sank and the last reports of the rescue were received. The full story of the sinking and the gallant action of the crews of both the *MV Stockholm* and the *SS Andrea Doria* and all participating units has been told in magazine articles, in commentaries on the radio and in presentations on television.

### *Rapid Action Saves Lives*

Another recent example in which the Coast Guard communications system played an active part is that of the collision in the Delaware River between the *USNS Mission San Francisco* and the Liberian freighter *SS Elna.* Here again the distress messages were picked up on radio by Coast Guard shore radio stations, and again the search and rescue teletype net was alerted. Then commenced a period in which the various radio stations on the East Coast intercepted traffic between the ships involved and those in the adjacent area. The messages they heard were forwarded to the rescue coordination center, thus giving full and complete knowledge of what was happening, permitting direction of Coast Guard forces into the correct area for rescue, and allowing participation to the maximum extent possible. Such rapid action results in a saving of life and property not possible many years ago. During the year 1956, the U. S. Coast Guard in its many operations saved 2511 lives and rescued property valued at $1,178,818,200. The total value of property saved has more than equalled the total money authorized and expended for the Coast Guard during the same year. No monetary value can be put on life. and the 2511 lives that were saved speak for themselves.

### *Constant Preparedness*

The Coast Guard communications system must always be prepared to meet obligations set forth for it by statute or practice and to anticipate any changes. At the present time an extensive guard is maintained on 2182 kcs, the international radiotelephone distress frequency. This frequency is used for both calling and distress traffic. In addition to commercial vessels authorized to operate on this frequency, such as fishing vessels, there are approximately 44,000 non-commercial vessels so equipped in the United States. When it is realized that there is a potential of 300,000 additional non-commercial users, it can be seen that serious interference could develop on this frequency. Add to this the characteristics of the 2 Mcs frequency which propagate it over a large area during the evening, causing a transmission in one area to interfere with communications in another area. It should be readily apparent that communications on 2182 kcs could soon become untenable. To combat this situation, the thinking has been to move much of the traffic of a short-range nature presently on 2182 kcs to the VHF-FM Maritime Mobile Band of 156.3 to 157.4 Mcs. This band contains a calling and safety frequency of 156.8 Mcs and several working frequencies. Being a short-range frequency, it will allow many more persons to use it simultaneously without harmful interference than is presently possible with 2182 kcs. The Coast Guard is making VHF-FM installations in major U.S. ports for port security operations and for pos-

st Guard Radio Station, East Moriches, York, played a vital role in the receipt dissemination of distress traffic in the ANDREA DORIA casualty.

sible operation on the VHF-FM band as other users become more active.

### *Scope of Communications*

To bring into focus the scope of Coast Guard communications, several types of operational communications will be elaborated on. The primary area of operational communications is that concerned with search and rescue. The illustrations previously given graphically portray how communications were used. Without the rapid means to alert people, to tell them where to go and what to do, the Coast Guard would be helpless to prevent the loss of lives and property. This same type of situation is repeated day after day in varying degrees. Perhaps today it is the saving of a small pleasure boat in the waters off Florida, or it might be the rescuing of personnel from a crashed military aircraft, and then again it may involve rescue of people from a merchant vessel afire at sea.

### *Dramatic Rescues*

A more detailed description of the search and rescue communication system of the Coast Guard follows. There are twelve primary and seven secondary radio stations located along the coasts of the United States. Each of these radio stations maintains an active 24-hour guard on the international distress frequency (500 kcs) and the international radiotelephone distress frequency (2182 kcs). Along the coasts of the United States there are an additional ninety Coast Guard units that maintain a continuous radio watch on 2182 kcs. Within the Great Lakes area sixty-one units are also maintaining a continuous listening watch on 2182 kcs.

It is through this large number of units guarding the important distress frequencies that the Coast Guard is able to receive almost instantaneously the first cries for help that are sent by the mariner in distress. Immediately upon receipt of distress information the rescue coordination centers are alerted by a landline teletype or telephone circuit. The rescue coordination center is the central command post within each Coast Guard district and has means at its fingertips for alerting all other services, both military and commercial, that are capable of providing supporting services in the way of direction-finding, communications, aircraft, and vessels. A direct circuit is maintained with the Civil Aeronautics Administration (CAA) for the purpose of coordinating rescues involving aircraft. Upon evaluation of the information received, appropriate aid is dispatched to the unit in distress.

### *Complex Systems Involved*

Operational communications with Ocean Station vessels closely follow search and rescue communications in importance. Under international agreements, the U.S. is required to man four Ocean Stations in the Atlantic and two in the Pacific. The Coast Guard operates the vessels which fulfill the U.S. requirements. Message traffic to and from the Atlantic stations is chiefly handled by the primary radio station at Washington, D. C. The primary radio stations at San Francisco, California and Honolulu, T.H., handle traffic for the Pacific stations. This traffic involves the passing of weather messages to and from the Ocean Stations and the Weather Bureau, and message relays by the ocean station vessels for merchant vessels and aircraft that cannot deliver their traffic in any other way. While maintaining two ship-to-shore circuits, the vessel is also guarding the international distress frequency (500 kcs) and the international survival craft frequency (either 8364 kcs or 2182 kcs). For the handling of aircraft traffic the vessel guards 3023.5 kcs, 121.5 Mcs,, one other frequency in the VHF band and 243 Mcs. A typical communication situation while on station might involve passing position information to one or more aircraft using the VHF or UHF frequencies, and at the same time, sending or receiving weather traffic and relaying a message for a ship or one of the aircraft. The communication set-up aboard these vessels must therefore, of necessity, be complex.

### *Methods Being Studied*

In addition to the above requirements, these vessels must be prepared to operate under the Navy. Here then we see a vessel which epitomizes the problem facing Coast Guard communications, namely that of being compatible with three different types of communication systems.

This brief dissertation on Coast Guard communications can only hope to skim the surface, but it is believed that some idea of the scope of the problem faced can be deduced from these few examples. Constant improvements and modifications are necessary to keep abreast of the advances in the field of electronics. All phases of Coast Guard communications are continually under study in order to obtain the maximum result from the equipment and personnel on hand and in order to keep communications prepared to assist in carrying out the duties assigned to the Coast Guard, whatever they may be.

# modern press communications

### By Eustace Florance, Jr.

AMONG THE MANY SERVICES WHICH the U.S. Communications industry renders the American people, none is more important than the domestic and international transmission of press material. In this day of grave U.S. responsibility in world affairs, when explosive events occur, even though they occur oceans away, we must know immediately.

For the sake of national defense and for the sake of speedy and intelligent American action in world affairs, the news must get through. This article is a look at members of the U.S. Communications industry and at the ways in which, to keep Americans informed, they perform the vitally important job of transmitting domestic and international press.

### *Major Communications Systems*

Probably the leading entity in the field of supplying international news channels which feed our newspapers, magazines and radio stations is Press Wireless, Inc., which has thirteen offices throughout the world and serves sixty-four countries for the purpose of international transmission. Other major communications systems serving this field are Western Union International Communications, R C A Communications, Mackay Radio and Telegraph Company and the Bell System. Tropical Radio Telegraph Co. serves between the U.S. and Central America.

Press Wireless, Inc., came into existence thirty years ago when U.S. publishers decided they needed a system to handle press material only. Its purpose is to insure low rates and speedy transmission.

PREWI, as it is known in the communications world, provides transmitting and receiving facilities for the handling of radio-printer, radio facsimile, radio telegraph, radio photo and broadcast operations. It handles close to a million words a day, about seventy percent of all press traffic to and from the United States.

The services of PREWI center around radio transmitters and receivers on the East and West Coasts of this country. Thirty-five transmitters at Hicksville, N.Y., and ten at Belmont, Calif., beam press messages overseas with power ranging from two and one-half to fifty kilowatts. Large receiving stations at Baldwin, N.Y., and Napa, Calif., pick up Press Wireless foreign signals and distribute the new material to American publications. A new Eastern transmission center is planned at Centereach, N.Y., which will occupy five hundred acres and cost $750,000.

### *Rapid Message Transmission*

The larger press services have what might be termed leased wire service in the operation of two-way radio or cable circuits between the United States, Europe and the Far East. They can transmit a message in a matter of minutes and receive replies just as quickly. Their operations are from their own offices without any manual relays to slow down the traffic.

Press Wireless also performs extensive information transmission services by voice and radioteletype for the United Nations, Voice of America, Radio Free Europe and other similar agencies in Europe, Latin America and the Far East.

### *Radio Relay System*

An important installation in the Press Wireless system is the radio relay station in Montevideo, Uruguay, which provides reliable international service during recurring cycles of atmospheric disturbance. Since North-South signals are subject to much less disturbance from "sun-spots" than East-West signals, messages relayed from New York through Montevideo to London often receive better than those sent directly, even though the distance is much greater.

Press Wireless during World War II served the press correspondents with mobile radio communication units in the combat area. Four days after D-Day, Press Wireless began operation of the first mobile unit in the field and no other communications system of any Allied Nation urnished this service until some time ater.

### *Service to the U. N.*

Another organization important in he transmission of world news is, f course, Western Union Internaional Communications. Western Union transatlantic cables, their word apacity greatly increased by the use f submerged cable repeaters, provide vital service in the handling of nternational press, especially when big" stories break.

In the United Nations Building in New York, Western Union maintains an office which is for the use of members of the press and United Nations personnel only. Last November, when he clouds of war hung over the world, while the General Assembly worked late into the night to restore peace in the Middle East, through the United Nations office of Western Union alone, newsmen dispatched a million words of telegraph and cable copy to all parts of the world.

But it is in the field of domestic press that Western Union's partnership with the Fourth Estate is most pronounced. A 24,000 mile nationwide press-wire network for the exclusive handling of news stories is Western Union's contribution in this partnership.

With key centers in New York, Chicago and San Francisco, the Western Union press-wire covers the entire country through thirty-three major news telegraph points. It has more than tripled the speed of former methods of news transmission stories travelling from origin to destination in an average of fifteen minutes. Nearly all newspapers in the U.S. are equipped with Western Union direct wires and page printers automatically receiving news stories from their bureaus and correspondents in this country and abroad. Millions of news words daily are handled over the Western Union system with no manual retransmission from origin to destination.

### *Telegraph Throughout the World*

One Western Union new institution which cannot go unmentioned is Carroll S. Linkins, Western Union's "White House man." In gratitude for his years of service to them, White House correspondents have named after him the railroad car in which they travel on Presidential campaigns.

RCA Communications, Inc., has performed many notable services for the press in the field of international radio broadcasting. As part of its regular operations, RCA Communications provides press telegraph service to all parts of the globe. Its particular contribution to worldwide news coverage has been most pronounced when stories have broken in out-of-the-way places.

### *Typical Accomplishments*

Typical of the accomplishments of RCA in this area were the mobile radio stations which saw service in the ETO during World War II. Using high frequency transmitters and receivers installed in vans, these mobile stations, keeping up with the Allied advance, provided correspondents with a means of filing their dispatches to the United States when cable heads and land line facilities in the battle area were destroyed.

Another service to the press, in which RCA has excelled, is the reception and processing of radiophotos. RCA maintains facilities for receiving press radiophotos from more than forty foreign countries. In 1954 RCA fed radiophotos of the coronation of Queen Elizabeth to NBC-TV for nationwide broadcasting in this country less than nine minutes after the pictures were taken in London.

### *Presscasts Over the Globe*

Despite its corporate relationship with the National Broadcasting Company, RCA Communications provides all broadcasters with international program facilities, and more than seventy-five percent of all overseas programs heard in the United States are received by RCA. The RCA transmitting and receiving facilities for transatlantic communications are at the eastern end of Long Island. Service to the Pacific area is provided through a terminal at San Francisco.

The Mackay service, used by Press Associations, "presscasts" to more than a hundred places on all continents, transmitting well in excess of a quarter million words a day. The Press Associations directly key Mackay's transmitters located at New York, San Francisco and Tangier, Morocco; the later being an important automatic relay station. Charges are established on a transmitter-hour basis.

Many points receive the same copy —especially edited for their particular area and in the language required. Considering wide area azimuthal and path length differences, two and sometimes three different frequencies are keyed simultaneously. In other cases, and in the interest of conserving radio frequency spectrum, two or three transmitters are keyed simultaneously on the same frequency.

Mackay's presscast service is a "blind transmission" service. The receivers are often unattended and out of reach of technical personnel. This, notwithstanding, an analysis of results in one service showed that all receiving points produced an aggregate net yield of ninety-five percent useable copy. One client used Mackay's transmissions for "radioteletypewriter" service, automatically to set type ready for publication.

During World War II, Mackay established a press station at Algiers, and in addition, using mobile radio equipment, provided direct press service to New York for war correspondents attached to General Patton's U.S. 3rd Army and other ETO units.

### *Transatlantic Cable*

The facilities of the Bell Telephone System serve some 11,000 press outlets in this country. The principal users are the major Press Associations. Bell Companies lease teletype lines and station equipment to these organizations as well as circuits for the transmission of photos.

The telephone itself, of course, is an important method of transmission for foreign press material. In most countries and territories—well over a hundred of them—telephone transmission is by radio.

But to Great Britain and eight other countries on the Continent, press voice transmission is often over the new transatlantic cable. British newspapers, in particular, make great use of the cable, daily dispatching stories from New York.

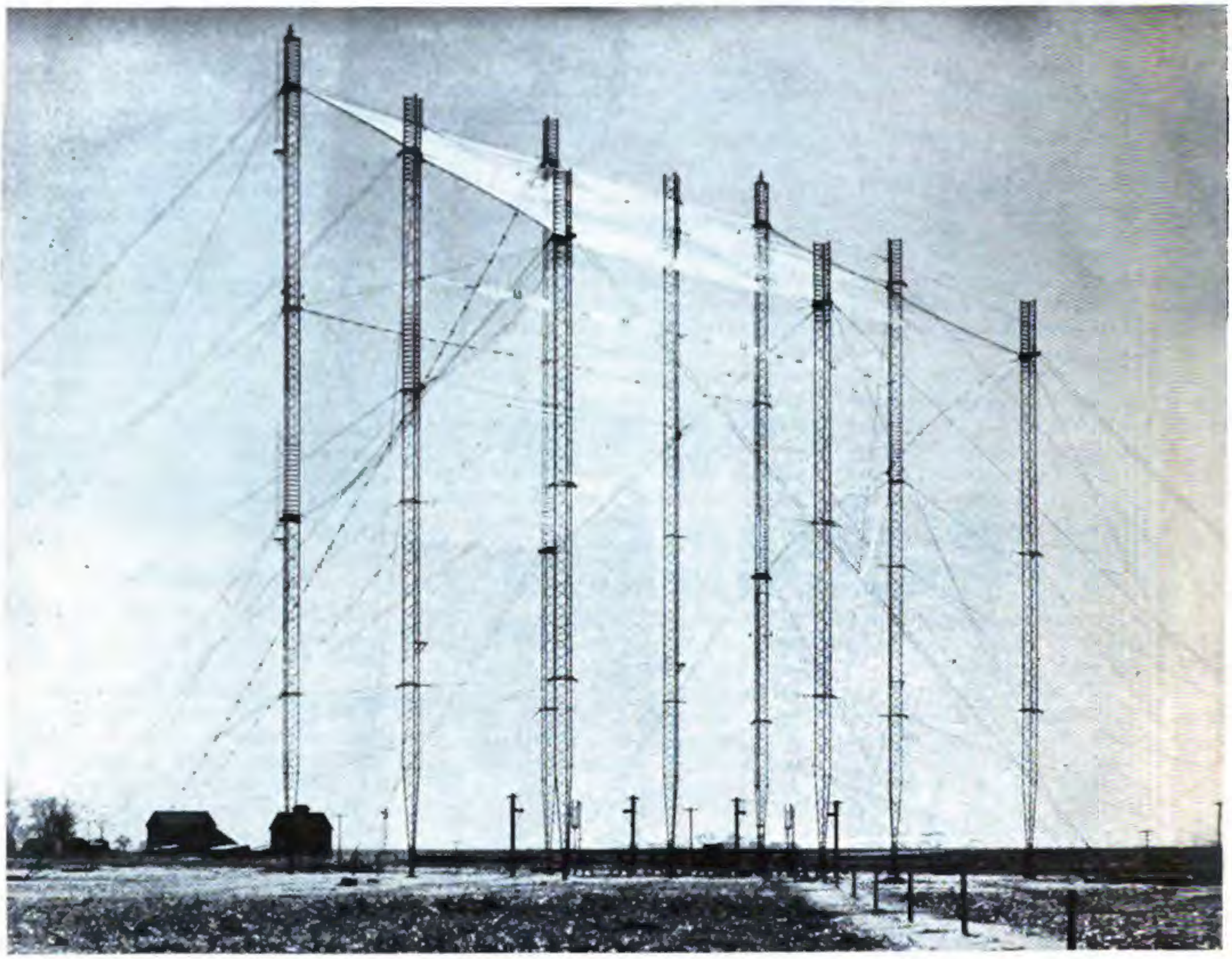
### *Communications Serves the Press*

The new cable to Alaska which runs along the Pacific Coast has encouraged press usage. A valuable aid to press coverage will be the new cable to Hawaii which is soon to come.

Millions of words carried daily—that is the service the communications industry performs for the press. Using cable and radio in all their forms, the U.S. communications systems provide the press with direct service from its own offices to keep the news flowing, both domestic and overseas.

In these days of uncertainty in world affairs, it is paramount that the word is passed. Serving the press, the communications industry is leaving no stone unturned to see that the function is accomplished.

* * *



High-gain corner-reflector antenna, designed, installed and test-operated by PAGE for Western Electric Company, under subcontract for DEW-Line project.

PAGE Communications Engineers, Inc. welcomes the members and guests of the Armed Forces Communications & Electronics Association to this significant gathering, and cordially invites you to meet with members of our organization while you are attending the AFCEA convention. Our work is internationally known and of increasing interest and significance. During the past seven years as pioneers in the design, construction, testing and operation of scatter and other advanced radio communications systems, PAGE has played responsible and challenging roles in the building of multi-million dollar telecommunications networks.

Members of our organization are working closely with representatives of the U. S. and foreign governments and industries in the development of such systems. Challenging assignments take our engineers to many corners of the globe.

Due to the increased demand for PAGE-designed, installed, tested and operated systems, we now offer a few exceptionally interesting positions in our Washington, D. C. office as well as overseas.

Engineers who elect to locate in the Washington, D. C. area will find it offers outstanding educational, cultural and recreational facilities. As a center of Government-sponsored engineering and research laboratories, it is particularly attractive to the engineer intent upon pursuing advanced studies. Urban and suburban housing is readily available in all price ranges and easily accessible to PAGE's main offices in the heart of downtown Washington.

**Stop by and visit us at Booth #96 or write for further details to: Mr. J. P. Gaines**

**PAGE COMMUNICATIONS ENGINEERS, INC.**

**710 FOURTEENTH STREET N.W., WASHINGTON 5, D. C.**

**Branch Offices: Seattle, Manila, P. I., Oxfordshire, England.**

**Affiliates: Rixon Electronics, Inc., Page, Creutz, Steel & Waldschmitt, Inc.**

# Electronics & Communications Engineers:

Sixty-foot paraboloidal-reflector antenna, typical of those tested and operated by PAGE for Lincoln Laboratory, M.I.T.

**PAGE HAS DESIGNED AND CONSTRUCTED**

# 9,000 MILES of scatter communication circuits since 1951

***Page has worked with Lincoln Laboratory, M. I. T., the National Bureau of Standards, and the Western Electric Company in the development, or installation and operation, of 10,000 additional miles of scatter communications circuits. Current contracts call for 78,000 miles of new circuits. A pioneer effort unmatched by any other organization.***

Bell & Howell Missile Scoring Pod with cover removed to permit removal and loading of its four 16mm high-speed motion picture cameras.

# photoprogress

by FRANK SMITH

PHOTO EDITOR
SIGNAL

### Missile-Scoring Camera Pod

Something new in photographic instrumentation is a new missile-scoring camera "pod" for determining how and why a guided missile hits or misses its aerial target. It is being manufactured by Bell & Howell, 7100 McCormick Road, Chicago 45, Ill. under U. S. Navy contract.

Since missile and target both fly at velocities approaching the speed of sound and at altitudes far beyond the range of human vision, a remotely controlled system of recording data is a vital tool in evaluating missile accuracy. The new Bell & Howell scoring system furnishes this data on motion picture film.

Mounted on the wing-tips of a drone target, each missile-scoring pod contains four 16mm high-speed Bell & Howell motion picture cameras, electrically operated. The eight cameras—four to a pod, with one pod on each wing tip—are mounted to give complete spherical coverage of a missile's flight as it nears the moving target. The cameras are so aimed that the approaching missile is always covered by no fewer than two cameras. As it passes out of the viewing field of two cameras, it automatically enters the field of two more. An important new feature of this scoring system is its economy factor of up to 300 percent. The 200-foot film capacity of each Bell & Howell camera is sufficient to cover as many as four missile passes at the moving target, with 10-second remotely controlled motion picture "bursts."

Actual scoring of missile behavior is done by assessing the film records against suitable grid coordinate charts. Data thus obtained show the missile trajectory, miss-distances, and other functional characteristics.

The cameras are watertight, interchangeable, and fitted with 142-degree wide angle lenses. Operating speed is 200 fps, exposure time 1/600 second per frame of film.

If there is a direct hit, the camera pods are jettisoned without damage by means of an explosive bolt or "squib." Once free of the drone, the pods are lowered to earth by means of self-contained 16-foot parachutes.

Access doors permit reloading or replacement of cameras without removing the pods from the wing-tips of the drone. Streamlined design and aluminum "skin" are among the pods structural features. Each pod weighs approximately 90 lbs. ready for use, the separate drone mounted electrical control gear weighing around 35 lb

The cameras are designed for operation between 5,00 and 50,000 feet, at velocities up to mach 0.95.

### A New Fast Extreme Wide-Angle Lens for Photographic Instrumentation

A new development in the way of fast extreme wide angle lenses for photographic instrumentation has been announced by Traid Corp., Encino, Calif.

Named the Traid 720, the new lens is claimed to be the most compact 3.45mm f/1.5 wide-angle lens that is available in the photographic instrumentation field. The lens covers an area 160 degrees both horizontally and vertically and is available either in a Gun Camera (GSAP) or "C" mount.

### Still Picture Cameras, Wide Angle and Otherwise

Those of our readers who are interested in ultra-wide angle photography will doubtless be pleased to know some of the details about the new whole Sky Cloud Camera developed by Dr. William S. von Arx of the Woods Hole Oceanographic Institution, Woods Hole, Mass., which photographs the entire sky, the horizon and the earth's surface 30 degrees below the horizon.

The field compressor is a parabolic mirror 16-inches in diameter, 3.75 inches focal length mounted with the vertex upward. A modified Kodak-100 16mm time-lapse camera is cycled at the rate of once each minute and mounted 36 inches above the field compressor mirror. The camera requires winding once each day but is triggered automatically by a six-volt timing motor. The motor is turned on by the light of the sunrise, and shuts off automatically at dusk. Film consumption (color) is about 100 feet/week. Surrounding the field compressor mirror are various instruments such as a clock, compass, aneroid barometer, anemometer dial, dry bulb thermometer and wet bulb anemometer, which show the various data on the film at the time of exposure.

Another newcomer to the wide angle camera field is the all-metal Panoram 120 still picture camera of Burke & James, Inc., 321 S. Wabash Ave., Chicago 4, Ill.

Custom built of aluminum, the camera is much lighter n weight than other wide view cameras and is available n two models. Specifications of the Panoram 120 Mark Camera are as follows:

- Four exposures, 2¼" x 7" on one roll of standard 120 film.
- Single speed louver type shutter—1/100 sec. only.
- Five-inch (5") Ross lens, fixed focus.
- Extreme wide angle view.
- Wire frame finder, ground glass back.
- Weight 9 lbs.
- Dimensions 4½" high x 10" wide x 8¼" deep.
- Detachable ground glass back and two detachable magazines included.
- Double bubble level.
- Price of the Mark I is $169.50. The Panoram 120 Mark II is the same as the Mark I but in addition has focusing mount and X Flash Synchronization. Price of the Mark II is $199.50.

### Terrain Scanning System for Electronic Photogrammetry

A new and revolutionary system which scans the ground photoelectrically and automatically producing a corrected orthographic photomap is described in an illustrated technical paper by Ross E. Williams and Paul Rosenberg in the Dec. 1956 issue of "Photogrammetric Engineering" (pp. 823-830).

The system described is unique in that no photographic processes are used to gather the terrain information. In operation, the varying light intensities which are gathered by the aircraft scanning components are converted to video signals by photomultiplier tubes and stored in magnetic tape, which takes the place of photographic film in conventional mapping.

After the signals are stored in the tape, it may be re-run and the signals are automatically oriented. The signals may then be used to print a corrected photomap, carve a relief model or produce a map manuscript.

The authors state that the principal advantages of the system as presently conceived are: the mapping operation can be conducted at high speed; operation of the system is automatic except for the photo interpretation part; the system is operable, under some conditions at lower levels of ground illumination than in conventional aerial photography; photographic processes are not used and the system is not affected by radioactivity; the size and weight of the aerial components, including the magnetic tape, are practical for aerial aircraft installation.

### Kodak New Retina Single-Lens Reflex Camera

A new 35mm camera, that extends the Kodak Retina line of miniature cameras into the automatic single-lens reflex field, has been announced by the Eastman Kodak Co., Rochester, N. Y.

The camera, which is tentatively scheduled to be available in the Fall of 1957, provides true single-lens reflex viewing with 24 x 36mm ground glass as well as range finder focusing.

A penta prism-type view finder, combined with an extra-fine grained ground glass, permits the photographer to sight and focus directly through the 50mm f/2 Retina Xenon C lens or through wide-angle or telephoto lenses, even when supplemented by close-up attachments. The view finder shows exactly what will be recorded on film, parallax-free, correct from left to right and in full negative size.

The camera is equipped with Synchro-Compur Shutter with internally linked exposure value setting, pre-set automatic diaphragm and self-timer. It is fully flash synchronized for X and M type light sources with safety-lock setting lever. Shutter speeds range from 1/500 second to "B." The tentative list price of the camera is $220.00.

### Xeroradiography

Although the word xeroradiography is rather long and formidable, the process fortunately is not. If anything it is a simplification and means merely the adaptation of the now well-known xerography process to x-ray work.

With the commercial introduction of xeroradiography, quality control on an economical, production-line basis is possible. There are three methods of utilizing this new tool: (1) the image can be viewed directly on the original plate, (2) a film record can be made by photographing the plate, (3) a permanent paper "print" can be made directly from the plate. All three methods are fast and permit corrective measures before a large number of defective parts have been processed.

The plates are reusable indefinitely and cost less than half that of conventional film. No darkroom is required and all operations are performed in the light. No solutions, liquid chemicals, tanks, plumbing, etc., are required since the process is entirely dry.

In operation, an aluminum plate, coated with photosensitive selenium, receives a positive charge which is lost when exposed to x-rays. The x-rays penetrate the specimen as in conventional radiography. The charge on the plate "leaks" away proportionally to the degree of x-radiation. A negatively charged powder adheres to a positively charged area. Density of the powder varies with amount of charge. The image can then be viewed directly, copied on film or transferred to paper. A print can be made by pressing a special paper on a plate by rollers. Powder from the plate is transferred, giving a positive image which is fixed permanently by applying heat. The plate then may be cleaned for reuse.

The X-ray Dept., General Electric Co., Milwaukee 1, Wisc., are manufacturers of this equipment from whom additional information may be obtained.

### New Developments in 16mm Motion Picture Camera Equipments

Enthusiasts of underwater photography will doubtless be pleased to learn of a new Bolex underwater camera available from Paillard Products, 100 Sixth Ave., New York 13, N. Y.

Designed to hold any Bolex H-16 16mm motion picture camera, the case is operable at depths down to 330 feet. The camera can be completely operated from the outside while under water since all essential controls are provided for, including winding, diaphragm setting, and shutter release. The footage counter is visible from the outside. Viewing is done through a parallax corrected gunsight located on the side of the case.

The shutter release can be locked to prevent accidental operation of the camera. Provision is made for a retaining strap on both handles and a lighting unit on the bottom of the case. The case is supplied with a filter to increase the picture contrast in black-and-white filming.

The case is calibrated for any Kern Paillard wide angle lens—Switar 10mm f/1.6, Switar 16mm f/1.8 and Yvar 16mm f/2.8. The Switar 10mm is especially recommended for underwater filming because of the high speed and wide field of view. The case is not calibrated for other make lenses. Retail price of the Bolex Underwater

*(Continued on page 105)*

# New KAY Vari-Sweep

## MODEL IF

CAT. NO. 866

## A Complete Alignment Instrument 4-120 mc

## Sweeping Oscillator • Calibrated Variable-Frequency Oscillator Fixed Crystal-Controlled Markers

The *VARI-SWEEP MODEL IF* retains the advantages of the standard fixed-band alignment unit and adds features which make it a flexible, "universal" laboratory instrument.

1. **It provides for continuously variable center frequency from 4-120 mc with a direct reading, individually calibrated frequency dial.**
2. **It provides for continuously variable sweep widths from kilocycles up to as much as 40 mc.**
3. **It provides a continuously variable frequency marker from 2 to 135 mc, with a separate direct reading, individually calibrated frequency dial. This is a pip type marker combined with the sweeping oscillator output within the unit. No external coupling is required.**

### DESCRIPTION

The sweeping oscillator is an all electronic unit, utilizing variable permeability techniques and operates throughout on fundamental frequency. It provides frequency sweeps, which are flat, wide and linear, and generates enough output voltage (1.0 volt rms into 70 ohms or 50 ohms) to permit the testing of lossy networks without the use of additional amplifiers. The usual errors introduced by broad-band amplifiers can thus be eliminated. The high output also permits the use of adequate padding in applications requiring the feeding of two or more paths. The RF output over the entire range is held constant by a fast acting AGC circuit, maintaining flatness within ± 0.5 db over widest sweep and over tuning range.

The sweeping oscillator covers the band in six, switched, overlapping bands with a direct reading, individually calibrated frequency dial.

For frequencies below 50 mc, the sweep width is continuously variable to at least 60% of the center frequency; above 50 mc, the maximum width is at least 30 mc.

To eliminate the necessity for phasing adjustments, a linear sawtooth voltage, synchronized with the sweeping output, is provided as a horizontal deflection voltage for the scope. The repetition rate of the sweep may be locked to the nominal 60 cps line voltage; or, for hum detection and other tests, varied around this frequency. To insure an accurate, zero voltage reference line on the scope, the sweeping output is blanked during the scope retrace period. The crystal marker circuits utilize quartz crystal filters in producing sharp, stable, pulse-type markers accurate to within ± 0.05% which are fed separately to the scope. The markers are completely isolated from the RF circuits under test and will appear on tr and on sharp slopes and skirts. Up to eleven markers ma selected, usable one at a time or in combination.

The variable marker is generated by a separate CW oscilla which operates at fundamental frequency and covers the ra from 2 to 135 mc in six overlapping bands. A separate individu calibrated, direct reading frequency dial is accurate to ± 1%. T variable marker is a "birdie pip" type of marker easily distingui able from the fixed pulse-type marks. It is available at the sa panel terminals as the fixed markers. A separate level control provided for adjusting the size of the variable marker. All coupli is provided within the unit, the variable marker is complet isolated from the RF circuits under test.

### SPECIFICATIONS

**FREQUENCY RANGE:** 4 to 120 mc, center frequency in six overl ping bands. Fundamental frequency. Direct reading frequency di

**SWEEP WIDTH:** Continuously variable to maximum of at least 30 (above 50 mc) or 60% of center frequency below 50 mc.

**SWEEP RATE:** Variable around 60 cps. Locks to line frequency.

**RF OUTPUT:** 1.0 volt rms into nominal 70 ohms. Output held const to within ± 0.5 db over widest sweep and over tuning range AGC circuit.

**ATTENUATORS:** Switched 20 db, 10 db, and 3 db plus continuo variable 6 db.

**ZERO REFERENCE:** A true, zero reference line is produced on t oscilloscope during display retrace time.

**SWEEP OUTPUT:** Regular sawtooth synchronized with sweeping osc lator. Amplitude approx. 7.0 volts peak.

**FIXED MARKERS:** Up to eleven, pulse-type, crystal-controlled ma ers at customer specified frequencies. Accurate to ± 0.05 %.

**VARIABLE MARKER:** "Birdie pip" marker continuously variable fro 2 to 135 mc in six switched overlapping bands. Direct reading fr quency dial accurate to within ± 1.0%.

**MARKER AMPLITUDE:** Continuously variable from zero to appr 5.0 volts.

**POWER SUPPLY:** Input approx. 180 watts, 117 volts (±10%), 5 60 cps AC. Electronically regulated.

**DIMENSIONS:** 10½" x 19" rack panel. 12" depth. Suitable for ra mounting. Supplied with cabinet—11½" x 20" x 15".

**WEIGHT:** Approximately 50 lbs.

**PRICE:** $950.00 f.o.b. Pine Brook, N. J., including cabinet and full co plement of crystal markers.

For literature and complete details regarding other Kay instruments, write:

**KAY ELECTRIC COMPANY**

**Dept. S-5, 14 Maple Avenue, Pine Brook, N. J., CAldwell 6-4000**

***See us at the Armed Forces Communications & Electronics Convention, May 20-22, Washington, D. C., Booth 46***

e, complete with filter, two diaphragm setting rings l two wrenches, is $600.00.

The other new Bolex item is the H-16 16mm Reflex tion Picture Camera. The outstanding feature of this nera is the reflex system which makes possible viewing l focusing through the taking lens before and during oting. The photographer need only look through eye level view finder to frame his picture, and press starting button to film. The reflex feature allows the st accurate alignment possible at all distances, with lenses, and is especially valuable for titling, special ects, extreme close up cinematography, microcinema-raphy, and absolute framing for all shots.

The image is picked up behind the lens in front of the tter by a semi-reflecting prism, and can then be viewed ht side up and six times enlarged from behind the nera through the eye level focus. The eye level focus equipped with an adjustment for various eyesights. e camera also comes equipped with the standard tameter view finder for use in those cases where an ical view finder might be more desirable.

The Bolex H-16 Reflex, in addition, is equipped with the valuable features of the other H-16 models, such filter slot, automatic threading, full 100 foot rewind, gistrator Claw, frame counter, visible and audible otage counter, etc. Price of the camera with 25 mm itar f/1.4 lens is $535.00.

Another camera item which is sure to attract a great al of attention is the new all-purpose instrumentation mera of the Traid Corp., Encino, Calif. Designated the Traid TN-9 the camera is a modification and aptation of the standard GSAP Bell & Howell N-9 mera. Three basic designs are offered: the TN-9, standard strumentation design; TN-9A, automatic exposure con-ol design, and TN-9B, pulse operated interval design. ptional features available on these cameras include: itomatic exposure control, strip or streak operation, nversion to slow speeds of 12, 24 and 48 fps, conver-on to a single high speed of 100 fps, conversion for e under loads to 100 g's, and conversion for use in ope recording. Timing system, event timer, view finder nd correlation output pulse installation are also avail-ble.

Accessories now being offered include: 100 ft. and 50 magazines, full range of "C" and GSAP mount lenses, pecial camera mounts, boresights, remote controls and olor film as well as black and white.

Another outstanding new arrival in the 16mm motion icture camera field is the spool-loading 240 series cam-ras of Bell & Howell, 7100 McCormick Road, Chicago 5, Ill.

The new cameras are available in single-lens and two-nd three-lens turret versions and feature automatic ilm-threading mechanism; a constant-speed easy wind-ng motor producing a long 32-foot spring run; 100-foot ilm capacity; single-frame; continuous-run lock; and a versatile range of camera speeds including 8, 16, 24, 32 and 48 fps. The camera is of die-cast aluminum construction and is equipped with an adjustable leather hand-strap for steadying the camera during filming. The motor is wound by means of an easy-winding crank which folds back out of the way between windings. The "negator-type" spring affords constant speed throughout the 32-foot run. The "zoom" view finder on the 240A and the 240T models is instantly adjustable to indicate the exact fields covered by lenses having focal lengths from 20mm (about 5/4 inch) to 4 inches. Various lenses, filters and accessories are available.

The Bolex Underwater Camera Case.

### New Paxar Aerial Reconnaissance and Spotting Lens

A new aerial reconnaissance and spotting lens, designated the Paxar, has been announced by the Pacific Optical Corp., 120 South Glasgow Ave., Inglewood 1, Calif. The new lens has a focal length of 24" and a relative aperture of f/4. The lens is magnesium fluoride coated and is a 5-element design conforming to Type I MIL-Std-150. The lens covers a format of 9" x 9" and the optical elements are manufactured with Grade A American optical glass. The mount is cast aluminum alloy and the weight of the lens is 20½ lbs.

### The World's Fastest Films! In Both Color and Black-and-White

A new and exciting development in the world of color photography has just been announced by Ansco, Binghamton, N. Y. The new color film, called Super Anscochrome, is so color sensitive that it can be used to make color snapshots by the light of an ordinary 40-watt fluorescent tube or by the daylight from an open window.

Super Anscochrome has an ASA Index of 100 with normal processing. This speed may be doubled to 200 by increasing the developing time.

The basic exposure for Super Anscochrome is 1/500 second at f/6.3 as contrasted to 1/50 second at f/6.3 for conventional-type color film.

The extreme speed of the new film will, according to a representative of the company, make it easy to take full color pictures of subjects under conditions where color photography has previously been impossible.

With Super Anscochrome Color Film, photographers will be able to use shutter speeds as high as 1/500 and 1/1000 second to stop movement in even the most rapidly moving subjects. Good pictures will also be possible in extremely unfavorable lighting—even in the rain, if the photographer wishes.

*(Continued on page 108)*

# Air-supported fabric antenna provides front-line support in minutes

One hundred and twenty minutes after the site is selected, high-power radar using a new, extremely portable antenna can be scanning the skies. This revolutionary, lightweight antenna has been developed by Westinghouse Electronics Division for the Rome Air Development Center.

The Paraballoon® antenna is blown up like a balloon! It maintains its shape with only slightly more than atmospheric pressure. Two fiberglass paraboloids—one of which is coated with vaporized aluminum—are zipped together to form the 30-foot antenna. In comparison with equivalent conventional antennas, the Paraballoon has shown weight advantages as much as 10 to 1.

The antenna retains its accurate contour no matter how many times it is erected and dismantled, so no contour checking is required in the field.

Major General Stuart P. Wright, Commander of Rome Air Development Center states: "This outstanding development is a major break-through in the design of ground electronics equipment. The air-inflated Paraballoon antenna is the key to a large and truly mobile radar set. It is now possible to employ high-power radars in tactical situations and locations where time and transportability are of utmost importance."

Design and development of advanced electronic equipment are only part of the service available to you from Westinghouse. For complete information about Westinghouse capacity to produce tomorrow's electronic equipment today, contact your Westinghouse sales engineer or write: Westinghouse Electric Corporation, Electronics Division, Friendship International Airport, Baltimore, Maryland. J-02306

**YOU CAN BE SURE...IF IT'S Westinghouse**

In less than one hour, this small crew can assemble the revolutionary Paraballoon antenna from these few parts. They will place the tripod directly on the ground.

Here, the crew has assembled the antenna tripod. With a block and tackle attached to the radome crown piece, they are positioning the antenna base.

The paraboloids are zipped to a two-ply neoprene-nylon tube. This tube forms a stiff arch—the main structural member of the balloon—which holds the inflated antenna in position.

The 30-foot antenna shown here, ready for operation, weighs only 1690 pounds complete with its base and tripod. It will rotate at 6rpm driven by a ¼-hp motor.

Initially, the new Super Anscochrome will be supplied in daylight type only, first in 120 size rolls and later in 20 exposure 35mm magazines.

Not to be outdone, at least in the black-and-white field, Eastman Kodak Co. has just announced the fastest film of all—their new Kodak Royal X-Pan. Designed for use by press, commercial and industrial photographers, the new film is panchromatic, Type B (high green, low red). The manufacturers state that the film is four times faster than Kodak Royal X-Pan when both are given equal development. When development of the new film is forced, even higher ASA ratings may be used as a basis for the new film's exposure. Ratings as high as ASA 8,000 have produced easily printable negatives.

The new film is the result of recent discoveries made by Kodak scientists working on emulsion research.

The grain size is said to be somewhat coarser than in Royal Pan but is finer than would be expected for such a large speed increase. Enlargements up to five or six diameters do not show excessive graininess.

Recommended development is in DK-60a, 6 to 10 minutes at 68 degrees Fahr.

Kodak Royal X-Pan Film is available in sizes 2¼ x 3¼, 3¼ x 4¼, 4 x 5, 5 x 7 and 8 x 10 in 25-sheet packages.

With this array of fast films the photographer will certainly be well equipped to get more and more of those "impossible" shots due to poor lighting conditions and other factors.

## Electronic Photography

An electronic system that takes, transmits and prints color pictures in seconds was predicted by Dr. Irving Wolff, Vice-President, Research, of Radio Corp. of America, speaking before a recent meeting of the Boston section of the American Institute of Electrical Engineers.

The system would consist of a high-speed chain using television pickup, tape recording and Electrofax Printing Process, and would provide permanent prints of pictures taken less than five seconds earlier at points thousands of miles away.

Dr. Wolff pointed out that techniques now exist for performing all steps in the photographic process by instantaneous electronic means "from exposure to final print, and including the means for storing images in electrical form on magnetic tape."

With such a system, a newsworthy event in New Orleans, San Francisco, Chicago or another city might be viewed by a portable television unit carried by a single newsman. The image would be transmitted instantaneously from the portable unit to a nearby relay point for transmission over a closed circuit or network facilities to New York or Boston, where the image could be recorded electronically on magnetic tape as it arrived. The tape recording could provide a motion picture record for instant viewing or later playback and re-broadcast. At the same time, any single section of the tape, corresponding to a single frame of the television picture, could be played back repeatedly at high speed to provide a still that could be printed electronically on paper directly from a special type of television picture tube. In this case, the entire process, from exposure in the distant city to the final print in New York or Boston, would take some seconds.

Dr. Wolff stated that the major elements of such a system already exist in basic form as follows: (1) a compact, light-weight television camera, employing a new ½-inch Vidicon pickup tube and transistorized circuits. While present developmental types are designed for black-and-white television, he stated that portable color cameras incorporating these small components "are certain to appear in the near future;" (2) a magnetic tape system for color television, which makes possible the recording of color or black-and-white signals for immediate or later playback; (3) the R.C.A. "Electrofax" process of high-speed, direct printing by electronic means. Dr. Wolff pointed out that progress will be made in adding color to the "Electrofax" process to achieve color prints on paper. "These comprise all of the elements of a photographic system," said Dr. Wolff. "However, a system employing these electronic steps would be totally novel in its over-all ability to handle motion and color, and to transmit visual information instantly to remote points for high-speed recording."

## Stanford Research Institute High-Speed TV Office Duplicator

An interesting combination of electrophotography and television is disclosed in a recent announcement by the Stanford Research Institute of Menlo Park, Calif. Briefly, the announcement concerns an instrument which is essentially a high-speed office duplicating machine which employs a closed circuit TV network and electrophotography for the reproduction of documents.

The system consists of a transmitter-printer-unit in which the printer, if desired, can be located remotely from the transmitter. The system as designed occupies about the same amount of office space as current office duplicating machines. This is important from the standpoint of mobility and because in most offices, space is likely to be at a premium. In this system, copies are printed directly from the original documents and there is no need for stencils as is required in most office duplicating machines.

At present, the system can duplicate line drawings and the possibility exists, that with further refinements, it can reproduce photographs as well.

In operation, a spot of light 0.006-inch wide scans the document to be reproduced. The light is flashed from left to right across the document at approximately one inch per 30 microseconds. In ⅓ second a total of 17,000 successive beams sweep horizontally across the surface of the sheet.

The scanner receives light reflected from the copy (video signal) and transmits it through a coaxial cable to the receiver, where it is amplified, and then applied to the grid of the cathode ray tube. Immediately, a small electric charge is deposited by means of a wire array in the tube faceplate onto the copy paper. After 17,000 successive scannings, a sufficient number of electrically charged dots is deposited on the paper to form a latent electrostatic image.

As the copy paper is fed past the faceplate, it is dusted with black powder which clings to the charges on the paper's surface and makes the latent (electrostatic) image visible. The powder is then heated and pressed into the paper to form a permanent record.

Conventional TV cameras have been found unadaptable for this system. To fill the gap, the Institute is developing a special camera to transmit a signal of the sharpness desired in reproduced copies.

At the present stage of development, the machine prints the text from a 35-mm film onto a ¾-inch wide tape. Proposed equipment modifications will enable duplication on 8½ x 11-inch sheets of paper.

* * *

# Association affairs

## SPECIAL APPRECIATION

We wish to express our appreciation to Mr. William Robinette and Mr. Lynn Anderson of Washington, D. C., Mr. John Ferguson, Monumental Printing Co. of Baltimore, Md., and Wm. C. Copp & Associates, N. Y., for their help and assistance with the 1957 AFCEA Convention.

Special recognition is due the following committee chairmen:

Social Committee—John Gilbarte; Ladies Program—Mrs. Frances Engel; Publicity—Roland Davies; Technical Sessions—Francis Engel, and Transportation & Tours — George Sheets.

## HONOR GRADUATE AWARDS

Honor graduates at the Signal School, Fort Monmouth, N. J. were recently presented with the AFCEA Award for outstanding scholastic achievement.

Five of the officers were enrolled in the Signal Officers Basic Course. They were:

Section 724 — Second Lieutenant Leland C. White of Rabb Road, La Feria, Texas, who is a graduate of Texas A & M College.

Section 725 — Second Lieutenant Lynn W. Craig of 2208 Laurel Ave., Knoxville, Tenn. He studied engineering at the University of Tennessee.

Section 726 — Second Lieutenant Frank S. Young, 2022 Aldo Circle, Salt Lake City, Utah. He studied at Stanford University.

Section 727 — Second Lieutenant Carleton K. Sherman, 3300 Wentwood, Dallas 25, Texas, who studied at Agricultural and Mechanical College of Texas.

Section 728 — Second Lieutenant Fred L. Adams, 47 East Third St., Morrestown, N. J., a graduate of Rutgers University.

Second Lieutenant Harry S. White, Jr. of 108 North Pike St., Grafton, West Va., and a graduate of West Virginia University, scored highest academically in the Signal Supply Officer Course, Section 931.

In the Microwave Radio Officer Course, Second Lieutenant David W. Klinge of 1503 Stoughtin Ave., Tomah, Wisc., took the number one spot. Lt. Klinge studied at Purdue University.

## Introducing AFCEA's New Group Member

The AFCEA welcomed Hallamore Electronics Co., of Anaheim, Calif., as a group member in March. Hallamore is a relatively new company, intensively engaged in military contract work.

The members of the firm who will be company representatives in AFCEA are: L. G. Hallamore, President; P. Eastman, Assistant Vice President; Leo Johnson, T. Prouty, C. L. Ambler, D. McCray, J. Carl, R. F. Bruce and E. E. Eiler, all Supervisors, and John J. Burke, Vice President in Engineering.

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Enclosed find $________ for annual dues for AFCEA membership, which includes subscription to the monthly magazine SIGNAL.
DATE: ________ SIGNATURE: ______________

# AFCEA Group Members

## Communications—Electronics—Photography

***Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.***

Admiral Corp.
Air Associates, Inc.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Berkshire Transformer Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Compagnie Francaise Thomson-Houston
Convair, Division of General Dynamics Corp.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
Dukane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Hallamore Electronics Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co.
Haloid Co.
Hammarlund Manufacturing Co., The
Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
Hoover Electronics Co.
Hopkins Engineering Co.
Hughes Aircraft Co.
Hycon Eastern, Inc.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Business Machines
International Resistance Co.
International Telephone & Telegraph Corp.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.
Kin Tel
Koiled Kords, Inc.
Lansdale Tube Co., Division of Philco Corp.
Leich Sales Corp.
Lenkurt Electric Co.
Lens Electric Manufacturing Co.
Lewyt Manufacturing Corp.
Librascope, Inc.
Loral Electronics Corp.
Machlett Laboratories, Inc.
Magnavox Co.
Maida Development Co.
Mallory, P. R., & Co., Inc.
Materiel Telephonique Co.
Merit Coil and Transformer Corp.
Michigan Bell Telephone Co.
Microwave Associates, Inc.
Montgomery Co., The
Motorola, Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co.
Mycalex Corporation of America
National Co., Inc.
Nelson Technical Enterprises
Nems-Clarke, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
New York Telephone Co.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Otis Elevator Co., Electronic Division
Pacific Mercury Television Mfg. Corp.
Pacific Telephone & Telegraph Co.
Packard-Bell Co.
Page Communications Engineers, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Production Research Corp.
Radiart Corp.
Radio Condenser Co.
Radio Corporation of America
Radio Corporation of America, Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Radio Receptor Co.
Raytheon Manufacturing Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Remington Rand, Division of Sperry Rand Corp.
Remler Co., Ltd.
Rocke International Corp.
Saxonburg Ceramics
Society of Motion Picture & Television Engineers
Sonotone Corp.
Soundscriber Corp.
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
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Sprague Electric Co.
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Standard Telephone & Cables, Ltd.
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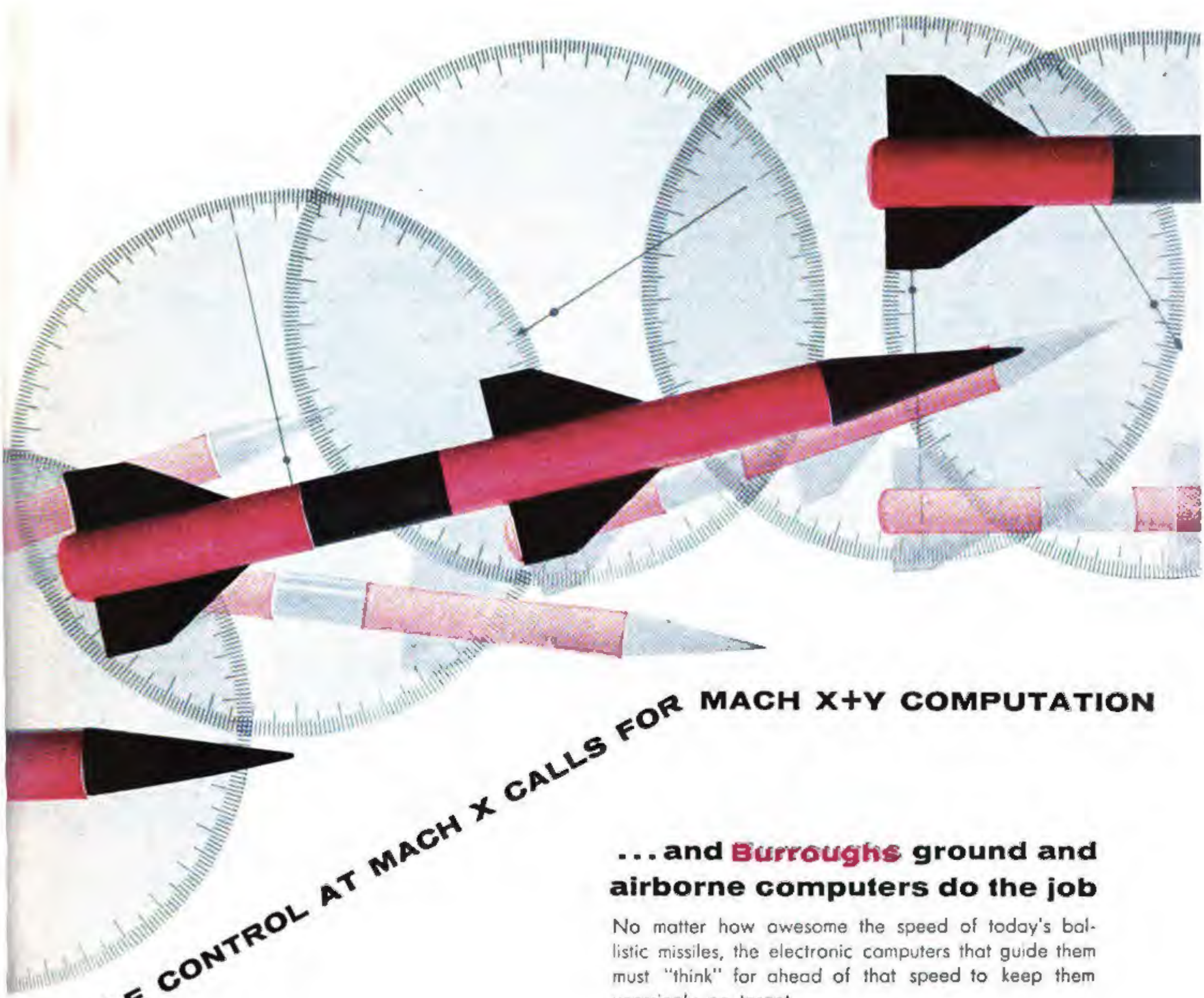

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"Sidewinder" is the Navy's newest air-to-air guided missile. Flight tests have proved the missile to be as vicious as the desert rattlesnake for which it was named.

In brilliant performances against airborne targets at China Lake, "Sidewinder", Navy's new air-to-air guided missile, has captured the attention of the entire missile industry.

Simple in operation, small and light enough to be carried in quantity by single-seat Interceptors, "Sidewinder" can be fired singly or in salvos. It requires no complex launching system or special pilot training, and it maneuvers deftly at supersonic speeds. The missile displays extremely high single-shot accuracy —and even more important, *it can be launched well beyond reach of the target aircraft's defense.*

"Sidewinder" was developed by the Naval Ordnance Test Station of the Navy Bureau of Ordnance at China Lake, California. Philco assisted NOTS in the research and development program, and performed the subsequent engineering required for manufacture of the missile. "Sidewinder" is *now in full production at the Philco Government and Industrial Division.*

Philco is proud to have made this important contribution to the development of more effective electronic systems for our national defense.

***Engineers: At Philco your opportunities in research and engineering are unlimited.***

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# Chapter News

## *Atlanta*

Major General James D. O'Connell, Chief Signal Officer of the Army, was guest speaker at the chapter's March 27th dinner-meeting held at the Fort McPherson Officers' Club. The subject of his address was "The Army in the Missile Age."

Citing the chapter and the Association, General O'Connell said: "I particularly welcome this opportunity to come here and talk to the Atlanta Chapter. This chapter, only nine years old, and with its over two-hundred members, has had a very vigorous growth. It is the up-to-date model of a parent organization that goes back almost 100 years. The vision, imagination and activity going on here is the happy result of this century of success. Up through the years, men of energy and drive have served this organization by giving freely of their vision and talent."

With "The Army in the Missile Age" as his topic, the General stated: "Your Army is well into the age of missiles. Key cities throughout the United States are being guarded by missiles tonight. Other Army missiles capable of carrying either atomic or high-explosive warheads are deployed with our troops in Europe and in the Far East. . . .

"The forward thinking in today's Army is not characterized by missiles alone. I might say that missiles are, in a dramatic way, symbolic of our continued emphasis on maintaining superiority over our potential enemies. We must have superior weapons to give us maximum deterrent effect and to leave no doubt in the Communist mind that he will be faced at all points by greater technical skill, productive capacity and determination than he can possibly muster."

General O'Connell illustrated his talk with films of various new types of equipment which the Army has or which are being developed.


Atlanta—Maj. Gen. James D. O'Connell, Chief Signal Officer of the Army, who addressed the March meeting, is shown with Chapter President Charles M. Eberhart and Maj. F. E. Werehime, Jr., of the Air Defense Command, Georgia Coordinator, Ground Observer Corps.

## *Baltimore*

A tour of the Maryland Air National Guard Headquarters at Harbor Field featured the chapter's February 26th meeting. Major J. Considine was host for the occasion.

During the tour, the chapter members and guests visited the briefing room, the maintenance shop, and inspected a C-47 and its modern aircraft communications system.

The group also were shown a film on the AACS, covering the development of air waves and air communications systems throughout the world, and "It's Your Decision," an animated film on the Armed Forces Industry Defense System, portraying the part industry plays in national defense.

On March 19th, a dinner-meeting was held at the Chesapeake and Potomac Telephone Company. Mr. Robert B. Alexander, Assistant Projects Manager, Engineering, Project 572, Defense Projects Division of the Western Electric Company, was the principal speaker.

Mr. Alexander discussed the DEW Line Project, with which he has been closely associated for the past two years, and showed a color film which gave a vivid portrayal of the problems encountered and solved in the construction of this radar net.

At the conclusion of the program, Mrs. Barkdoll, Chesapeake & Potomac Telephone Company hostess for the evening, conducted a tour of the telephone switchboards and a home planning center display.

## *Boston*

Meeting at the Harvard College Observatory on March 28th, the chapter heard a trio of experts from the Smithsonian Astrophysical Observatory in Cambridge tell how to watch and take pictures of a 20-inch satellite 300–1000 miles away as it races around the world at speeds faster than 18,500 miles per hour. The speakers also disclosed progress in coordinating 1500 volunteer astronomer watchers as they partake in the "Operation Moonwatch" phase of the satellite program.

Heading the speakers was Dr. Fred L. Whipple, director of the Observatory, who spoke on "The United States International Geophysical Year Earth Satellite Program." Assisting him were


Arizona—Shown during a recent meeting are, left to right: Maj. Gen. Emil Lenzner, Commanding General, USAEPG, Fort Huachuca; Col. Kirk Buchak, chapter president; and Dr. H. R. J. Grosch, computer division, General Electric Company, the principal speaker.

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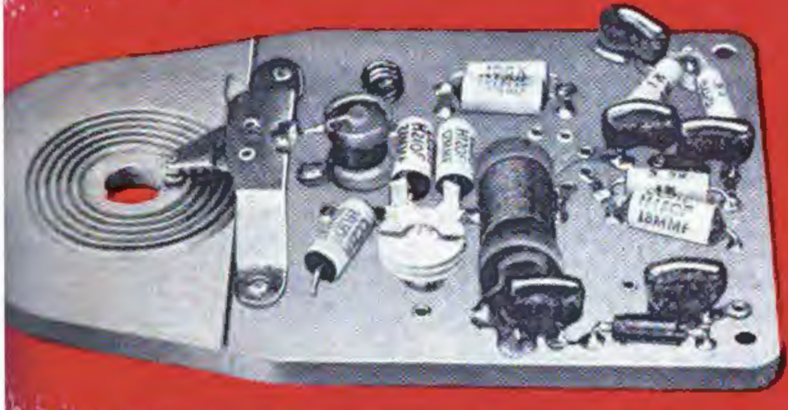

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Boston—Dr. Fred L. Whipple, director, Smithsonian Astrophysical Observatory, holds model of designed camera-telescope to be used during IGY and which illustrated his talk at the March meeting. Looking on, left to right, are: Fred E. Moran, chapter president; Dr. Don A. Lautman of the Observatory; and Capt. A. R. Taylor, program chairman.

Dr. J. Allen Hynek on "Communication Requirements for the Satellite Station Network," and Dr. Don A. Lautman who reviewed "Computing for the IGY Satellite."

A major problem facing the Observatory in its quest to photograph the hurtling sphere will be how to pinpoint its position in time and space. More than 70 teams in the United States will try to glimpse the image as it streaks across the country in less than 10 minutes.

Data from these teams, as well as from 30–50 more stationed throughout the globe, will be relayed into central headquarters at Cambridge where an electronic computer will supply predicted satellite positions to be pointed at by special camera-telescopes to be located at 12 sites around the world.

Dr. Whipple, Observatory director, was in charge of developing "Window," a confusion reflector used as a radar countermeasure in World War II. He has received the Donohue Medals for the independent discovery of six new comets, and the J. Lawrence Smith Medal of the National Academy of Sciences for research on meteors in 1949. He is the author of the book, "Earth, Moon and Planets" as well as other papers in these fields.

Dr. Hynek, associate director of the Observatory, is in charge of the earth satellite optical tracking program, and Dr. Lautman is in charge of satellite computations for the Observatory.

### Chicago

Mr. W. C. Hasselhorn, President of the Cook Electric Company, was host to the chapter at a meeting held on March 14th at the Lake Shore Club.

Diversified subjects featured the evening's program. The speakers were: Dan Shevelenko, division manager, Diaphlex Division, who discussed color films on switches and relays; Charles Flubacker, technical assistant to the president, "The Morton Grove Technological Center;" George Brown, business manager, Inland Testing Laboratories, "Reliability Testing;" and George C. Payne, field office manager, U.S. Department of Commerce, Chicago, "Commerce Aids to Industry."

A record number of members and guests turned out for the meeting and the social hour and dinner which preceded it.

### Fort Monmouth

Dr. R. D. Shelton of the Radiation Physics Department of the Admiral Corporation gave a talk on "The Effects of Nuclear Radiation on Electronic Components" at the chapter's March 26th dinner-meeting at Gibbs Hall Officers' Club.

The component types discussed and presented in color slides of before and after effects, included vacuum tubes, resistors, capacitors and semi-conductor devices. An analysis of the mechanisms of damage was presented with the experimental data.

The meeting was presided over by A. William Christopher of Sylvania Electric Products, Inc., chapter vice president.

### Kansas City

Mr. John T. Naylor, president, United Telephone Company of Missouri, addressed the chapter's March 6th dinner-meeting at the Wishbone Restaurant.

Mr. Naylor, who served as president of the Philippine Long Distance Telephone Company from 1950-1956, related some of his experiences in rehabilitating the telephone system in the Philippines following World War II. Included in his presentation were some of the strange customs associated with telephony in some of the Oriental countries.

### Korea

The Minister of Communications of the Republic of Korea, Mr. E. J. Lee, was the principal speaker of the chapter's February 21st dinner-meeting at the "Kimchi Copa" Officers' Club of the 304th Signal Battalion. Also in attendance were Mr. H. H. Choi, Vice Minister of Communications, Republic of Korea; Col. S. K. Kim, Chief Signal Officer, ROK Army; Mr. A. J. Allen, advisor to the ROK Ministry of Communications, and James Ramsey, president of AFCEA's Tokyo Chapter.

During the business session, the annual election of officers took place, with Col. Walter E. Lotz, Jr., Signal Officer of the Eighth Army, chosen to head the chapter. Other officers elected were: first vice-president—William L. Wardell, Chief of Communications, Office of the Economic Coordinator, Republic of Korea; second vice-president—Col. C. W. Janes, Senior Signal Advisor, U. S. Army Advisory Group; third vice-president—Col. J. W. Grant, Signal Officer I Corps (Group); secretary-treasurer—Wendell B. Carman, Signal Corps contractor technician on duty with KMAG.

In introducing Minister Lee, Colonel Lotz announced that the Minister had become an associate member of AFCEA and officially welcomed him into the Association.

Prior to his discussion of communications problems in his country, Minister Lee expressed his gratitude for the opportunity of addressing so many communicators and his hope that through such an organization closer relationships between the people of the world would be established.

Among the ninety members and guests present were delegations from the Republic of Korea Ministry of Communications, the OEC, and the U. S. Armed Forces.

Chicago—Mr. W. C. Hasselhorn, president of Cook Electric Company, was host to the chapter's March meeting. Appearing with him are Arthur J. Schmitt, president of Amphenol Electronics Corp., at left, and Chapter President Raymond K. Fried.

### Lexington

The work of the Nucleonics Laboraory at the Lexington Signal Depot was discussed at the March meeting of the chapter by Phillip G. Jackson, nucleonics scientist at the Lexington Signal Depot.

In his talk on "The Atom Comes to he Bluegrass" he discussed various aspects of the nucleonics operations at he Depot which is the only laboratory or the processing of film badges for he Army.

The laboratory at the Signal Installaion tests all photo-film badges worn by all Department of Defense persons who work with radioactive materials. A photographic film badge records the amount of radiation the body of the wearer has absorbed. The badges are ent to the Lexington Laboratory each week from military installations in the United States and Overseas. Approximately 20,000 films are processed each month. Within two days after receipt of the film from the user, a report with recommendations, particularly if the radiation absorption rate is considered dangerous, is sent to the Installation where the badges were received for test.

Mr. Jackson also spoke on radioogical defenses, radiological safety and he probable results of a hydrogen bomb attack in this area.

The program also included "Operaions Ivy," a 28 minute movie depictng hydrogen bomb tests in the Pacific Testing Area, demonstrations of skills and techniques of photo-dosimetery detection and evaluation.

### London

Visits to plants of two foreign associate group members of the AFCEA featured the January and February activities of the chapter.

The Plessey Co., Ltd., was host at its main works at Ilford on January 16th. Messrs. W. W. Clark and John A. Clark, directors of Plessey, welcomed the chapter members and guests.

A tour of the works covered the following: C42 and vactric shop; components division M/c shop; equipment division M/c shop; tool room; radio and TV assembly shop; loudspeaker assembly shop; aircraft division M/c shop; electronics development laboratory; telephone assembly, and vibrator shop. A display of Plessey products was viewed at the conclusion of the tour.

Dinner speaker was Mr. M. W. Clark who discussed the origin and growth of The Plessey Company and outlined future developments.

Mullard, Ltd., was host to the chapter at Mullard House, its new headquarters at Torrington Place, London, on February 14th. Talks by Mr. S. S. Eriks. O.B.E., Mullard managing director and Mr. T. E. Goldup, C.B.E., director of Mullard and a vice president of the chapter, acquainted the AFCEA group with the background of the host company and its research and development program.

Demonstrations of various electronic techniques (including products not yet commercially available) were presented as follows: automatic broadband measurements at X-band; multi-cavity Klystron as a stable source at X-band; communications equipment; high-brightness cathode ray tube; transistorized AM and FM radio sets; power transistors driving a Ferrite Memory; transistor oscillator workiug at 100°C; avalanche transistor; transistor transmitter; transistor D.C. converter; transistor shift register; transistorized oscilloscope; precision pulse oscilloscope; precision pulse generator, and ultrasonic machining.

In addition, the group saw one of U.K.'s science films produced by countries of the Western European Union—"Mirror in the Sky."

The Hurlingham Club in London was the scene of the chapter's annual ladies' night on March 14th. Business was dispensed with and the evening was devoted to a social hour, dinner and dance. Major Russ C. Foss, chapter secretary, officiated as toastmaster.

Special guests were: Maj. Gen. and Mrs. G. H. H. Vulliamy, honorary life member of the AFCEA; Lord and Lady Glanusk, Mullard, Ltd.; and Cdr. and Mrs. C. G. Mayer, managing director, RCA Great Britaiu, Ltd., and a past

(*Continued on page* 120)

Fort Monmouth—Pre-dinner gathering at March meeting. Seated, left to right, William Christopher, first vice-president of the chapter; Dr. R. D. Shelton, Admiral Corporation, the guest speaker. Standing, left to right, Brig. Gen Stuart S. Hoff, commandant, The Signal School; Lt. Col. Mervin C. Bowers, chapter secretary; and Brig. Gen. Earle F. Cook, commander, Army Signal Engineering Laboratories.

Korea—Col. Walter E. Lotz, Jr., chapter president, greets Mr. E. J. Lee, Minister of Communications of the Republic of Korea, who addressed the February meeting. Others pictured are, left to right: Col. O. G. Buser, Deputy Signal Officer, EASCOM; Col. S. K. Kim, Chief Signal Officer, Republic of Korea; Col. J. W. Grant, Signal Officer, First U. S. Corps; Col. C. W. James, U. S. Army Advisory Group; A. J. Allen, Communications Advisor, O.E.C.; H. H. Choi, Vice Minister of Communications, Republic of Korea; W. L. Wardell, Chief Communications, O.E.C.

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Other distinguished developments by resources of IT&T companies include: VOR, DME, Navascreen, Navarbo, VHF Airport Radio Direction Finder, automatic weather "typewriters" for transatlantic planes (serving the new weather reporting

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stem called Narcast) . . . and now more recently, acan (Tactical Air Navigation) installed in U. S. ilitary planes and scheduled for integration in the ation's common civil air navigation system known s Vortac . . . as well as Over-the-Horizon microwave inks and Tacan Data Link, an important tool for peeding the flow of air traffic; guidance systems nd electronic countermeasures.

These are but a few of the outstanding contribu-ions of IT&T research, development and manufacturing facilities in the United States. Many more will come as IT&T scientists and engineers continue their task of unlocking the secrets of this atomic, electronic and supersonic age . . . bringing new strength to our country as a mighty and growing force for international peace.

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president of the chapter.

### *Louisiana*

A color television broadcast of Kraft Theatre at the Walther Bros. Auditorium featured the chapter's March 27th meeting.

Mr. C. C. Walther, past president of the chapter, was host to the AFCEA group. A cocktail hour and buffet supper preceded the evening's program.

### *New York*

"White Alice," the communications project that when completed will connect thirty-three Air Force sites throughout Alaska, was the subject of the March 27th dinner-meeting at the Belmont Plaza Hotel. The program was presented by Lt. Col. John D. Crisp, Chief of the White Alice Project.

Colonel Crisp described the system, which employs microwave radio relay and tropospheric scatter, and stated that eventually it will cover 3300 route miles and 170,000 telephone circuit miles.

He reported that the third link of the White Alice Alaskan communications system was officially opened on March 30th and that the completed segment of White Alice now covers a distance of 368 route miles, making use of two tropospheric scatter stations and seven microwave relay stations. The entire cost of the project is expected to be in excess of $130 million. Installation and cost of electronic equipment at each of the 33 sites is approximately $2 million.

In describing some of the equipment, Colonel Crisp stated that extreme ice and snow conditions necessitate the use of three oil furnaces in each parabolic tropospheric antenna, with each furnace capable of 500,000 BTU's to melt ice formations.

London—Mullard Ltd. (AFCEA group member) was host to the chapter for its February meeting. Left to right are: Capt. E. F. Metzger, USN, chapter president; Mr. S. S. Erik, managing director, Mullard Ltd., and Mr. T. E. Goldup, Director, Mullard Ltd., both of whom addressed the meeting.

When completed, White Alice will be a vital part of the continent's air defense enabling combat centers of the Alaskan Air Command to receive reports of aircraft detected by the DEW Line, north of the Arctic Circle. Because of its ability to carry many messages and conversations at the same time, the new communications network will also serve Army and Navy installations, the CAA and the people of the Territory.

### *Northwest Florida*

Col. R. B. H. Rockwell, Director of Communications – Electronics, Air Proving Ground Command, was elected president during the chapter's recent annual elections. Formal installation of the new officers took place at a meeting on March 21st.

The other new officers are: vice-president—Lt. Col. Blair Baylor, USAF (Ret.); treasurer—Maj. William F. Brown, APGC; and secretary—Capt. Edmund G. Forkner, APGC.

### *Paris*

The chapter held a dinner-meeting at the Cercle Militaire on March 22nd. The acting president, Arian H. de-Geode welcomed several distinguished visitors including Rear Admiral Joseph N. Wenger, USN, Director of Communications and Electronics, The Joint

(*Continued on page* 122)

Lexington—The Nuleonics Laboratory of the Lexington Signal Depot presented the program of the March meeting. Pictured around a film densitometer, which was part of a display of nuclear detection equipment, are, left to right: Phillip Jackson, nucleonics scientist, who was the principal speaker; Maj. K. J. Holmes, chapter president; William C. Jordan; Michael Keller, chapter secretary; John W. Davis; John Roche; and Raymond Soard, chapter vice president.

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- **Adaptable to Any Speed:** low-pass filter & frequency-determining elements are plug-in units.
- **Completely Self-contained:** includes power supply and line battery.
- **OTHER OUTSTANDING FEATURES:**
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| **Input Keying Signal Requirements:** | (1) Neutral keying, positive or negative sense<br>(a) on-off 60 ma pulses<br>(b) on-off voltage pulses 10-100V into 100K ohms<br>(2) Polar keying<br>(3) Dry contact keying |
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| **Output Distortion:** | (a) Signal bias distortion less than 0.5%<br>(b) Signal element random jitter less than 1%<br>(c) Signal history (duty cycle) distortion less than 0.5%<br>(d) Total distortion less than 2% |
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Annual elections were held and placed into the presidency, Brig. Gen. Frank W. Moorman, U.S. Army Attaché, France, with other new officers as follows:

Vice-Presidents—Maj. Gen. E. Blair Garland, Chief Signal Officer, SHAPE; Rear Admiral Frank Virden, Director, Communications—Electronics, USEUCOM; Mr. Alexander deBondini, Vice-President, International Automatic Electric Company. Honorary Vice-Presidents—Dr. E. M. Deloraine, Technical Director, International Telephone and Telegraph Company; Mr. G. Rabuteau, Managing Director, Le Materiel Telephonique Company; Mr. Maurice Jean, Director, Group Electronic Company Francaise Thomson-Houston; General de Division Charles Bobet, Chief Signal Officer, Allied Forces Central Europe.

Directors—Col. Charles M. Baer, Chairman, European Military Communications Coordination Committee; Col. Arian H. deGeode, Manager of International General Electric Company; Col. William E. Heltzel, Chief Signal Officer, Allied Land Forces Central Europe; Col. Ross T. Sampson, Allied Air Forces Central Europe; Lt. Col. Estell S. Thurston, Headquarters, Signal Officer, SHAPE; Mr. Joseph R. Pernice, European Manager, Collins Radio Corporation.

Secretary-Treasurer—Lt. Col. Charles E. Harrison, Assistant Military Attaché, Paris, France.

Following the business session, Mr. Pierre Chouipe of the Services d'Expansion Technique of Kodak-Pathe Company presented a lecture on "Color Photography." This included information on types of film, lighting, portrait posing, filters and other technical aspects of color photography. Mr. Chouipe's talk was supplemented with color slides and a live model for demonstrating various techniques. Members were invited to bring their cameras and receive expert technical advice on any of their photographic problems.

London—Chapter members were guests of The Plessey Co., Ltd., (AFCEA group mem at its main works at Ilford in January. Shown above, left to right, are: Capt. F. C. B. Jor USN, chapter vice president; Mr. M. W. Clark, director, Plessey Co., Ltd., guest spe Chapter president E. F. Metzger and Mr. John Clark, director, Plessey Co., Ltd.

### Philadelphia

On February 20th, the chapter met jointly with the professional group chapters of the Institute of Radio Engineers and the Franklin Institute. The subject, "The SAGE System and its Implementation," was presented by Brig. Gen. Stanley T. Wray, USAF, Chief of Electronics Defense Systems Division in New York, and Robert Bright, Jr., Superintendent, Systems Engineering, ADES, Western Electric Company, Inc., New York.

The speakers described the development of the system, explained its functioning and outlined how the Air Force, the Western Electric Company and many other manufacturers have teamed up to implement the system as rapidly as possible. Slides were used to illustrate the talk.

The meeting was held at the Fra lin Institute following a reception a dinner. Toastmaster for the eveni was Brig. Gen. J. Harry LaBru national director of the AFCEA.

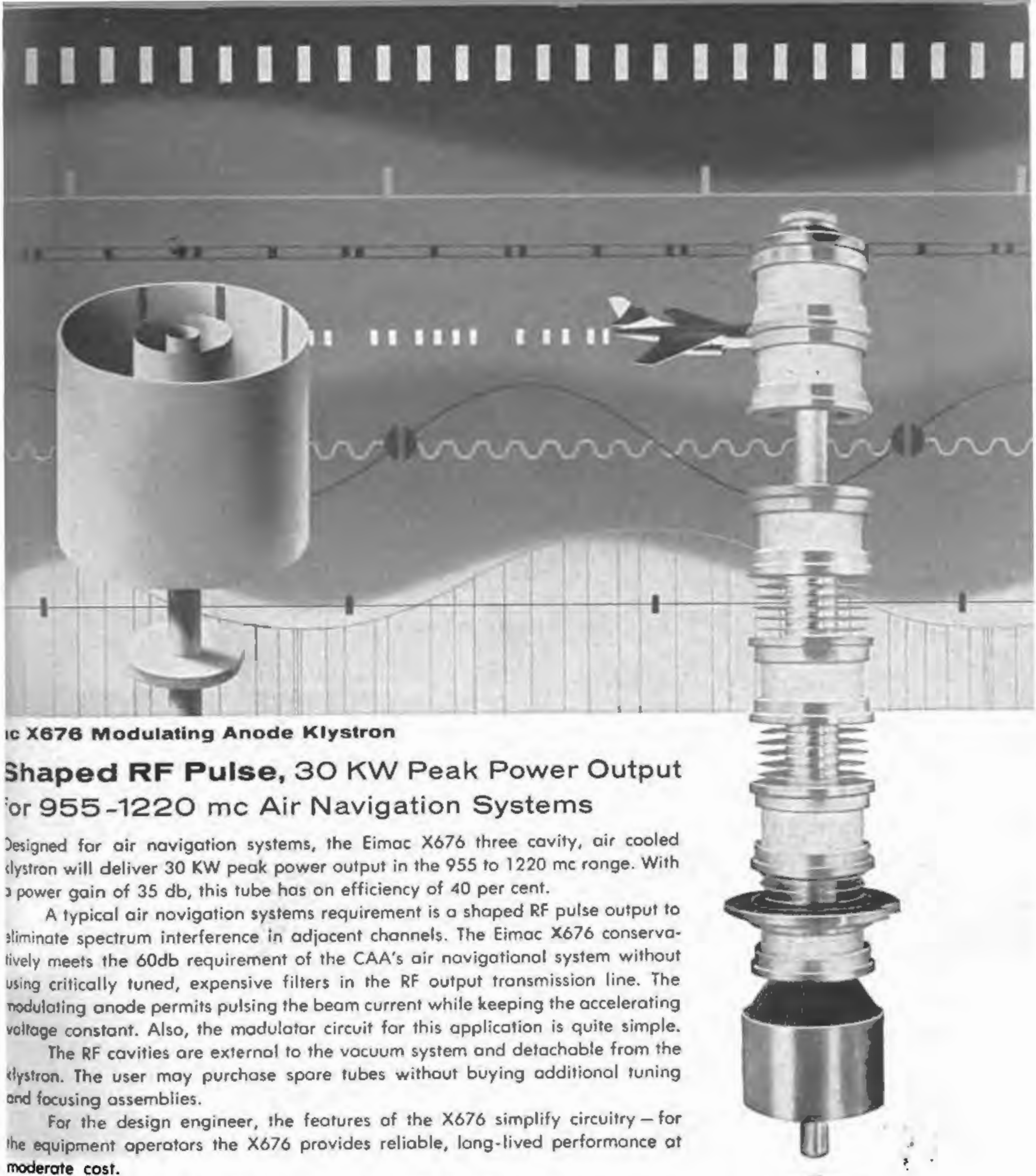
### Pittsburgh

The Pittsburgh Chapter also held a joint meeting on the subject of "SAGE." Co-sponsors were the American Institute of Electrical Engineers and the Institute of Radio Engineers, with the meeting held at the Mellon Institute on February 18th.

Featured speakers were Brig. Gen. Stanley T. Wray, USAF, Chief of Electronics Defense Systems Division in New York, and Ernest W. Baker, Assistant Project Manager, Engineering, ADES, Defense Projects Division, Western Electric Company. Their combined presentation, illustrated with slides, gave a comprehensive account of the civilian and military aspects of the development and operation of the SAGE System.

(Continued on page 124)

Paris—Guests and newly elected officers pictured at a meeting at the Cercle Militaire in March. Left to right: M. Pierre Chouipe, Paris office of Kodak-Pathe, guest speaker; Lt. Col. Estell Thurston, Hqs. Signal Officer, SHAPE; Lt. Col. Charles Harrison, Asst. Military Attache, Paris, secretary-treasurer; Rear Adm. Frank Virden, Director of Communications-Electronics, EUCOM, 2nd vice president; Mr. Arian de Geode, manager of International General Electric, director; Brig. Gen. Frank Moorman, U. S. Military Attache, Paris, president; Rear Adm. Joseph N. Wenger, Director, Communications-Electronics, The Joint Chiefs of Staff, a former vice president of the chapter; Col. Charles Baer, Chairman, EMCCC, director; Dr. E. M. Deloraine, Technical Director of IT&T, honorary vice-president; and Col. William Heltzel, Chief Signal Officer, LANDCENT, director.



**ic X676 Modulating Anode Klystron**

## Shaped RF Pulse, 30 KW Peak Power Output For 955-1220 mc Air Navigation Systems

Designed for air navigation systems, the Eimac X676 three cavity, air cooled klystron will deliver 30 KW peak power output in the 955 to 1220 mc range. With a power gain of 35 db, this tube has an efficiency of 40 per cent.

A typical air navigation systems requirement is a shaped RF pulse output to eliminate spectrum interference in adjacent channels. The Eimac X676 conservatively meets the 60db requirement of the CAA's air navigational system without using critically tuned, expensive filters in the RF output transmission line. The modulating anode permits pulsing the beam current while keeping the accelerating voltage constant. Also, the modulator circuit for this application is quite simple.

The RF cavities are external to the vacuum system and detachable from the klystron. The user may purchase spare tubes without buying additional tuning and focusing assemblies.

For the design engineer, the features of the X676 simplify circuitry — for the equipment operators the X676 provides reliable, long-lived performance at moderate cost.

**For further information about the Eimac X676 Modulating Anode Klystron, consult our Application Engineering Department. Also available are two highly informative booklets; "The Care and Feeding of Klystrons" and "Klystron Facts . . . Case Four".**

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***Eimac First* in high power amplifier klystrons**

Eimac

**Typical Pulse Operation X676**

| | | | | | |
|---|---|---|---|---|---|
| DC Beam Voltage | 24 KV | Power Output | 32 KW | Power Gain | 35 db |
| DC Beam Current | 3.3 Amps | Driving Power | 10 watts | Average Power | 1 KW |
| Power Input | 80 KW | Efficiency | 40% | | |

# CHAPTER NEWS

On March 29th, Copperweld Steel Company's Wire and Cable Division at Glassport played host to approximately 140 chapter members and guests. The group was welcomed by Mr. F. E. Leib, Manager of Sales of Copperweld Steel.

## *Rocky Mountain*

A chapter meeting was held on February 21st at the famous Antlers Hotel in Colorado Springs. Attendance at the combined banquet and meeting totaled 109 members and guests.

Mr. P. B. Reed, Vice President-in-charge of Government Service Department of RCA Service Company of Camden, New Jersey, was the main speaker of the evening and presented a program on the missile tracking facilities at Patrick Air Force Base, Florida. The program included color slides, a color film on all phases of missile testing procedures and actual films of the firing of many types of Air Force and Army missiles.

Distinguished guests at the meeting included Lieutenant General and Mrs. Atkinson, Commander of Air Defense Command; Major General and Mrs. R. H. Lynn, Vice Commander, Air Defense Command, and Brigadier General and Mrs. Haskell E. Neal, Deputy for Communications and Electronics, Headquarters CONAD and first president of the Rocky Mountain Chapter.

## *Sacramento*

Captain Les Williams of the California Highway Patrol was the featured speaker at the March meeting of the chapter, held in the Sacramento Signal Depot Officers' Club.

Captain Williams spoke on "The Communication System of the Highway Patrol," explaining how an "All Points Bulletin" from headquarters reaches the patrol officers.

Darrell J. McConnell of United Air Lines, also participated in the program, showing a short color film on Hawaii.

## *San Francisco*

On March 28th the Navy Department was host to the chapter. Following a social hour and dinner held at the Treasure Island Officers' Club, 150 members and guests boarded the Navy Picket Ship, the USS "Scanner" (YAGR-5). Her Captain, Lt. Cmdr. H. H. Pruett, welcomed the group at the ship's social hall and gave a comprehensive talk on the role played by the Picket Ships in the USAF reconnaissance operations.

San Francisco—Capt. E. B. Patterson, USN, Director of Communications, Western Sea Frontier and a chapter director, speaking before the March meeting which was sponsored by the Navy.

The tour through the ship included inspection of the CIC and radio communications quarters. Here officers on Cmdr. Pruett's staff gave detailed explanations of the operation of the radar and radio equipment, and told how reconnaissance information is processed and relayed to shore stations.

A visit to the ship's brigade and living quarters was also made part of the tour.

## *Scott-St. Louis*

Major General Edward H. Underhill, Vice Commander, Headquarters Air Training Command, addressed the March 1st dinner-meeting held at Augustine's Restaurant in Belleville.

General Underhill discussed his experiences and observations as a member of the Military Armistice Commission in Korea, which met with the Communists to settle details of the armistice at the end of the conflict. He elaborated upon the differences in background and thinking which must be understood before they can be effectively counteracted.

One hundred and ten members and guests were in attendance.

South Texas—Featured speaker at the March meeting was Col. J. Francis Taylor, Jr., Commander, 1800th AACS Wing, Tinker AFB. Shown with Colonel Taylor (center) are Stephen H. Simpson, Jr., chapter director and past president, at left, and Col. Albert H. Snider, USAF, chapter president, at right.

## *South Texas*

The chapter's March 21st meeting at Randolph Field Officers' Club was addressed by Colonel J. Francis Taylor, Jr., Commander of the 1800th AACS Wing at Tinker Air Force Base, who presented an authoritative talk on the problems encountered in the use of radio navigational aids by aircraft flying at very high altitudes.

Not only does a jet pilot at high altitudes run into interference problems from signals located several hundreds of miles apart, Colonel Taylor said, but the characteristics of signals from radio beacons and beams change at high altitudes. As he went on to explain, when a jet aircraft at high altitudes flies through the leg of a radio range, it tends to push the leg ahead, so that instead of being over a known location on the ground, the aircraft is actually several miles farther along on its course. This has caused considerable confusion and a problem to the air traffic controller when he attempts to plot the course of an aircraft making position reports to him while flying at high altitudes.

Scott-St. Louis—Maj. Gen. Edward H. Underhill, Vice Commander, Headquarters, Air Training Command, Scott Air Force Base, addresses the March meeting. Also shown is Elmer J. Weber, Southwestern Bell Telephone Co., chapter vice president.

The speaker also pointed out the problem of flight checking navigational aids at high altitudes. Flight checks on radio facilities are normally performed in good weather with the pilot being able to determine his position over a known location on the course by visual means. Flight checking at 40,000 feet is considerably more difficult because of the more limited time when the weather is clear from the ground to 40,000 feet, and because it is much more difficult to locate the exact position of an object at extremely high altitudes.

Colonel Taylor's presentation, accompanied by slides, pictorially showed tests that had been run on high altitude flight checks, and indicated that considerable study and research is still necessary on this problem of using navigational aids by jet aircraft.

(Continued on page 126)

# THE FLIGHT HEARD 'ROUND THE WORLD

Recently three B-52 bombers flew around the world in 45 hours and 19 minutes. They were only specks in the vastness of the sky, yet they were in voice-contact every mile of the way—with SAC headquarters in Omaha, with each other, with bases along the route and with the KC-97 tankers that refueled them in the air.

Their speed-of-light contact was the AN/ARC-21 liaison communications set in each of the ships. This is a long-range, pressurized, high-altitude airborne system, capable of world-wide communications. It may be operated by the pilot, so no radio operator is needed. It is characterized by minimum training requirements, simplified maintenance, high reliability, positive channel selection—with a choice of any 20 of 44,000 frequencies.

In this as in other ways, RCA serves our Nation's armed forces. RCA scientists and engineers are constantly creating, designing and producing new and better electronic systems and equipment.

**RADIO CORPORATION of AMERICA**

DEFENSE ELECTRONIC PRODUCTS CAMDEN, N. J.

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Tinker-Oklahoma City—Guest speakers at the chapter's annual research symposium are shown above. Left to right: Mr. Paul Davis, Texas Instruments, Inc., representing industry; Chapter President Loyd Dorsett; Col. Edward A. Friedlander, Air Research and Development Command; and Dr. Homer Hicks, Magnolia Petroleum Company, representing education.

### *Southern Connecticut*

Mr. Walter Wainwright, Head of the Special Devices Branch of UDT (Underwater Demolition Teams) and Amphibious Section, U. S. Navy Underwater Sound Laboratory, New London, was the featured speaker at the March 28th dinner-meeting held at the Wonder Bar Restaurant in Bridgeport.

With "Underwater Communications" as his subject, Mr. Wainwright discussed and displayed equipment used by demolition crews to communicate with other crews, boats, and submarines, both on and below the surface of the water. He also showed a sound movie on underwater creatures and the sounds they make.

### *Tinker-Oklahoma*

The chapter's annual research symposium was held at the Student Union Building, University of Oklahoma, on March 22nd. The program was presented by three speakers representing military, education and industry. Chapter President Loyd Dorsett acted as moderator.

The first speaker, Colonel Edward A. Friedlander, Air Force Research Liaison Officer, Air Research and Development Command in Baltimore, Md., spoke on "The Challenge of Research in Defense."

Dr. Homer Hicks, Director of Field Development, Magnolia Petroleum Company, Dallas, Texas, representing education, discussed his experiences in promoting science and engineering in the Southwest.

Representing industry, Mr. Paul Davis, Director of Semiconductor Development, Texas Instruments, Incorporated, Dallas, Texas, spoke on "The Role of Industry in Military Electronic Research" and related some of the experiences of industrial laboratories in the growing field of communications and electronics.

Guests included representatives from the University of Oklahoma; the Naval Air Technical Training Center at Norman; Army, Navy and Air Force ROTC and reservist personnel, the Oklahoma Development Council, Frontiers of Science and the State Legislature.

### *Washington*

Major General A. L. Pachynski, Director of Communications-Electronics, USAF, was guest speaker at the March 7th luncheon meeting held at the Willard Hotel.

General Pachynski's address appears on page 59 of this issue.

Other guests at the head table were: Mr. Richard H. Aue, Director of Communications Division, B.D.S.A.; Maj. Gen. C. J. Bondley, Jr., USAF, Director of Supply and Services, DCS/Materiel; Maj. Gen. D. F. Callahan, USAF, Assistant for Programming, DCS/Operations; Mr. Russell Hughes, Director of Production, Communications and Mobilization Planning, OASD S&L; Maj. Gen. T. P. Gerrity, USAF, Assistant for Production Planning, DCS/Materiel; Brig. Gen. D. C. Doubleday, USAF, Airways and Air Communication Service, HQ, Andrews Air Force Base; Mr. Paul Goldsborough, Staff Director of Communications, OASD S&L; Brig. Gen. Albert T. Wilson, Jr., USAF, Deputy Chief of Staff, Operations, Military Air Transport Service, Andrews Air Force Base; Brig. Gen. M. A. Preston, USAF, Deputy Director of Operations, DCS/Operations; Col. B. M. Wootton, USAF, Deputy Director, Communications-Electronics, DCS/Operations.

Northeastern University—Newly elected officers of the Northeastern University Chapter's Division A are congratulated by Col. Murray D. Harris, SigC, PMST for Northeastern, and vice president of AFCEA's Boston Chapter. Left to right are: Maj. Fred J. Frank, chapter advisor; Cadet 1st Lt. Wilfred J. Picard, president; Cadet 2d Lt. Edward O'Keefe, treasurer; and Cadet 2d Lt. Thomas King, secretary.

## Air Traffic Control

*(Continued from page 67)*

The successful evolution of a modern air traffic control system is dependent, among other things, upon successful evolution of appropriat instrumentation for both ground an air. While much of the technolog now exists in one form or another there is a requirement for the adaptation of this technology and development of procedures for its use. Thi includes data handling and displa radar improvements, mechanized communication techniques, position determination, area marking, and man others. These should be among th tasks assigned to an integrated research and development facility.

It is essential that the Nationa Aviation Facilities System, which i required to provide the smooth an healthy growth of aviation, has a continuing program of modernizatio that will encompass all the functions including such diverse items as runway and taxiway layout, dispatch procedures, terminal area control, en route separations, path stretching techniques, and landing.

What I have said here, of course represents only an outline of our recommended approach to provide a adequate system of facilities. Many more specific details are being developed. It is obvious, however, that a job of this magnitude can only be accomplished by operational and engineering people working together in Government and industry, using th best modern scientific methods of operations research and experimentation. Much of the required engineering talent and many of the facilities must be furnished by industria organizations competent in variou aspects of the field. If industry is to supply top flight talent, they have the right to expect from Government that an authoritative agency is available to decide on programs to be developed and to supply adequate direction to the work. Without this decisive direction from Government much time, money, and manpower will inevitably be wasted on efforts which do not directly contribute to the final goal.

Whatever system and development program is decided upon, it is certain that electronics in all its phases will play an important and essential part. The members of your organization, therefore, have a special interest in continuing your activities in a field where you have already contributed so much.

# **Admiral**® develops military **TV CAMERA** with mid-day vision in deep twilight

The image orthicon may not be pictured for reasons of security. However, the monitor on which the picture is displayed is commercially available. Designed for the Armed Forces, it is a unit of unsurpassed quality offering superb resolution, extremely good linearity and such unusual features as control of size independent of linearity and the ability to reverse the phase of the signal. Write for detailed description and price.

The human eye is a remarkably sensitive instrument. But it is no match for the image orthicon TV camera developed by Admiral for the Armed Forces. Light from an ordinary match reveals as much to this TV camera as a man with 20/20 vision sees in the light of a 150 watt bulb. Obviously, the armed services will find countless ways to use this sharp-eyed observer for reconnaissance under adverse conditions.

Admiral developed the special circuitry that gives the image orthicon its amazingly keen "eye-sight." For all its extreme sensitivity, there is no penalty in excess bulk or weight.

Admiral has also "packaged" the unit to permit its use not only for land-based and airborne reconnaissance, but *even under water*. Development of the image orthicon again demonstrates Admiral's engineering capabilities in the field of military electronics. Inquiries are invited.

LOOK TO ***Admiral*** FOR
**RESEARCH • DEVELOPMENT • PRODUCTION**
**IN THE FIELDS OF:** MILITARY TELEVISION
COMMUNICATIONS UHF AND VHF • RADAR
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# ITEMS OF INTEREST
## From Government, Industry and the Services

Pictured above are some of the visitors at the recent Nuclear Congress who were afforded their first opportunity to sit at the controls of an operating nuclear reactor.

### Nuclear Reactor Exhibited

The world's first mass produced nuclear reactor, the AGN 201, developed by Aerojet-General Nucleonics of San Ramon, California, was, for the first time, exhibited for the public at the Nuclear Congress in Philadelphia.

Over twelve thousand people were afforded an opportunity to see this nuclear reactor in operation. Among the viewers were 200 scientists and engineers from "Atoms for Peace" countries, who were able to sit at the control console of a reactor and have complete and safe direction over a nuclear chain reaction of fissioning and splitting uranium atoms.

The story of AGN's production, which involves 21 reactors in the construction stage, was recorded by the "Voice of America" for broadcasting throughout the world.

### Human Engineering Institute

Dunlap and Associates, Inc., will present its 5th Annual Human Engineering Institute at Stamford, Conn., during the week of June 17, 1957.

Giving special emphasis to advanced as well as basic concepts, the Institute will deal with design of equipment and systems to meet human requirements. Senior members of the Institute's professional group will present a planned sequence of lectures and participate in small group discussions aimed at acquainting design and development people from industry and military organizations with the newest data and techniques of Human Engineering.

Enrollment will be limited to permit appropriate attention to specific needs and interests. The fee is $290.00.

### A Squeeze of the Hand Demonstrates Digital Converter

A novel spectator-participation display, which utilized a hand "squeeze" device, was exhibited by the Industrial Products Division of Federal Telephone and Radio Co., Clifton, N.J., at the 1957 IRE Convention in New York City. A lightweight, compact analog-to-digital converter, called the Andicon, was the model demonstrated.

The Andicon permits the user to take information, usually presented in the form of a wave or graph on a chart or oscilloscope, and instantly convert the data into easily readable numbers. A hand grip actuates a servo which drives the Andicon, whose coded output is fed into an automatic typewriter. The information then appears in digital form directly proportional to the strength of a hand grasp.

Designed for use in radar studies, navigation, aircraft instrumentation, telemetering, and wind tunnel aircraft engineering work, the analog-to-digital converter has application in many fields.

### Navy Has New Five-Inch Rocket

ZUNI, a new five-inch high velocity aircraft rocket named for the Pueblo tribe of Indians, has been announced by the Navy.

Developed for the Navy's Bureau of Ordnance by the Naval Ordnance Test Station, China Lake, Calif., the ZUNI has been approved for operational use in the fleet. It has almost twice the velocity of the World War II model it replaces.

In tests it has proven ability to hit hard, rapidly and accurately. As an air-to-ground weapon, it will be highly effective against tanks, pillboxes, trains, motor convoys, fuel dumps, and small ships. As an air-to-air weapon, it will have a high kill potential against aircraft because of its high velocity and consequent short target time. One ZUNI is capable of bringing down a jet plane.

The Naval Ordnance Test Station also developed the ZUNI launcher, which holds four rockets and is used for transporting and storing the rocket as well as launching it. Thus, greater speed in re-arming planes as they return to their bases between combat strikes is achieved, and greater economy is provided by the elimination of conventional packing crates.

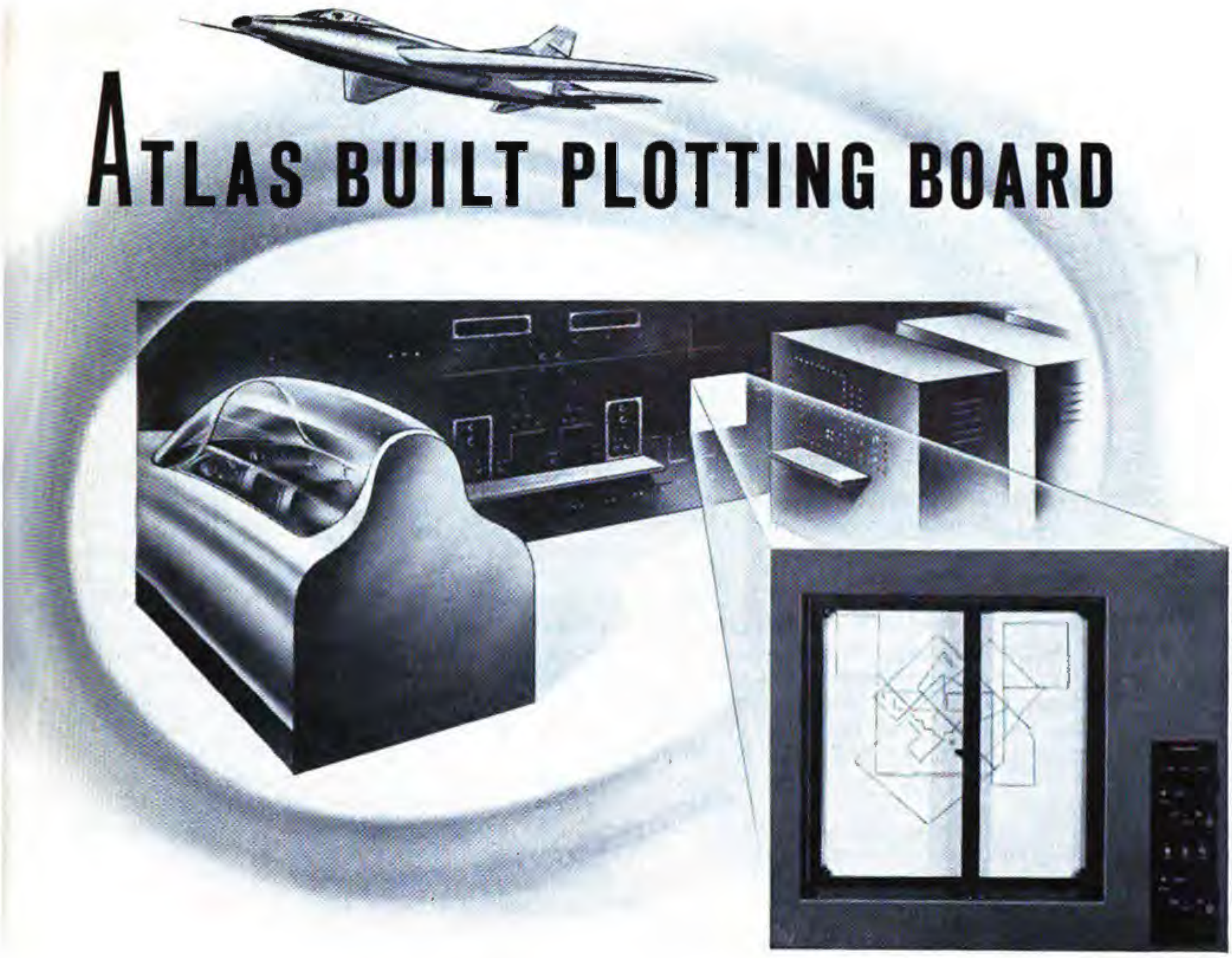
### Army Units Visit IT&T Labs

Two Army Reserve units, sponsored by International Telephone and Telegraph Corporation, toured Federal Telecommunication Laboratories, IT&T's research division in Nutley, New Jersey, recently. They heard talks by the Labs' engineers who developed some of the Armed Forces' latest communication and navigation equipment.

The units were the Headquarters and Headquarters Detachment 352nd Signal Batallion (Support), composed mainly of IT&T employees, and the 311th Signal Company (Support), made up of personnel of American Cable & Radio Corporation.

(*Continued on page* 132)

# ATLAS BUILT PLOTTING BOARD



## Scoreboard For Tomorrow's Pilots

THE plotting board designed by Melpar Inc.—scoreboard of the new U.S. Air Force supersonic simulator for F-100A planes—is another example of Atlas manufacturing ingenuity at work.

Atlas specializes in "precisioneering" electro-mechanical assemblies from the pilot stage to production efficiency. Furnishes the practical engineering step and the facilities between the idea and the production line.

Bring your electro-mechanical designs to us. Our design, production and methods engineers, tool makers and skilled mechanics are ready to work on your project on a job basis . . . as many men, machines and hours of work it requires and no more. Every modern tool and cost cutting technique is at your service to save you time and labor on a complete electro-mechanical assembly or a special part for electronic equipment. Write today for your copy of "Precisioneering Electro-Mechanical Equipment." ATLAS PRECISION PRODUCTS CO., Philadelphia 24, Pa. (Div. Prudential Industries).

*"From Drawing Board . . . to Production Line"*

SERVICE ATLAS DEPENDABILITY QUALITY

**ATLAS**

*Precision Products*

# ITEMS OF INTEREST

an IT&T associate company.

The reservists heard addresses by the engineers who developed TACAN, VORTAC, and over-the-horizon microwave systems. They toured FTL's famed 300-foot experimental microwave tower, and were guests of IT&T for luncheon in the Labs' Clubhouse.

The Battalion standard was displayed for the first time during an inspection by Rear Admiral Ellery W. Stone, USNR (ret.), President of AC&R, and Henri Busignies, FTL President and prime mover in the development of TACAN.

### First Refueling of Nautilus

The *USS Nautilus* was refueled for the first time in Groton, Conn., after steaming over 20,000 leagues from power generated by her reactor.

Refueling of the submarine involves replacing the nuclear reactor core and installing an entirely new heat generating machine inside the empty steel container which remains. The new core will incorporate important technical advances which will greatly extend the fuel performance, as well as making it simpler, less expensive and more reliable.

The atomic submarine *Seawolf*, which is bigger and faster than the *Nautilus* and uses liquid sodium as a reactor coolant instead of pressurized water, has already begun her sea trials in the Atlantic.

### Breaking the Weather Barrier

The concept of breaking the zero-zero weather barrier for safe aircraft operation appears more optimistic as a result of tests on an electronic "brain" developed by Bell Aircraft Corporation.

Principal parts of the new device are an electronic computer and a radar unit which may be installed either on landing strips or carrier decks. A plane flying in zero visibility and zero ceiling atmosphere, brought within a "radar gate" as far as four miles away from the runway, can safely land by fully automatic controls.

It differs from present remote-control systems in that no visibility and no human operator is necessary on the ground or in the plane. The new system not only has commercial value for bad weather landing, but useful military application in cases where pilots suffering from wounds or fatigue can land by means of automatic control.

Already tested extensively on land, the new electronic device is now undergoing comprehensive testing at sea by the Navy.

### World's Largest Electronic Brain

The world's largest electr "brain," built by the Radio Corp tion of America, has been install at the Army Ordnance Tank-Auto tive Command Headquarters in D troit.

Known as Bizmac, the $4.1 milli electronic data processing system h reduced months of paper work minutes of push-button operation. keeps track of more than 100,000 facts about the Army's vast invento of tank and automotive spare pa throughout the world—everythi from nuts and bolts to entire engin At electronic speed, Bizmac can t inventory, catalog spare parts, pr pare manuscripts for catalogs, fo cast supply requirements and pr duce budget summaries.

The Bizmac system includes fo basic units: Input Devices for pr paring and feeding information a instructions into the system; Stora Devices for filing information withi the system so that it is readily a cessible on demand; Data Processin Devices for sorting and computing dictated by instructions; and Outp Devices for providing finished copi of the information required. Sinc Bizmac operates on the "buildin block" principle, a business orga zation can use as many or as fe units as it needs to do its job.

### War Missile Becomes Weather Observer

A supersonic antiaircraft missil built by the Army is being convert into a peaceful weather observer b scientists at the Naval Ordnanc Laboratory, White Oak, Md. Orig inally known as the Loki rocket, th new weather observer has been re named the Hasp-high-altitude soun ing projectile.

As a single-stage solid-propell rocket which can be fired from 5-in naval guns, the Hasp will ena ships at sea to make regular meteoro logical observations to altitudes over 100,000 feet. A timing device in the dart's nose splits open the casing at the summit of its flight and eject instruments to detect temperature and humidity in the ionosphere.

The weather instruments are lowered back to earth by a balloon which is inflated when the dart's casing splits. The telemetering equip ment in the balloon sends back tem peratures and humidity in the layers of air through which it passes. An included tracking system enables the balloon to supply data about wind

(Continued on page 134)

# In BOBBIN CORES, you need PRECISION

## *and precision is the word for ARNOLD*

Ultra-thin tape for bobbin cores is rolled to high precision standards for thickness and finish on our own 20-high Sendzimir cold reducing mill, beta-ray controlled.

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Includes essential data on applications and properties, fabrication and testing of Arnold Bobbin Cores; lists standard sizes, etc.

**ADDRESS DEPT. S-75**

For use in shift registers, coincident current matrix systems, pulse transformers, static magnetic memory elements, harmonic generators and similar equipment, Arnold Bobbin Cores meet the most exacting requirements.

Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps depending on the ultimate use of the core. Magnetic materials usually employed are Deltamax, Permalloy and Supermalloy, in standard thicknesses of .001", .0005", and .00025". Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation. • Let Arnold supply your requirements for Bobbin Cores—or other tape-wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry. WSW 6399

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## ITEMS OF INTEREST

direction and velocity at succeeding levels of descent.

For the first time, in January, 3 Hasp darts were launched from a Navy rifled gun for rapid air measurements. The engineers at Ordnance Laboratory believe that a fully-instrumented Hasp can be test launched within a year.

### New Anti-Submarine Defense Command

Reorganization of the fleet anti-submarine warfare forces was announced by Admiral Jerauld Wright, USN, Commander-in-Chief, U.S. Atlantic Fleet. The new command, known as the Anti-Submarine Defense Force, U.S. Atlantic Fleet, will expand the responsibilities and tasks of the present force.

Heading the new organization is Vice Admiral Frank T. Watkins, USN, who has been reassigned the responsibility for planning war-type protection and control of shipping. In addition to operational and training tasks, he spearheads the activities of the U.S. Atlantic Fleet in the anti-submarine field, and has extensive cognizance of ASW research matters in order to program new devices into the operating forces.

The new defense force will be given centralized authority for all anti-submarine efforts of the fleet with certain other responsibilities in connection with the Atlantic Fleet's mission of defending the U.S. from attack through the Atlantic. This includes dual-purpose seaward extension of the radar early warning line that stretches across the top of the continent, in which special electronically equipped ships and aircraft are engaged constantly. The fleet units are on the alert to detect both submarines and aircraft which may be enroute to the U.S. coastal areas.

In the field of training, the new organization operates on a wider scale than the older force since it supervises the coordinated inter-type training of the several fleet forces—air, surface, and submarine—with anti-submarine capabilities.

### Electrical Engineer Award

Eta Kappa Nu Association, national electrical engineering honor society, announced the openings of nominations for the 1956 Outstanding Young Electrical Engineer.

Awards are made on the basis of social and civic accomplishments as well as technical achievements. Nominations are solicited from all accredited colleges, American Institute of Electrical Engineers, Institute of
Radio Engineers and em
electrical engineers.

Candidates do not have t
bers of Eta Kappa Nu, bu
less than 35 years of age
baccalaureate degrees in
engineering from colleges i
and Canada within ten years
May 1, 1957. Selections are m
a Jury of Award appointed
leaders in industry and education
the National President of Eta Ka
Nu.

Nomination forms may be obta
from A. B. Zerby, Executive Se
tary, Eta Kappa Nu Associat
P.O. Drawer 447, Dillsburg, Pa.,
should be returned no later
May 31.

### Phone Dialing Applied to Nike

Bell Telephone Co. has devel
new electronic techniques in di
long distance phone calls which
been applied to the Nike antiair
missile, enabling it to zero in o
target.

Albert S. Barnes, supervisor
customer information for Bell,
plained that the problems and s
tions were similar. He pointed
that in the U.S. and Canada t
were 60 million telephones.
1,800 billion different calls possi

"With the firm's new system of
tomer dialing by long dista
through a numbering plan syst
the two countries are divided i
100 different geographical areas.
you need to do is dial the first three digits of the area involved, then the last four numbers direct," he said.

The Nike, using the identical system, automatically chooses the appropriate air patch in which the enemy bomber is flying. This is related to a sky chart in which the sky is broken down into grid patterns.

### World's First Tropospheric Scatter System

The Federal Telecommunication Laboratories, Nutley, N.J., have built and designed the world's first tropospheric scatter system with a band sufficiently broad to carry a television signal and up to 120 telephone channels.

It will be placed in operation between Florida and Cuba by late summer. The northern terminal, at Key Largo, will be operated by the Long Lines Department of the American Telephone & Telegraph Co., as part of the Bell System, while the southern terminal at Guanabo, near Havana, will be run by the Radio Corp. of Cuba, an affiliate of the Interna-

(Continued on page 136)

# Systems engineering—38th parallel style

Here's the challenge we received from the Korean Civil Assistance Command and the U. S. Army Signal Corps:

*Build a telephone communications system to their specifications that will function over mountainous terrain. Cost to be within reasonable limits . . . upkeep minimum . . . equipments compatible with the experience and background of the population.*

The answer is the system now being installed in South Korea.

Manually operated telephones, central offices and PBX switchboards, suited to a civilian population unfamiliar with dial methods.

Wire lines for basic country-wide linkage, augmented with many channels of *Carrier,* wherever estimated traffic warrants it.

And—delivery on schedule.

**STROMBERG-CARLSON COMPANY**

A DIVISION OF GENERAL DYNAMICS CORPORATION

**General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.**

tional Telephone & Telegraph Co. The most spectacular aspect of each terminal will be two wave reflectors, each 60 feet high and wide, to be installed 200 feet apart.

Possessing a 70 mc. transmitter, receiver and driver-amplifier, the tropo system is said to have a maximum effective range up to 185 miles. Line-of-sight wideband radio systems will link each power-amplifier-reflector unit with telephone or TV circuits in Havana and Miami.

Quadruple-diversity wave transmission and reception is provided for the best possible results, regardless of prevailing radio transmission conditions. This diversity also provides a complete standby channel, in case of failure of some component. With all transmitters, receivers, and reflectors operating, the system can carry two complete television programs simultaneously.

Cost of the scatter equipment, without antennas and installation, is said to be about $1 million, while upkeep is expected to be around $140,000 a year. Similar links are in various stages of development in Europe and the Western Hemisphere.

### Saving Spectrum Space

Due to the increasing scarcity of frequencies in the radio spectrum, means of saving spectrum space are receiving cooperative attention from industry and the Federal Communications Commission.

In order to find room for new users, help to reduce interference, and obtain more efficient use of the radio spectrum, three conservation techniques have been offered to relieve heavily congested frequency bands. They are known respectively as "offset carrier," "single sideband" and "split channel" operation.

In the first, a station may be required to operate with its carrier frequency "offset" 10 kilocycles above or below the normal carrier frequency. A channel assigned to such a station is designated "plus" or "minus" accordingly. This results in less mutual interference and makes more assignments possible.

The "single sideband" eliminates the two-sideband transmission which utilizes more frequency space than is actually required. By eliminating one sideband, a narrower channel may be used, assignments can be made closer together, and room is made for added stations. A further improvement is in making use of what is called "suppressed carrier." The power of a station is concentrated in whichever sideband is being used and shuts down automatically, "between words," when power is not needed.

Through a combination of technical improvements in equipment, manufacturers have been able to produce equipment which can operate in channels half as wide as the previous designs. Thus, more assignments can be crowded into a particular band of frequencies by making use of "split channels," as more stations occupy a smaller amount of space.

Pictured above is the Air Force's new, supersonic fighter-bomber, Republic F-105 Thunderchief, which has been selected for volume production. Flying faster than sound on its very first flight, the Thunderchief has already proved itself in more than 250 test flights. It has been designed under the Weapons System Concept as a nuclear-bomb-carrying fighter and is powered by the Pratt and Whitney J-75 engine. Outstanding design features are the long, cylindrical fuselage, the short, very thin swept-back wings, the needle nose and the ventral fin on the bottom of the aft fuselage near the tail. Scheduled to reach a production peak late in 1958, the F-105 assembly line is already in operation.

The methods mentioned are not the only means of saving spectrum space. Government and industry are continually working closely together to develop new techniques in this vital area.

### Army and Industry Strengthen Ties

A major step forward in strengthening the ties between the Army and industry was made with the activation of the new U.S. Army Reserve unit, the 262nd Signal Company, last month.

The new unit, sponsored by the American Cable and Radio System in Washington, D.C., exemplifies the strong relationship between industry and the Army Signal Corps. Such an affiliation will serve to strengthen our national defense now and in the future.

According to Brigadier General Kenneth F. Zitzman, Chief, Personnel and Training Division, Office of the Chief Signal Officer, the concept of affiliation goes back to the Civil War when commercial telegraph furnished much of the Army's required communications. He said, however, that "the present offers a new kind of challenge to the time-tested relationship between the Communications-Electronics industry and the Army Signal Corps—for the first time in history we have a requirement for a large and truly ready reserve force."

The activation ceremony was held in the office of Major General J. D. O'Connell, Chief Signal Officer in the Pentagon. The new unit is commanded by Captain Joseph J. Cancie, Assistant Superintendent of American Cable and Radio.

Among those attending the ceremony were Major General P. D.

(Continued on page 138)

WORLD'S LARGEST ELECTRONIC BRAIN

# RCA BIZMAC reduces weeks of paper work to seconds—cuts costs by millions!

**In almost the twinkling of an eye,** electronics handles calculations that would take any person days of work.

The newest – and largest – electronic "brain" (more accurately, electronic data processing system) is Bizmac, developed by RCA.

Bizmac is quickly becoming one of the most powerful allies of business and industry. It "reads," sorts, catalogs, analyzes, calculates, forecasts—reduces months of paper work to seconds—cuts costs by millions!

For insurance companies, Bizmac can digest mountains of statistics daily and put its finger on any one of millions of facts with push-button speed.

It can help department stores keep split-second inventory control, can greatly simplify warehousing, storage and product-supply problems for big chain-store operations.

And for the U. S. Army, it keeps track of literally *billions* of ordnance parts all over the world.

The leadership in electronic research that made Bizmac possible is inherent in all RCA products and services—to help make life fuller, easier, safer through "Electronics for Living." TMK(s) ®

**RADIO CORPORATION OF AMERICA**

ELECTRONICS FOR LIVING

## ITEMS OF INTEREST

Ginder, Assistant Chief of Staff for Reserve Components; Major General Phillip E. Lindeman, Chief, Army Reserve and ROTC Affairs; Rear Admiral Ellery W. Stone (ret.), President, American Cable and Radio Corporation, New York; Major General W. Preston Corderman, Deputy Chief Signal Officer; Mr. Edward J. Girard, Assistant Vice President, Federal Telephone and Radio Co., and Assistant Vice President, Federal Communication Laboratories; Major General James R. Pierce, 2nd Army, Ft. Meade; Brigadier General Kenneth Zitzman; Col. Arthur Symonds, Assistant Publisher, ARMY; Col. W. J. Baird (ret.), Editor, SIGNAL.

### *Enlisted Personnel Benefit Association*

A non-profit association open to "regular" enlisted personnel has just been organized, which makes available to the "enlisted man" certain benefits formerly enjoyed only by commissioned and warrant officers.

Created to advance and safeguard the economic interests of service men and women stationed throughout the world, The Armed Forces Enlisted Personnel Benefit Association will initially offer its members emergency loan privileges, scholarship grants to deserving children of members, and low-cost group life insurance. Additional benefits will be considered as membership increases.

Regulars of all grades (male or female) from all branches of the service are now eligible for membership. A board of directors, composed of enlisted personnel, will be elected annually by the members; however, officers, directors, and advisors will serve without compensation.

Information and applications may be obtained by writing The Armed Forces Enlisted Personnel Benefit Association, 422 Washington Building, Washington 5, D.C.

### *Engineering Show at Coliseum*

Twenty thousand engineers in industry, who design consumer products and the machines which turn them out, are expected to attend the second Design Engineering Show at the New York Coliseum, May 20-23.

The show, which has grown in one year to a size which places it among the five largest annual industrial expositions, will bring to New York engineers from all parts of the U.S. and Canada, plus visitors from 15 other nations. Three hundred and seventy-five companies will exhibit component parts, materials, fasteners, finishes and coatings, shap
forms, and accessories to prod
velopment. Representatives of
hibiting companies will be
to answer the engineers' quest

The exposition is the sho
for the original equipment
Products which go into the
of end products are demonstr

Concurrently with the sho
machine design division o
American Society of Mechanic
gineers will sponsor a three-da
ference on design engineering
lems. The conference will ope
a panel discussion of "Proced
Developing New Designs" an
have sessions on the mechanic
terials, and electrical aspects
sign engineering.

### *New Division at C.E.I.*

The Council for Economic
try Research recently held a d
stration at their headquarters.
Jefferson Davis Highway, Arli
Va., of an IBM giant electronic
puter 704. The demonstratio
given to announce the opening
Council's new Computer Se
Division. This division, in the
of Dr. Herbert W. Robinson, C
President, "will make availab
the trained, imaginative minds
C.E.I.R.'s engineers, economists,
entists and mathematicians an
tremely powerful tool which will
up the effectiveness of these pe
in tackling difficult problems for
business, government and finan
clients."

Examples of the types of probl
which will be handled with the
of the computer by C.E.I.R.'s
are: economic development progra
market projections, production sch
uling and operations research
erally.

### *Rear Admiral, Nuclear Propulsion*

The Royal Navy of Great Brit
has announced the creation of a n
post, that of Rear Admiral, Nucl
Propulsion.

The announcement of the positi
said that the Rear Admiral Nucl
Propulsion "will act as the fo
within the Admiralty of the ope
tional and material aspects of
clear propulsion." It will keep
touch with developments made by
Atomic Energy Authority and by
dustry in the application of nucl
propulsion to ships. The new positi
is to be the link in such specifi
matters between the Admiralty a
other Government Departments, M
istries and Services as well as co
monwealth foreign Navies when
propriate.

*(Continued on page 1*

Photo at right shows operators inserting secondary coils and connecting leads to commutators for units like the compact Sangamo "GY" Flatpak—a rugged, small size dynamotor for mobile radio use.

Final assembly operation. Push line type of operations contribute substantially to overall efficiency and accelerated production . . . aids in fulfilling all delivery schedules, even for units like the Type SF below, which are built to the most exacting specifications.

# Now... dependable power supply units on dependable delivery schedules

## Sangamo expands facilities to meet growing demand!

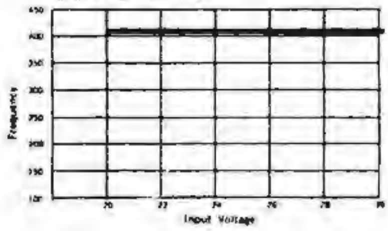
Sangamo power supply units for the military and commercial fields—Dynamotors, Rotary Converters, Generators, Special DC Motors—are built to meet your most exacting specifications for quality and performance.

And... Sangamo has the facilities to insure prompt, efficient, volume delivery to meet *your* production schedules.

A new 200,000 square foot "controlled conditions" plant, in Pickens, South Carolina is equipped with the newest, most modern equipment to utilize the latest production techniques in the manufacture of these power supply units. This plant is geared for full-capacity production for units and components for mobile communication equipment. Look to Sangamo for your requirements.

SG57-1

**SANGAMO**
**Electric Company**
*Electronic Components Division*
SPRINGFIELD, ILLINOIS



# PERSONNEL CLEARING HOUS

## *AFCEA Members Available to Industry*

**The pages of SIGNAL are open to active AFCEA mem who are seeking positions in the communications, electr and photographic industries. Any member is entitled to sp free of charge in this column for three issues of the ma zine. Please limit your notice to five lines. In replying, e ployers are asked to address: Box ____, SIGNAL, 1624 Street, N. W., Washington 6, D. C. Letters will be forward to the AFCEA member.**

Communications Specialist—Communications System Mana with leased long-line interphone experience plus 10 years milit and civilian air traffic control. Broad background in electro air operations, and flight movement. AB and LLB degrees. W consider any location. Box 122.

Field Engineer: Electronic, Communication, Marine Equi Data processing and automation. DOD project coordinati Branch Management, sales promotion, customer relations. Surv and reports, subcontract and material expediting, program p ning, production control, priorities. Box 123.

Representative, with all clients performing R & D or sup work for Wright Field and other agencies, needs more line develop with both military and commercial potential. Prefer are electronics or photographic equipments and ANP (have A Access) or packaging material. Box 124.

Manufacturers Representative, Washington, D. C. Long est lished and contacting all government procurement points Washington, D. C., has opening for an additional account. Pr a company manufacturing an end-use item and which is alre doing some business with the military. Can also cover Ph delphia and Fort Monmouth. Replies confidential. Box 125.

Manufacturers Liaison Representative. Retired Lt. Colo Communications-Electronics Officer with twenty-one years perience. Education: Electrical Engineering and Business ministration. Familiar with Operational Suitability Testing R & D. Desires to represent manufacturers or act as liaison companies conducting business with Eglin Air Force B Florida. Box 126.

## *Government and Military Positions Available*

**Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.**

The Special Devices Center, an activity of the Office of Naval Research, located at Sands Point, Port Washington, Long Island, has several vacancies for electronic engineers at $7,035 a year and for Engineering Draftsmen at $4,080 a year.
Inquiries should be directed to the Industrial Relations Officer. Telephones: Flushing 7-8300 and Port Washington 7-3800.

Ordnance Engineer ($7,000 a year). Assistant Inspector of Naval Material, Germantown, Pa., has opening in development and production of ordnance equipment. Requirements: Bachelor's degree in engineering (or four years' equivalent experience) and 2½ years' engineering experience, one in ordnance engineering. Master's degree can be substituted for one year's experience; Doctor's degree in ordnance engineering can be substituted for all experience. For further information, write: Supervising Inspector of Naval Material, 17 Brief Ave., Upper Darby, Penna.

Electronic Engineers, Electronic Scientists, Mechanical Engineers, starting salaries $5,335-$6,390. Engineering Draftsmen, $3,415-$4,080. Vacancies now exist at the U. S. Navy Electronics Laboratory, a major West Coast scientific organization engaged in research and development of electronic equipment and systems. For further information address: U. S. Navy Electronics Laboratory, Civilian Personnel Division, San Diego 52, California.

Radio Operator Technicians. Veterans $3,400-$4,200 to start. Overseas opportunities. Amateur or commercial licenses helpful. Full pay during advance training. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, private training, work experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

(*Continued on page* 142)

Robert Rossler, FICo engineer, holding plug-in analog modules — a transistorized amplifier unit and an electro-mechanical unit. Electronic panel of analog computer is in background.

FICo digital engineer Peter Carbone holding digital module, comprised of easily removable transistorized printed circuits. Rack-type digital computer is in background.

# ANALOG or DIGITAL:

## WHICH TYPE OF SPECIAL-PURPOSE COMPUTER IS BETTER?

**THE ANSWER:** ***It depends on the application.***

Ford Instrument develops and produces *both* types of computers — analog and digital — for an unlimited range of systems applications. FICo analyzes the problem and designs the computer best suited to the needs of the application, in terms of reliability, flexibility, economy, and size. For both types of special-purpose computers FICo employs modular techniques, simplifying the problems of design and manufacturing . . . and making servicing fast, simple, and economical.

FICo has developed and produced special-purpose computers to handle an extreme variety of problems—including missile and rocket launching, missile guidance, airborne and tank navigation, test and other data processing, degaussing, torpedo launching, gunfire control, and many others.

**FICo modular techniques as applied to an amplifier for an airborne navigational system. Arrows point to printed circuit amplifiers. Two typical cards are shown at right.**

## FORD INSTRUMENT CO.

DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, New York
Beverly Hills, Calif. Dayton, Ohio

**ENGINEERS** of unusual abilities can find a future at FORD INSTRUMENT CO. Write for Information.

Teletype Operators and Cryptographic Technicians. Veterans $3,200-$3,700 to start. Overseas opportunities. Full pay during training period. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Electronic Technician ($7,570-$8,645 plus 25% (non-taxable) cost of living allowance). Major duties are to plan, direct and supervise the operation and maintenance of carrier, repeater, terminals, telegraph and associated equipment installed in the toll test rooms. Includes inspections of facilities to determine required training, the organizing of the training and when necessary the actual conducting of the training. Three years general experience required and three years specialized experience. Inquiries should be directed to Civilian Personnel Officer, Alaska Communication Sytem, 550 Federal Office Building, Seattle 4, Wash.

Electronic Engineers GS-5 through GS-12. These positions have a salary range of $4,480 through $8,645 per annum. Employees in these positions serve as advisors and consultants to Signal Corps Contracting Officers on technical phases of procurement of Signal Corps equipment during the period of solicitation and during the life of the contract. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

Supervisory General Engineer ($6,950 a year). To serve as an assistant to the military post engineer. Function of the Depot Facilities Division is related to maintenance, care and preservation of all buildings, structures, and rights-of-way and other real estate of the depot; responsible for fire protection and prevention for the depot; and management of depot facilities. Inquiries may be directed to the Civilian Personnel Office, Decatur Signal Depot, Decatur, Illinois.

East Coast Pictorial Center has an opening for a studio electrician at $2.51 an hour. Duties include operating most electrical equipment, required for motion picture production. Knowledge of lighting effects and switchboard wiring required. A position is also available for an architectural draftsman at $4,525 a year. Situation requires ability to execute designs and plans for motion picture settings, and to paint and dress sets, dioramas and other pictorial representations. Clerical duties include filing, developing and printing of blue prints, and a minimum amount of typing. For further information, write to Civilian Personnel Office, Army Pictorial Center, Long Island City, 1, N. Y.

Physicist—GS-9. Qualified expert on radiology responsible for the operation of the film badge service unit and for the monitoring of personnel, material, equipment and radioactive sources. Accountant—GS-9. Responsible for receiving and analyzing all reports generated by the Finance and Accounting Branch; practical application of accounting theories. Cost Accountant—GS-9. Serves as Staff Accountant for the Maintenance Division responsible for performing professional accounting work in connection with cost accounting and Army Industrial Fund activities. Electronic Engineer GS-7. Responsible for independent accomplishment of professional engineering work as related to research, development, design, evaluation, standardization, modification, etc., of prototype production and fabrication models of electronic equipment. Inquiries should be directed to the Civilian Personnel Director, Lexington Signal Depot, Lexington, Kentucky.

Medical Officer GS-12. This position pays $8,645 per annum. The employee will be responsible for the operation of a Federal Civilian Health Service type of dispensary containing examining and treatment rooms and equipment. Examines military personnel having initial responsibility for diagnosis and disposition of cases for treatment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

### Fort Monmouth Vacancies

Supv. Physicist (General), GS-14; Electronic Engineer (General), GS-14.

*Duty Station:* Pasadena, California.

Electronic Engineer (Radio), GS-13.

*Duty Station:* Christ Church, Hampshire, England.

Electronic Engineer (General), GS-13; *Duty Station:* Fort Monroe, Va., Fort Knox, Ky., Fort Bliss, Texas, and Fort Rucker, Ala. Electronic Engineer (Radio, Instrumentation), GS-12; Chemical Engineer, GS-11; Electronic Engineer (Radio, General & Wire Communications), GS-11: Mechanical Engineer (S&S Signal Equipment), GS-11; Training Officer (General Field), GS-11; Mechanical Engineer and Mechanical Engineer (Signal Equipment), GS-9; Employee Utilization Representative, GS-9; Instructor (Radar, Radio-Microwave, Wire Sound Recording), GS-9; Radio & Electronic Equipment Installer and Repairer, WB-15.

U.S. Civil Service Commission. Vacancies now exist for Electronic Technician positions in the Civil Aeronautics Administration in Alaska. Starting salaries are $4,080 and $4,525. No written test required. Full information on how to apply may be obtained at many post offices throughout the country or from the U.S. Civil Service Commission, Washington 25, D. C.

U.S. Civil Service Commission has announced vacancies for communications cryptographic coding clerks at $3,415 a year. Applicants must have general experience as a clerk, typist, teletypist or telegrapher, plus 6 months of specialized experience in enciphering and deciphering messages, involving the use of a variety of current cryptographic systems and devices. Radio broadcast technician positions are also available in the International Broadcasting Service at $5,915 a year. No written tests required. Further information and application forms from the U.S. Civil Service Commission, Washington 25, D. C.

Electronic Engineers. Starting salaries $5,335 and $6,115. Electronic Technicians, salaries from $3,670 to $5,440. Vacancies now exist at the Electronics Division of the New York Naval Shipyard, located at Navy and Sands Streets, Brooklyn 1, N. Y. The shipyard is engaged in activities ashore and afloat, including construction of new super-carriers. Direct inquiries to the Industrial Relations Officer, Telephone Main 5-4500, Extension 2877, 2379 or 2593.

### Fort Huachuca Vacancies

Supervisory Electronic Engineers (2) GS-855-14, General
Electronic Engineers (2) GS-855-13, General
Electronic Engineer GS-855-13, Instrumentation
Electronic Engineer GS-855-13, Radio
Electronic Engineer GS-855-12, General
Electronic Engineers (2) GS-855-11, General and Radio
Electronic Specialist GS-855-9
Electronic Engineer GS-855-9
Physicist GS-855-9
Supervisory Analytical Statistician GS-1530-12
Mathematician GS-1520-12

## ITEMS OF INTEREST

### Dreyfus Promoted to Major General

Confirmed by the United States Senate and recently announced by the Chief Signal Officer in Washington is the promotion of Brigadier General James Dreyfus to the rank of Major General.

Since January 1, 1956, General Dreyfus has been Chief of the Procurement and Distribution Division, Office of the Chief Signal Officer. Currently, he is visiting various commands in the Far East.

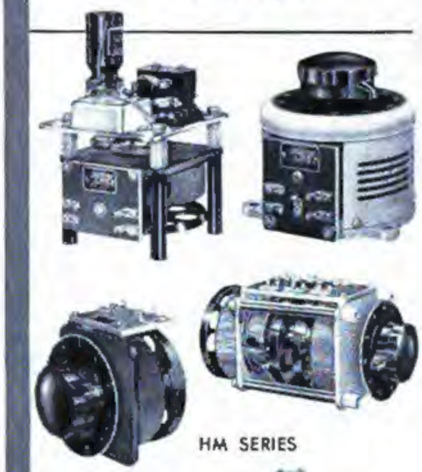
### New National Vice-Chairman of IRE Professional Group

Edward N. Dingley Jr., Chief Communications Engineer of the National Security Agency, has been elected Vice-Chairman of the Institute of Radio Engineers Professional Group on Communications Systems (PGCS).

Mr. Dingley, a member of AFCEA, is a registered Professional Engineer. He is also a member of AIEE, a Fellow of the IRE, and a Naval Reserve Captain. He has been honored with the Defense Department's Distinguished Civilian Service Medal and is currently serving as Chairman of the Washington Chapter IRE PGCS.

# *Now a standard line*
# POWERSTAT®
## VARIABLE TRANSFORMERS *for* HIGH FREQUENCY APPLICATIONS


HS SERIES


HM SERIES


HL SERIES

### — ⅓ the weight — ½ the size of 60 cycle units

Designed for use in high frequency control systems where weight and space must be minimized, these POWERSTATS are ideal for ship, aircraft, guided missile and other 400/800 cycle applications.

Listed are some of the standard line of POWERSTATS for high frequency applications. However, many high frequency requirements necessitate designing to individual needs. The Superior Electric Company will be pleased to work with you on the design of POWERSTATS to satisfy new or unusual needs.

| INPUT | | OUTPUT | | | | MANUALLY-OPERATED MODELS | | | | MOTOR-DRIVEN MODELS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLTS | FREQUENCY CYCLES PER SECOND | VOLTS | MAXIMUM AMPERES | MAXIMUM KVA | TYPE OF CONSTRUCTION | TYPE | METHOD OF TURNING | APPROX. WEIGHT (POUNDS) NET | APPROX. WEIGHT (POUNDS) SHIPPING | TYPE | STANDARD MOTOR-DRIVES | SPEED OF TRAVEL IN SECONDS | APPROX. WEIGHT (POUNDS) NET | APPROX. WEIGHT (POUNDS) SHIPPING |
| SINGLE PHASE | | | | | | | | | | | | | | |
| 28 | 400/800 | 0-28 | 2.0 | .056 | Open | 3HSO2UK | Knob | 0.5 | 0.9 | | | | | |
| 28 | 400/800 | 0-28 | 4.0 | .112 | Open | 3HSO4UK | Knob | 0.8 | 1.2 | | | | | |
| 120 | 400/800 | 0-120 or 0-140 | 1.0 | .14 | Open | 1HSO1UK | Knob | 0.9 | 1.3 | | | | | |
| 120 | 400/800 | 0-28 | 2.6 | .073 | Open | 1RHSO3UK | Knob | 0.6 | 1.0 | | | | | |
| 120 | 400/800 | 0-120 or 0-140 | 3.0 | .42 | Open Square Frame | 1HMSO3UK | Knob | 2.4 | 2.8 | DM1HMSO3U | 28 Volt D-C | 60 | 4.5 | 5.1 |
| | | | | | | | | | | AM1HMSO3U | 120 Volt A-C, 400 Cycles | 60 | 4.5 | 5.1 |
| 120 | 400/800 | 0-120 or 0-140 | 7.5 | 1.0 | Open Square Frame | 1HMSO7UK | Knob | 3.4 | 3.8 | DM1HMSO7U | 28 Volt D-C | 60 | 5.5 | 6.1 |
| | | | | | | | | | | AM1HMSO7U | 120 Volt A-C, 400 Cycles | 60 | 5.5 | 6.1 |
| 120 | 400/800 | 0-120 or 0-140 | 15.0 | 2.1 | Open | 1HL15UK | Knob | 11.4 | 14.0 | DM1HL15U | 28 Volt D-C | 60 | 13.2 | 16.2 |
| | | | | | | | | | | AM1HL15U | 120 Volt A-C, 400 Cycles | 60 | 13.2 | 16.2 |
| 240 | 400/800 | 0-240 or 0-280 | 3.0 | .84 | Open Square Frame | 2HMSO3UK | Knob | 3.4 | 3.8 | DM2HMSO3U | 28 Volt D-C | 60 | 5.5 | 6.1 |
| | | | | | | | | | | AM2HMSO3U | 120 Volt A-C, 400 Cycles | 60 | 5.5 | 6.1 |
| 240 | 400/800 | 0-240 or 0-280 | 9.0 | 2.5 | Open | 2HLO9UK | Knob | 12.8 | 15.4 | DM2HLO9U | 28 Volt D-C | 60 | 14.6 | 17.6 |
| | | | | | | | | | | AM2HLO9U | 120 Volt A-C, 400 Cycles | 60 | 14.6 | 17.6 |
| THREE PHASE | | | | | | | | | | | | | | |
| 240 | 400/800 | 0-240 or 0-280 | 3.0 | 1.5 | Open | 2HMSO3UK-3Y | Knob | 7.6 | 8.5 | DM2HMSO3U-3Y | 28 Volt D-C | 60 | 9.3 | 10.5 |
| | | | | | | | | | | AM2HMSO3U-3Y | 120 Volt A-C, 400 Cycles | 60 | 9.3 | 10.5 |
| 240 | 400/800 | 0-240 or 0-280 | 7.5 | 3.6 | Open | 2HMSO7UK-3Y | Knob | 10.6 | 11.6 | DM2HMSO7U-3Y | 28 Volt D-C | 60 | 12.3 | 13.6 |
| | | | | | | | | | | AM2HMSO7U-3Y | 120 Volt A-C, 400 Cycles | 60 | 12.3 | 13.6 |
| 240 | 400/800 | 0-240 or 0-280 | 15.0 | 7.3 | Open | 2HL15UK-3Y | Knob | 34.5 | 41.0 | DM2HL15U-3Y | 28 Volt D-C | 60 | 38.0 | 45.0 |
| | | | | | | | | | | AM2HL15U-3Y | 120 Volt A-C, 400 Cycles | 60 | 38.0 | 45.0 |
| 480 | 400/800 | 0-480 or 0-560 | 3.0 | 2.9 | Open | 4HMSO3UK-3Y | Knob | 10.6 | 11.6 | DM4HMSO3U-3Y | 28 Volt D-C | 60 | 12.3 | 13.6 |
| | | | | | | | | | | AM4HMSO3U-3Y | 120 Volt A-C, 400 Cycles | 60 | 12.3 | 13.6 |
| 480 | 400/800 | 0-480 or 0-560 | 9.0 | 8.7 | Open | 4HLO9UK-3Y | Knob | 39.0 | 45.5 | DM4HLO9U-3Y | 28 Volt D-C | 60 | 42.5 | 49.5 |
| | | | | | | | | | | AM4HLO9U-3Y | 120 Volt A-C, 400 Cycles | 60 | 42.5 | 49.5 |

See us in
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*Company*....................................................................................
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*City*.................................................*Zone*.......*State*..................

# NEW PRODUCTS FROM INDUSTRY

## *Electronic Larynx*

Rand Development Corp. has developed an electronic larynx which will allow persons without vocal chords to talk.

The transistorized unit which consists of a small speaker case and a plastic tube, can generate a composite sound ranging from 80 to 6,000 cycles simultaneously. It has a built-in speaker attached to the one-eighth inch diameter plastic tube leading to the mouth.

Words are formed by the mouth of the person wearing a unit, and sound, which includes the overtones, is audible through the speaker. A unit is small enough to be worn in a vest pocket or on a necklace.

James H. Rand, president of the company, said that the electronic larynx, which is the smallest vocal chord in the world, will be marketed commercially in several months and will retail for about $300.

## *"Transac S-1000" Transistorized Computer*

The Philco Corp. of Philadelphia, Pa., now offers a large-scale electronic computer for scientific application in research labs, industries and universities.

The Philco TRANSAC, Type S-1000, features new speeds and extensive command structure, providing for the solution of lengthy and complex mathematical problems. The transistors used require no periodic replacement, and the transistor circuitry eliminates bulky insulation and the heavy power supply equipment associated with vacuum tube devices.

Generating comparatively little heat, the S-1000 requires only a small fraction of the air-conditioning equipment normally required for large-scale computers—only the amount of cooling needed for human comfort.

The TRANSAC computer needs no installation work or special wiring. It may be plugged into existing 110 volt, 60 cycle outlets and is equipped with casters, making it highly mobile.

## *Radiotelephone for Field Work*

A new portable AM radiotelephone has been announced by Kaar Engineering Corp., Box 1320, Palo Alto, Calif.

Designated the TR 246 Packset, the new unit was developed to provide reliable field communications in terrain where VHF equipment is impractical—in oil exploration, geological survey, mining, foreign construction, etc.

A small quartz cell, the size of a peanut shell, is the heart of the new "Ionovac," an invention of the DuKane Corp., St. Charles, Ill. The device uses ionic clouds to replace diaphrams in loudspeakers and to beam ultra-sonic (silent sound) waves for industrial, therapeutic and research purposes.

The Packset provides approximately two watts of output power in the 2 to 8 mc. frequency range. Its power is obtained from three 1.5 volt "A" batteries, three 4.5 "B" batteries, and two 7.5 "C" batteries.

Special features include built-in metering facilities, receiver noise limiter, and squelch system. The Packset is entirely self-contained in a watertight canvas backpack and has a base-loaded, telescoping, 16-foot antenna to insure maximum portability. Measurements are 12" x 6" x 11⅜", and weight, including full complement of batteries, is 23 lbs.

## *New "Radio Pill" for Medical Research*

A new 1"-long "radio pill" containing a tiny FM radio station will broadcast news to medical researchers on gastro-intestinal ills.

The new "pill" is an easily swallowed plastic capsule containing a tiny transistor, an oscillator, a ferrite cup inductance core and a minute, replaceable storage battery which powers the oscillator and lasts for 15 hours. The oscillator is so sensitive that its frequency varies with changes in the pressure to which the "pill" is exposed, sending out FM signals which are picked up on an outside FM radio receiver. The "pill" may be manipulated through the body by means of outside magnetic forces, and its course may be traced by fluoroscopy.

The main purpose of the "pill" is to give information on pressures and muscular contractions in the intestinal tract, and it may prove useful in revealing acidity and temperatures. It is designed to study human digestion and absorption under both normal and pathological conditions. Also, it is hoped that the "radio pill" will aid researchers in gaining knowledge about the muscular activity of the right side of the colon, heretofore almost inaccessible for study. This knowledge may prove useful in understanding the pathological physiology of such ailments as spastic colitis, ulcerative colitis and other organic and functional disease conditions.

The "radio pill" was designed by Dr. V. K. Zworykin, as it had been envisioned by Dr. John T. Farrar, and it has been developed and tested jointly by the Rockefeller Institute, the New York Veterans Administration Hospital and the Radio Corporation of America. At present, the "pill" is being used experimentally.

## *Power Supply Unit and Field Test Set*

Two new proprietary products, a missile airborne power supply unit and the Model 604 field test set for AN/ARC-34 radio sets, are now available from the Cal-Tronics Corp., Los Angeles, Cal.

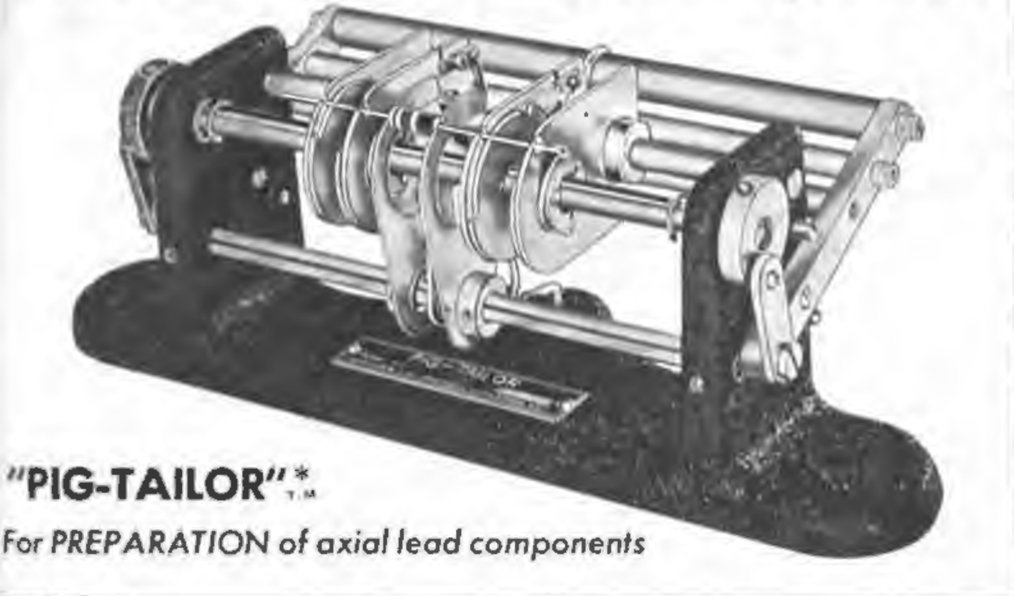
The missile unit is used to furnish power to a missile prior to release. It plugs into the aircraft system, modifying the electrical power to the proper requirements. The unit is potted with a plastic lock-foam which solidifies it in a metal container to withstand vibration or shock.

Model 604 field test set for commercial airlines provides a systematic means of completely checking the operation of the airplane's communication set. Designed in three units to match those of the radio set, it tests out the remote system, the frequency generator or monitor and the mechanical tuning system. According to Cal-Tronics' engineers, a complete check can be made in approximately one hour.

*(Continued on page 146)*

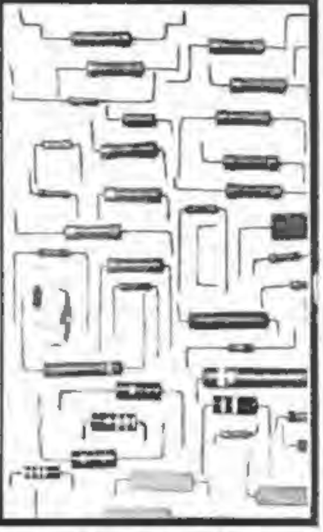
# PROVEN-on the assembly line!

**PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"**



**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*



# "PIG-TAILORING"

***. . . a revolutionary new mechanical process for higher roduction at lower costs. Fastest PREPARATION and ASSEMBLY f Resistors, Capacitors, Diodes and all other axial lead omponents for TERMINAL BOARDS, PRINTED CIRCUITS and IINIATURIZED ASSEMBLIES.***

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time 'rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

**"SPIN-PIN"*** T.M.

**Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.**

* PATENT PENDING

***Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-5P***

**BRUNO-NEW YORK INDUSTRIES CORPORATION**

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET • NEW YORK 1, N. Y.

Pictured here is the new Fairchild UHF beacon transmitter, built inside a standard size sardine can. Transistors and printed circuitry are used throughout.

### Beacon Transmitter Fits in Standard Size Sardine Can

A completely transistorized UHF beacon transmitter, small enough to fit into a standard size sardine can, has been announced by the Electronics Division of Fairchild Controls Corp., Syosset, L.I., N.Y.

Using a Kel-f laminate for its printed circuit, the transmitter is designed to send radio signals a distance of 25 miles continuously for 24 hours. It can be modified for voice or code operation at frequencies other than the 280-322 mcs. for which it was designed.

The output feeds a standard subminiature 50 ohm coaxial cable, attached to a simple self-erecting quarter-wave antenna radiator. The antenna is housed in a hermetically sealed tube only 12" long, but is exploded into action by a small gunpowder charge.

A toroidal type power supply is built into the sardine can that houses the transmitter. Size of the can is 2-3/4" x 4-5/16" x 1". Finished can weighs less than 8 oz.

### Television Line Selector

A new television line selector (Type L.196) is offered by Mullard Ltd., Mullard House, Torrington Place, London W.C.1, England.

With this instrument, it is claimed that any conventional triggered oscilloscope can be used to give a jitter-free display of one or more lines of a television video signal.

The output of the line selector is a sharp-fronted 30V pulse, which can be delayed with respect to the frame pulse by up to 2.5 milliseconds. The delay is "stepped" in synchronism with the line pulse, and coarse and fine delay controls are incorporated for easy selection of the required display.

### New Test Instrument Kits

A new line of electronic test instruments in kit form has been announced by Paco Electronics Co., Inc., 70-31 84th St., Glendale, L.I., N.Y.

The kits are expected to find wide application in radio and TV servicing, hi-fi custom building and service, electronic hobbies and amateur radio, science education and technical schools, as well as industrial testing and quality control.

The first five kits in the Paco line, now ready for shipment, are: The Model B-10 battery eliminator kit, with both 6 and 12 volt outputs; the Model C-20 resistance-capacity-ratio bridge kit, with capacity ranges from 10-2,000 mmfd and resistance ranges from 0.5 ohms to 200 megohms; the Model S-50 5" cathode-ray oscilloscope kit, with 1, Mc bandwidth; the Model T-60 tube checker kit, with free-point lever element selector system; and the Model V-70 vacuum-tube voltmeter kit, with a total of 21 ranges.

### Ultrasonic Flaw Tester

An ultrasonic flaw tester, which gives three simultaneous pictures of the matter being tested, can find flaws in any metallic material.

Mr. Benson Carlin, President and Chief Engineer of Alcar Instruments Inc., Little Ferry, N.Y., described this $25,000 instrument to members of the Society for Nondestructive Testing. He said that it was originally developed for use at the Watertown, N.Y. Arsenal, where it is finding flaws in 14-inch armor plate for Army tanks.

By utilizing sound waves in the ultrasonic frequencies, the instrument is able to detect and plot flaws. Not only is it electronically simple to operate, but no computation procedures are necessary in order to read presented data correctly.

The flaw tester is militarily useful in testing metals in airplanes, ships, guided missiles, and rockets, but it also has industrial applications in the inspection of steel castings and pressure vessels. Mr. Carlin said that the instrument has not yet been placed in production for industrial uses, but will be if there is a demand.

### Instrument Display Projector

A new and successfully tested development in simplified aircraft cockpit instrumentation has been announced by Autonetics, 9150 E. Imperial Highway, Downey, Cal.

Called the Instrument Display Projector, the compact device provides at a glance essential information to pilots for completing an instrument landing, while at the same time allowing visual contact outside the airplane.

Components are a miniature-type cathode ray tube, a mirror system, collimating optics (which make light rays parallel), and a trichroic combining glass using a color contrast principle to enhance definition of the reflected image.

With the color separation principle and cathode ray tube, the instrument can obtain suitable image definition against a bright sky background.

Since the display is focused to infinity, flight data reproduced on the cathode ray tube appear to the pilot as a bright image suspended in space. As a result, the pilot has no eye accommodation problem; he need not transfer his visual attention from the tube image to objects outside the airplane.

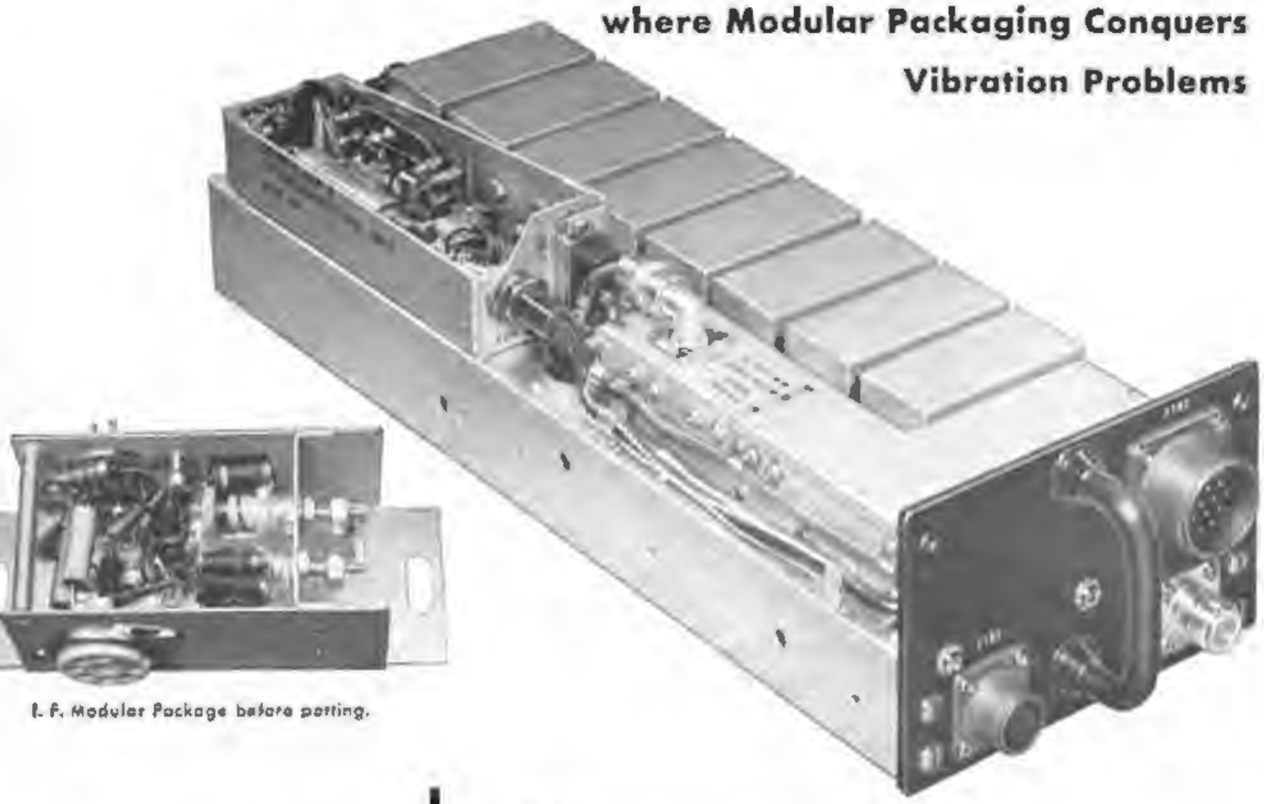
The Instrument Display Projector requires only about 4,000 volts to obtain necessary image brightness—five times less than that needed by conventional cathode ray tube systems.

(Continued on page 148)

# Introducing . . .

# BELL AIRCRAFT'S NEW 400 mc RECEIVER

## where Modular Packaging Conquers Vibration Problems



I. F. Modular Package before potting.

### ELECTRICAL SPECIFICATIONS

**Type:** FM 300 KC Deviation

**Tuning Range:** 406 to 420 megacycles Plug-in assemblies to extend range to 500 mcs available

**Oscillator:** Crystal controlled

**Sensitivity:** 5 microvolts or better for 10 db quieting

**Input Impedance:** 50 ohms

**Bandwidth:** 1.15 mcs ±.1 at 3 db

**Image and Spurious Response:** Better than 60 db

**Output:** ±0.5 db 40 cps to 40 kc 3 db at 100 kc 3.5 volts RMS 500 ohms closed circuit

**Squelch:** Adjustable squelch relay from 10 to 100 microvolts input

**Power Input:** Less than 50 watts. Power supplies available for 400 cycles per second 115V or 28VDC

### MECHANICAL SPECIFICATIONS

**Dimension:** 3.6 x 5.5 x 15.25 inches. Volume 300 cubic inches

**Weight:** 10 pounds

**Mounting:** Solid mounting 9 mounting screws

**Operating Environments:** 15g's 5 to 2000 cycles -55° to +72°C

Bell Aircraft's recent breakthrough in Modular Packaging Techniques was utilized in this rugged, 400 megacycle receiver designed to meet the exacting vibration requirements of Bell's own missiles and guidance systems. It is immediately available for commercial or military applications where demodulated control signals for the activation of any communications system requiring a high signal-to-noise ratio, high sensitivity, high stability, and a wide audio bandwidth with low harmonic and phase distortion are needed. The receiver is equally efficient as a radio controlled receiver for guided missiles...as a ground telemetering instrument...or as either a ground or airborne communications receiver.

The modular construction of the plug-in units in this revolutionary new 400 megacycle receiver also facilitates fast, easy servicing. A comparable 500 megacycle receiver is in the final stages of development.

This is but another example of the engineering imagination of Bell Aircraft's Avionics Specialists in solving tomorrow's complex problems today.

For complete information on these receivers or any other avionic units, systems or components write, wire or phone: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, N. Y.

*WELCOME A. F. C. E. A. MEMBERS AND GUESTS to the exhibit of Bell Aircraft's Avionics Division, Booth 97-98...and to our Hospitality Suite at the Sheraton Park Hotel.*

BELL
Aircraft CORP
**Avionics Division**
**BUFFALO, N. Y.**

# NEW PRODUCTS

Simple dialing procedure for using automatic "dial-direct" mobile two-way radiotelephone system, developed by Du Mont, is here demonstrated by engineer James A. Craig.

## *Automatic Mobile Radiotelephone System*

The first completely automatic "dial-direct" mobile two-way radiotelephone system is now available from Allen B. Du Mont Laboratories, Inc., of Clifton, N.J.

The unique system allows phone calls to and from vehicles to be relayed, completely unattended, through local telephone systems. Unlike other radiotelephone systems, it operates on a 24-hour basis, requiring no manual operators.

Calls are made by dialing a number within a local telephone system; also, anyone within the system may call a vehicle in the same manner. A long distance operator must be contacted for the placing of toll calls only.

It is believed that the low cost of the system will open radio-telephone service to the general public, to truck and other vehicle fleet operations, to boats, and to rural radiotelephone installations in isolated areas.

The system consists of a dial radiotelephone in a vehicle, employing a 2-way radio system as a carrier to the local telephone company installation. A transmitter-receiver base station is also interconnected with the local telephone system. Termination and switching equipment at the base station automatically transfers the radio calls to the telephone system and vice versa. Calls can also be made from vehicle to vehicle. Only two telephone lines—one for telephone-to-radio calls, the other for radio-to-telephone calls — are required to interconnect the base station equipment with the telephone company's central office.

The system is presently used by the Richmond, Indiana Radiotelephone, Inc.

## *New Sweeping Oscillator*

"Rada-Sweep Sr.," a new sweeping oscillator designed to sweep Radar IF's to 280 mcs., is announced by Kay Electric Co., 14 Maple Ave., Pine Brook, N.J.

A broad-band, all-electronic fundamental sweeping oscillator with six switched bands, the new Rada-Sweep Sr. has 24 precise crystal markers set at customer-specified frequencies. Center frequencies are from 1 to 260 mcs. The company states that the unit features all the advantages of the Rada-Sweep plus the integral design of the Vari-Sweep. It is very stable, has low harmonic content and is free of spurious output.

The new oscillator's dimensions are: Standard 8¾" x 19" rack panel, 10" deep, and its weight is approximately 45 lbs. It is suitable for rack mount and can be supplied with a cabinet.

## *Lightweight Telemetering Filters*

The Pacific Coast Division of Aerovox Corp., 2724 Peck Road, Monrovia, Cal., has announced a new line of subminiature, lightweight telemetering filters for missile applications.

The remarkably small size of these filters is 2 cubic inches or less per unit. Telemetering filters for channels 1-6 weigh only 71 grams; channels 7-18 weigh 36 grams.

Completely cast in an epoxy-filled resin, all units are hermetically sealed and are said to meet all applicable MIL specifications for immersion, shock and environmental tests. Temperature range is —55°C to +85°C. Standard input impedance is 20K and output impedance is 100K. This can be varied to meet customers' specific requirements.

## *Airborne Infrared Monochromator*

A new airborne infrared monochromator (AIM) that can be installed in a bomber to observe radiations from other aircraft and missiles is being manufactured by Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

A complete radiation laboratory in itself, the AIM is designed to determine the absolute spectral distribution of radiation from airborne targets in the 1.5-25 micron region, to determine the total radiation from targets, and to record these measurements on a two-channel recorder.

## *New System of Navigation*

Sperry Gyroscope Co. of Great Neck, L.I., N.Y., has announced CYTAC, a new long-range radio navigation system designed for extremely high accuracy.

The new system is said to require only 15 ground transmitters to provide a complete, 24-hour-a-day, all-weather air and sea navigation umbrella over the entire U.S.A. and adjacent sea lanes. CYTAC, reported to be up to 10 times more accurate than presently used systems, is the first navigation system having the range and accuracy for common use by helicopters, and transcontinental or transoceanic planes and ships. The standard LORAN system, developed during World War II and now in use, can be adapted for CYTAC with a simple, two-tube frequency converter.

The proposed system, until recently a highly classified military project, may be a step toward solving the Nation's civil air and sea lane traffic problem.

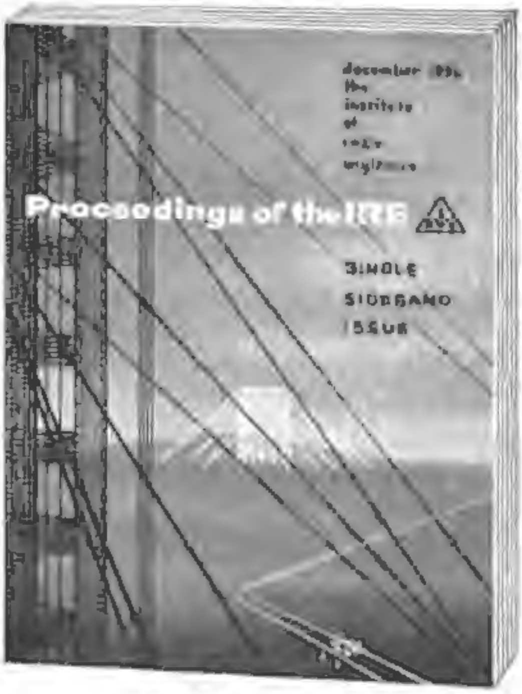
## *Scriber for All Surfaces*

Arch Crown Tags Inc., Newark, N.J., announces the "Perma-Scribe," a marking stylus featuring a newly developed point for inscribing a permanent marking, writing or identification on almost any surface.

Shaped and used like an ordinary pen, the stylus point is designed with cutting edges that cover the base and side in a radial pattern, producing a flowing mark on metals of all degrees of hardness, all types of plastics and

*(Continued on page 150)*

# IRE reports on SINGLE SIDEBAND!



The December issue of **Proceedings of the IRE** presents a round-up of the most recent technical discoveries as presented by the Joint Technical Advisory Committee through its sub committee on single sideband techniques.

Because single sideband offers advantages over conventional AM systems for police radios, taxi radios, ship to shore radios, as well as in many other practical uses, the JTAC has launched a special study for the FCC on this new development in radio communication. Interest in single sideband systems is high because they:

1. **Reduce the size and weight of equipment, allow effective communication when conditions limit the size of the installation.**
2. **Conserve the radio spectrum by not taking up as wide a band of frequencies as do AM signals.**
3. **Permit a reduction in the total radiated power required to accomplish a given communication function.**

The December issue of **Proceedings of the IRE** begins with a guest Editorial by the Honorable George C. McConnaughey, Chairman of the Federal Communications Commission and will take its place in the record of radio-electronics growth. IRE gave you the color TV issues of October, 1951, and January, 1954, the scatter propagation issue of October, 1955, the earth satellite issue of June, 1956, and now December's special single sideband issue—a reference work of the decade!

## Get the Decemher Proceedings of the IRE and get the facts about SINGLE SIDEBANDS

Partial list of contents:

**"Factors Influencing Single Sideband Receiver Design"** by L. W. Couillard, Collins Radio Co., Cedar Rapids, Iowa

**"Frequency Control Techniques for Single Sideband"** by R. L. Craiglow, E. I. Martin, Collins Radio Co., Cedar Rapids, Iowa

**"A Suggestion for Spectrum Conservation"** by R. T. Cox, E. W. Pappenfus, Collins Radio Co., Cedar Rapids, Iowa

**"Power and Economics of Single Sideband Equipment"** by E. W. Pappenfus, Collins Radio Co., Cedar Rapids, Iowa

**"Automatic Tuning Techniques for Single Sideband Equipment"** by V. R. DeLong, Collins Radio Co., Cedar Rapids, Iowa

**"Linear Power Amplifier Design"** by W. B. Bruene, Collins Radio Co., Cedar Rapids, Iowa

**"Distortion Reducing Means for Single Sideband Transmitters"** by W. B. Bruene, Collins Radio Co., Cedar Rapids, Iowa

**"Linearity Testing Techniques for Sideband Equipment"** by P. J. Icenbice, H. E. Fellhauer, Collins Radio Co., Cedar Rapids, Iowa

**"Early History of Single Sideband Transmission"** by A. A. Oswald, (retired) formerly Bell Telephone Labs., Inc., Murray Hill, N. J.

**"Comparison of Linear Single Sideband Transmitters with Envelope Elimination and Restoration Single Sideband Transmitters"** by L. R. Kahn, Kahn Research Labs., Freeport, L. I., N. Y.

**"Application of Single Sideband Technique to Frequency Shift Telegraphy"** by C. Buff, Mackay Radio & Telegraph Co., Inc., Brentwood, L. I., N. Y.

**"A Third Method of Generation and Detection of Single Sideband Signals"** by D. K. Weaver, Stanford Research Institute, Stanford, Calif.

**"An Introduction to Single Sideband Communications"** by J. F. Honey, Stanford Research Institute, Stanford, Calif.

**"Synchronous Communications"** by J. P. Costas, General Electric Co., Syracuse, N. Y.

**"Synthesizer Stabilized Single Sideband System"** by B. Fisk, C. I. Spencer, Naval Research Lab., Washington, D. C.

**PROCEEDINGS OF THE IRE**
1 East 79th Street, New York 21, N. Y.

☐ Enclosed is $3.00
☐ Enclosed is company purchase order for the December, 1956 issue on SINGLE SIDEBAND

**Send to:**

**Name**________________

**Company**________________

**Address**________________

**City & State**________________

All IRE members will receive this December issue as usual. Extra copies to members, $1.25 each (only one to a member).

**The Institute of Radio Engineers**
1 East 79th Street New York 21, N. Y.

wood surfaces, glass, and rubber linoleum. It is said to retain its ability to inscribe for long periods of time without appreciable wear.

The stylus is claimed to be especially useful for the plastics industry, for identification marks on photographic film, for the recording, optical and medical fields, for machinery identification, on jewelry, mirrors, appliances—wherever a permanently inscribed mark or scratch must be made into a surface.

### New ST-10 Aids High Fidelity Systems

David Bogen Co., Inc., of Paramus, New Jersey, has recently announced the introduction of Model ST-10, a moderately-priced facility for the enjoyment of stereophonic tape playback in high fidelity systems.

The ST-10 incorporates dual preamplifiers and a 10-watt amplifier in a single compact unit, plus volume control and tone control.

This addition to the Bogen line now makes possible conversion to stereophonic reproduction utilizing inexpensive tape decks without preamplifiers. It has a shipping weight of 11 pounds and is available with cage and legs.

### Amperex UHF Twin Tetrode

Amperex Electronic Corporation claims that its new Type 6939 twin-tetrode is the world's smallest UHF twin tetrode.

With a seated height of only 2-9/32 inches, the Amperex 6939 is said to be the only miniature tube that delivers 5.5 watts useful power in the load (ICAS rating) at any frequency up to 500 megacycles.

The performance of the Amperex 6939 is due mainly to its exclusive "Frame-Grid" construction, insuring extreme accuracy of inter-electrode. The 6939's special characteristics often permit the elimination of entire stages in original equipment design, resulting in lowered manufacturing costs.

For further information, write to: Communications Tube Division, Amperex Electronic Corp., 230 Duffy Avenue, Hicksville, L.I., N.Y.

### 3-Dimensional Flux Meter

A unique three-dimensional flux meter, which measures the strength of a magnetic field along each of its three rectangular axes, is now offered by the Federal Telephone and Radio Co., Clifton, N.J.

Federal states that the new meter measures three magnetic spatial components instead of the single component measured by most meters. It is equipped with a long thin probe permitting convenient measurements in narrow spaces. It is light, compact, portable and simple to use.

The 3-D flux meter is essentially a d-c generator, and its sensing elements are two armatures, in the form of small measuring coils, which rotate at 3600 rpm in the magnetic field being measured. By means of a special commutator arrangement, one of the coils senses both the X and Y axis of the field while the second is used to sense the Z axis.

### Automatic Radar Performance Monitor

Airborne Instruments Lab., Mineola, N.Y., announces a new radar performance monitor that continuously and automatically presents on meters the r-f parameters of a radar system, i.e., noise figure, transmitter power and relative tuning.

The equipment monitors these parameters during normal operation of the radar without affecting system performance, and it can be adapted either for permanent installation as part of the radar or for such applications as pre-flight checkout of airborne radar in aircraft or missiles.

The system consists in part of 3 precision directional couplers, one for injecting noise from a standard argon discharge noise generator, a second for measuring forward power and a third for measuring reverse power. A separate i-f amplifier channel and video detector system develops two voltages, one proportional to system noise and the other proportional to system noise plus generator noises. This difference in voltage is then measured with a stable vacuum tube voltmeter.

Power is measured with a temperature compensated power bridge and presented on a meter. Comparison of forward and reverse powers produces a VSWR reading on the same meter. Relative tuning is produced by a meter indication on the discriminator in the AFC channel of the system. The relative noise figure of the crystal in use can also be indicated utilizing the normal crystal current meter when the transmitter is off.

## New Literature

### Booklet on Industrial Motion Pictures

A new Kodak booklet, "Industrial Motion Pictures," is now available from Kodak dealers at a price of 50¢.

The 76-page booklet, an optional addition to the Kodak Industrial Handbook, gives the industrial photographer the information he needs to produce low-cost films, plus complete data on all 16mm Kodak motion picture films.

Fully illustrated and prepared after extensive research with industrial companies, the booklet outlines the planning, writing, shooting, editing, processing and titling of industrial motion pictures.

### Price List of AEC Reports

A new free price list of AEC unclassified research reports is now available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D.C.

This listing of the more than 3,600 AEC reports in the OTS collection contains 454 items acquired since June 30, 1956. To obtain the new list, request AEC Research Reports Price List No. 27. The next list will be available in August, 1957.

### Radiation Protective Equipment Folder

A brochure on radiation protection material for X-ray and radioscope applications is available free of charge from Ameray Corp., Route 46, Kenvil, N.J.

The 4-page illustrated folder describes the company's lead insulated lathe, blocks, panels and screens as well as lead doors, pass boxes. light-proof shades and protective windows. Also included are descriptions of control windows, louvers and fume hoods.

### New Bulletin on Resistors

International Resistance Co., of 401 N. Broad St., Philadelphia 8, Pa., now offers its new Catalog Data Bulletin C-1b on tubular and flat power wire wound resistors.

12 pages of comprehensive data are given on construction, characteristics, coating, winding, insulation identification, mechanical strength. terminals and brackets. Detailed charts and graphs are included in the bulletin.

### Radiography on Subminiature Tubes

A new 6-page bulletin, "Radiography in Production Control and Inspection of Subminiature Tubes," is available from the Instruments Division, Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N.Y.

Reprinted from a national technical magazine, the article deals with the basic requirements for precision radiography and describes techniques used by Raytheon Manufacturing Co. Explanatory drawings and photographs are included.

# Armed Forces Communications and Electronics Association

*SALUTES*
*TEN YEARS OF NATIONAL MILITARY UNIFICATION*

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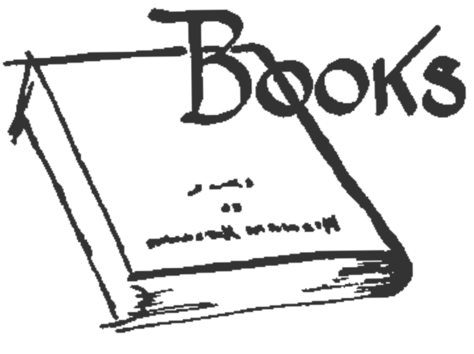
**armed forces day**
**MAY 18, 1957**



***VICTORY IN PAPUA, by Samuel Milner. Office of the Chief of Military History, Department of the Army, Washington, D. C. 409 pages (plus attached maps), $6.00.***

*Victory in Papua* is a companion volume to the one on Guadalcanal in the Department of the Army's series on the war in the Pacific.

The book treats in detail the operations designed to halt the Japanese advance toward the vital transpacific line of communications with Australia in order to secure Australia as a base. Success in Papua and Guadalcanal, gained in February, 1943, enabled the Allies to neutralize Rabaul and, after this was accomplished, to advance to the Philippines.

The author concentrates on the action of the 32nd U. S. Army Division, thus presenting the combat experience of small units in sharper focus than has generally been possible in most full-scale campaign volumes.

Mr. Milner has based his history of the "long cruel fight" on a rich variety of official records—U.S., Australian, and Japanese—plus many interviews and extensive correspondence with the chief participants in the action. The results of his painstaking research show in the wealth of information, plus ample illustrations and maps, that make the pages of *Victory in Papua* come alive.

***FREQUENCY MODULATION, by L. B. Arguimbau and R. D. Stuart. Methuen & Co., Ltd., London; John Wiley & Sons, Inc., New York. $2.00, 96 pages.***

In its discussion of the frequency-modulation system as developed by Armstrong, this book places primary emphasis on the system's most useful feature: reducing the effect of extraneous disturbances introduced during transmission.

The authors state that the improvement is achieved by utilizing changes of instantaneous frequency which are large in comparison with those occurring naturally. The concept of changing instantaneous frequency is given great importance, and in the light of this concept, much detailed circuitry has been discussed.

The book states that attempts to make rapid changes in frequency give rise to circuit response problems restricting the naive concepts of instantaneous frequency. These problems are studied in terms of spectra.

The writers explain that this monograph is mainly based on experience which they gained in the Research Laboratory of Electronics of the Massachusetts Institute of Technology.

***PULSE AND DIGITAL CIRCUITS, by Jacob Millman and Herbert Taub. McGraw-Hill Book Co., Inc., New York, N.Y. 687 pages, $12.50.***

The purpose of this book is to present the important new developments in the field of electronic circuits over the past ten years.

An analysis is made initially of the response of linear networks to the types of waveforms commonly encountered in pulse circuits. The basic non-linearites of tubes and semiconductor devices and their effect on waveform transmission are described and studied. Waveform generating circuits are analyzed in detail, and other fundamental circuits and components are carefully considered. Finally, the basic building blocks are assembled into pulse and digital systems such as radar, television, and digital computers.

Each chapter assembles and correlates circuits and techniques required to perform a basic operation. A number of illustrative examples are worked out in detail.

***THE FIRST 150 YEARS, by the House of Wiley. John Wiley & Sons, New York, N.Y. 242 pages, $7.50.***

This volume, beautifully designed and bound, is a history of the growth of the Wiley firm since 1807 and of the books it has published, largely in the fields of science and technology.

Because the subject matter of the books Wiley & Sons have published is very diverse, specialists in each subject, particularly those with a wide knowledge of the bibliography of that subject, were needed to write an authoritative history of the firm.

The book also describes the people responsible for Wiley & Sons' past publishing ventures, giving some of the problems they faced and some of the ambitions they realized.

Special credit must be given to Martin Matheson, senior vice president and secretary of John Wiley & Sons, for the major role he played in making this book possible.

***HIGH SPEED FLIGHT, by E. Ower and J. Nayler. Philosophical Library, New York, N.Y. 227 pages, $10.00.***

This book deals with the special problems found in high-speed and supersonic flight, including information not previously released for general publication.

First, the authors explain the fundamentals of flight, followed by an account of how successive difficulties were met and overcome and of the inauguration of a new era: breaking of the sound barrier. Research and experiments in aerodynamics and the use of wind-tunnels are clearly described. Also, some account is given of modern rockets and guided missiles, as many of the problems encountered in supersonic flight are as important to rocketry as to aeronautics.

The authors, both of whom are well-known experts in aeronautical research, also review the physiological problems of high-speed flight and assess some of its future possibilities. The style of the book is clear and factual. Illustrations and charts are plentiful, and technicalities are reduced to a minimum.

***GLOBAL STRATEGY, by E. J. Kingston-McCloughry. Frederick A. Praeger, Inc., New York, N.Y. 270 pages. $4.50.***

*Global Strategy*, together with the earlier *The Direction of War* by the same author, has been called a new and important contribution to military science.

The author first reviews the evolution of war and the transition from classical to modern strategy. He then deals with the strategic importance of the world's various geographical zones, followed by a detailed analysis of strategy, including Allied, National, Theatre and Service concepts.

The book advocates Allied responsibility for solving strategic difficulties, and relates National and Service strategies to this problem. The roles and functions of the Services are clarified and new methods and weapons are discussed.

In conclusion, the author states the facts of the contemporary strategic situation, advocating principles and a method of solving Allied strategical problems in order to make the Western world master of that situation.

***TRANSISTOR TECHNIQUES, published by Gernsback Library, Inc., New York, N.Y. $1.50, 96 pages.***

The booklet is a collection of material, originally presented in *Radio-Electronics Magazine*, and presents the next step for those who have already begun studying transistor theory.

The practical applications of ansistors are also discussed. Tran-tor performance, tests, and checks e explained in considerable detail. ae manual includes chapters on the ansistor dc transformer, oscillators d triggers, and the Geiger counter.

### *ANUFACTURING METHODS AND PROCESSES, by Arthur C. Ansley. The Chilton Co., Philadelphia, Pa. 561 pages, $12.50.*

Here is a concise yet varied sum-ary, in one volume, of the newest velopments in manufacturing meth-s, their end products and economics.

The book's main purpose is to give e executive, the purchasing agent, e design engineer and others inter-ted in manufacturing production d design a broad, general back-ound in the latest developments in anufacturing methods and proc-ses. The book is an excellent text d reference book for technical, vo-tional and college courses.

The volume describes briefly the ethods and equipment used in the rious manufacturing processes. It atures over 450 illustrations. It aces its principal emphasis on the nd of parts, plus their chief appli-ation and cost, made by each proc-s. Special attention is given such ew developments as plastics, power etallurgy, investment casting, ultra-nic machining, dielectric heating, tomation and electronic printed cir-uits. Especially to be noted is the hapter on assembly production, hich emphasizes tremendous savings be made on this phase of manu-acturing.

### *HE OFFICER'S GUIDE, 23rd Edition. Compiled by the Military Service Publishing Co., Harrisburg, Pa. 505 pages, $5.00.*

The Officer's Guide is a convenient eference on customs and correct pro-edures pertaining to U. S. Army ommissioned officers.

A new edition of the book was nade necessary by important changes n Army regulations which became ffective this year. They include the ew uniforms, increased survivor enefits, contributory Social Security, he Family Medical Plan, a new effi-iency report, the new "Pentomic" rganization, and other items. A umber of chapters have been exten-ively revised to include these impor-ant new developments.

This illustrated, up-to-date volume ontinues to provide a variety of in-formation on today's officer needs.

### *THE HISTORY OF GERMANY FROM THE REFORMATION TO THE PRESENT DAY, by Prof. Minna R. Falk. Philosophical Library, New York, N. Y. 438 pages, $6.00.*

This text deals with four centuries of German history, emphasizing factual material essential to the reader's understanding of modern Germany.

The author stresses political and economic factors and their effect upon the German people. Included is a full discussion of the present government of the Federal Republic, the situation in Eastern Germany, and a summary of Germany's many unsolved problems.

Professor Falk has served three years with the military government in Germany and Austria.

### *AN INTRODUCTION TO SEMICONDUCTORS, by W. C. Dunlap, Jr. John Wiley & Sons, Inc., New York. 417 pages, $11.75.*

This book is said to be the first single volume on semiconductors to give a complete coverage of the subject. Included are basic concepts, properties of materials, methods of measurement, and applications. Designed to prepare the reader for active work in the field of semiconductors, this study provides a source of general information on all phases.

The approach of the book is almost entirely physical, with emphasis on mechanisms and modes of operation. The author minimizes formal theory and minute detail wherever possible.

### *ELEMENTS OF COLOR IN PROFESSIONAL MOTION PICTURES, edited by Wilton R. Holm. Society of Motion Picture and Television Engineers, New York. 104 pages, $3.50.*

This book is intended to provide authoritative help in the use of color to the producers and buyers of theatrical, industrial, educational and television films. It is also of interest to engineers and amateur photographers.

The volume's twelve chapters take up such topics as: characteristics of color, color films and processes, photographing a motion picture in color, special effects, color processing and printing, and the relationship of motion pictures and color television.

Members of a special committee under the SMPTE Color Committee contributed their specialized knowledge of motion picture and TV production. 27 pages of color illustrations supplement the text.

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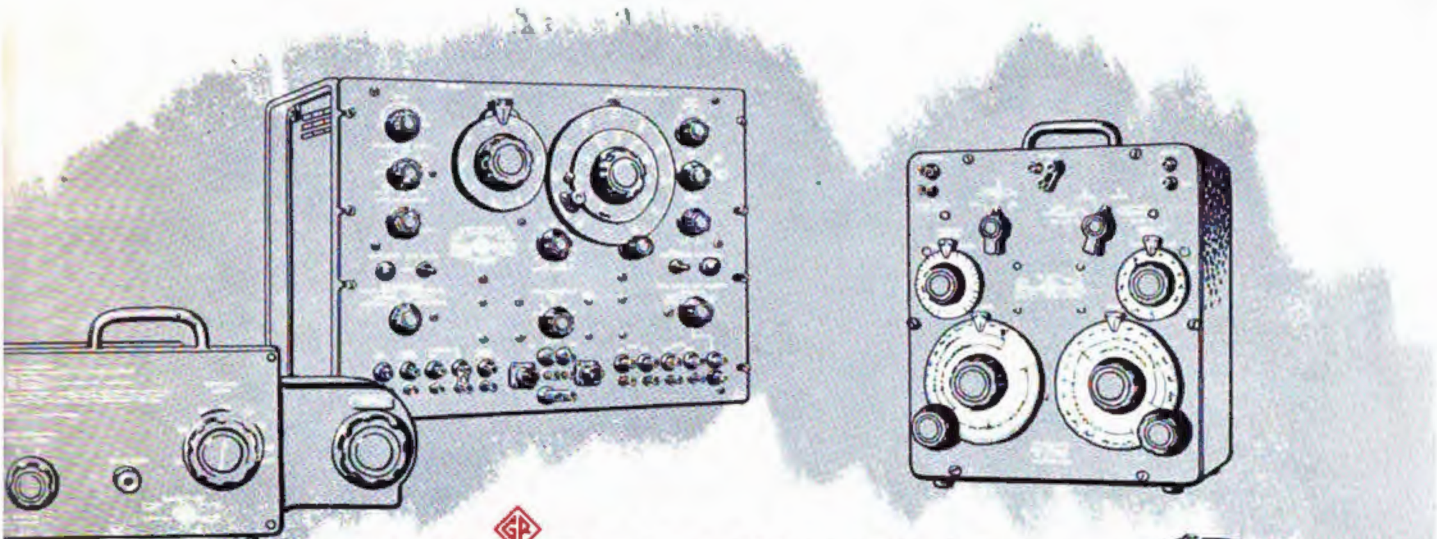

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- ✓ Ganged units available with no loss of excellent low-capacity characteristic offered by individual units.

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**Uniform Contact Pressure** at all settings assured by unique circular brush-arm — also minimizes effects of side-thrust on shaft.

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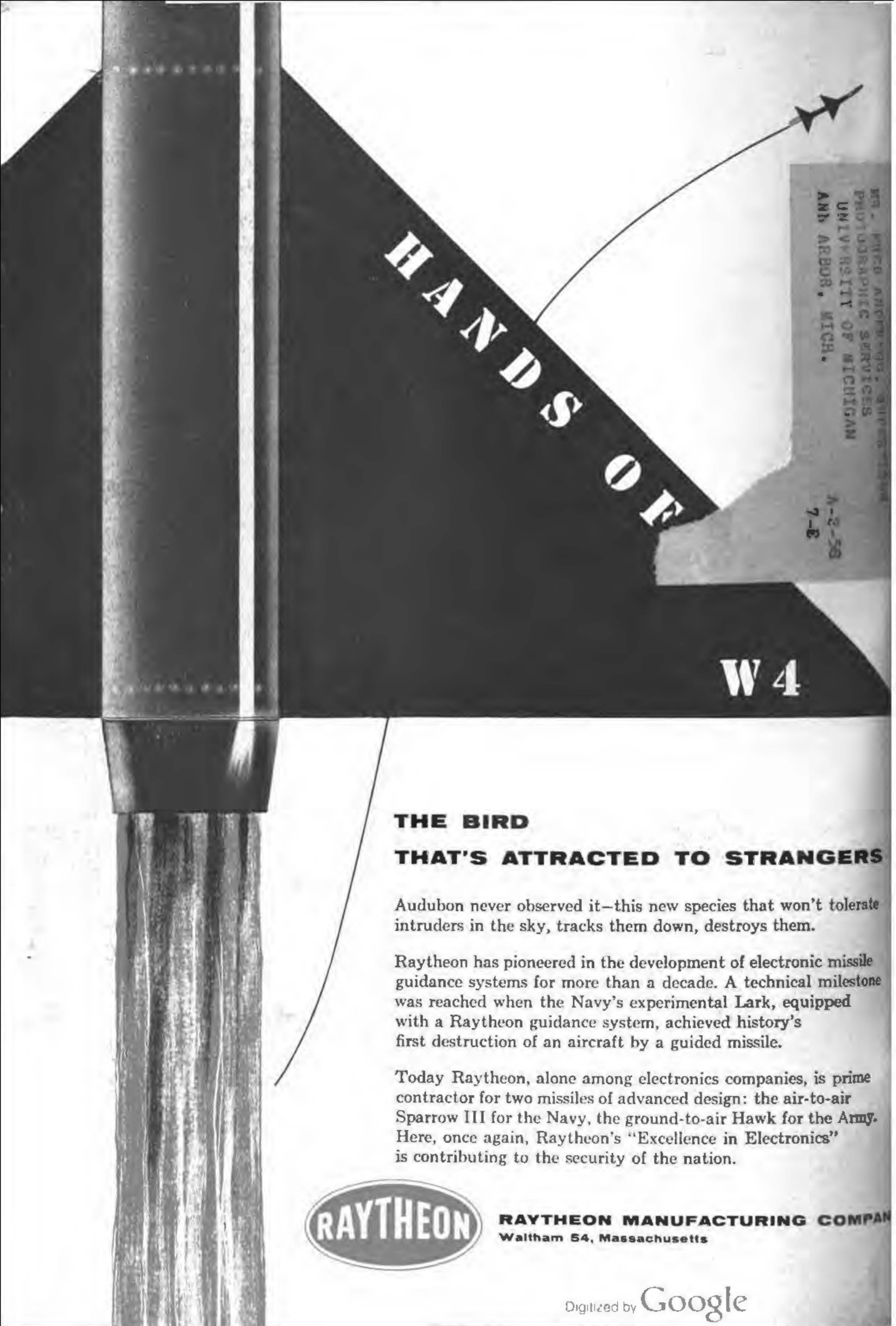
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June 1957

Communications—Electronics—Photography

# SIGNAL

Armed Forces Communications and Electronics Association

# THE FLIGHT HEARD 'ROUND THE WORLD

Recently three B-52 bombers flew around the world in 45 hours and 19 minutes. They were only specks in the vastness of the sky, yet they were in voice-contact every mile of the way—with SAC headquarters in Omaha, with each other, with bases along the route and with the KC-97 tankers that refueled them in the air.

Their speed-of-light contact was the AN/ARC-21 liaison communications set in each of the ships. This is a long-range, pressurized, high-altitude airborne system, capable of world-wide communications. It may be operated by the pilot, so no radio operator is needed. It is characterized by minimum training requirements, simplified maintenance, high reliability, positive channel selection —with a choice of any 20 of 44,000 frequencies.

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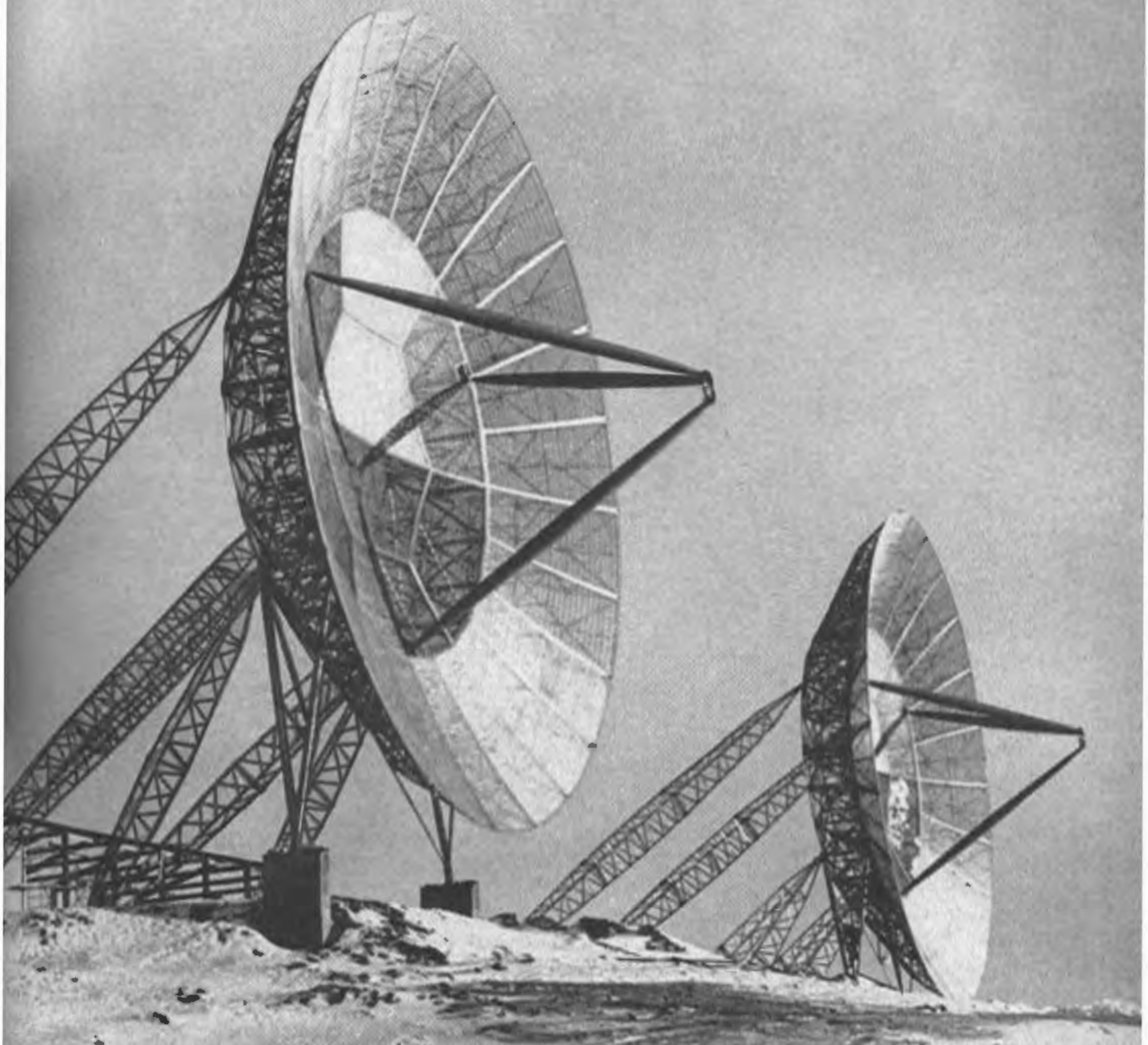

# SIGNAL

**Communications-Electronics-Photography**

Journal of the Armed Forces Communications and Electronics Association

**VOLUME XI** **JUNE 1957** **NUMBER 10**

1624 Eye Street, NW
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BPA

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## Cover

SIGNAL's *cover picture is a new Raytheon "Flight Tracker" radar with a giant 40-foot antenna which will be a key part of a complex Civil Aeronautics Administration air surveillance system that follows and helps safeguard all aircraft during every stage of flight.*

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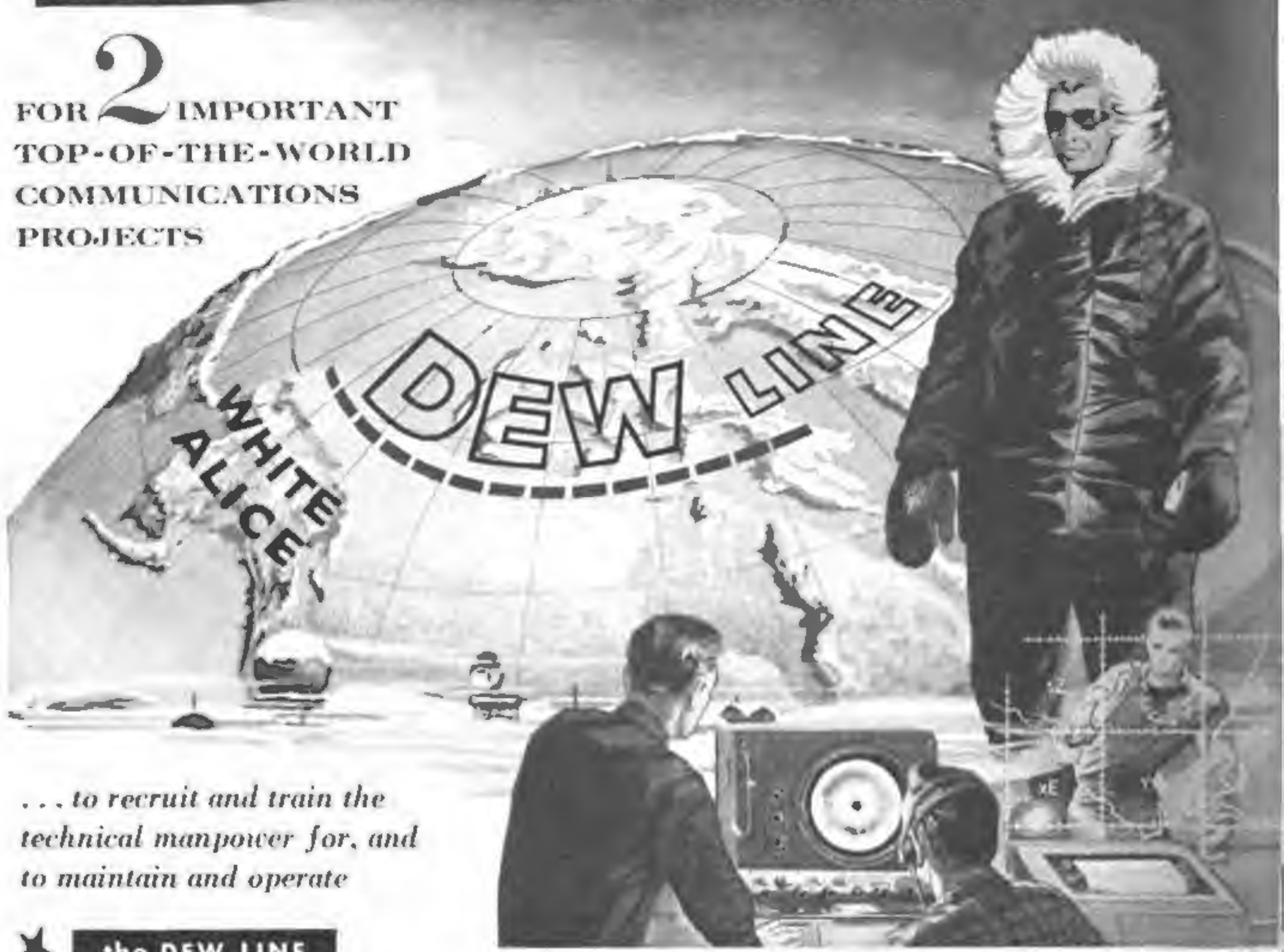

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- **WHITE ALICE**

Two of the greatest Arctic construction jobs ever attempted are drawing to a dramatic climax.

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The other, Alaska Integrated Communications Exchange (White Alice), is a vital network including "over-the-horizon" and "line-of-sight" microwave links connecting isolated communities and defense installations across Alaska, as well as existing telephone and telegraph services.

Manpower of the highest order in skills, stamina and intelligence is imperative. The U. S. Air Force has selected Federal Electric Corporation, a subsidiary of International Telephone and Telegraph Corporation, to operate and maintain both these far-flung installations.

Federal Electric Corporation's experience on military assignments in the Arctic . . . in the maintenance of specialized navigational equipment for the Air Force . . . as a field service and maintenance organization for IT&T's laboratories and factories . . . coupled with the world-wide experience of IT&T, make this an ideal partnership for so broad and technical an undertaking.

IT&T

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, 67 Broad Street, New York 4, N. Y.

# BUAER'S NEW AVIONICS DIVISION MEETS ELECTRONIC WEAPONS NEEDS OF NAVY AIR ARM

U. S. Navy Photo

Brand new in the Navy Bureau of Aeronautics, the Avionics Division is responsible for all aspects of research and development of electronic fire control and weapons launching equipment for Navy aircraft and guided missiles. This Division deals daily with problems undreamed of as recently as World War II. To ensure that our Navy air arm will continue to be the most effective and ultra-modern in the world, it plans in terms of 10, 15, or 25 years hence. Its personnel must think in terms of Mach 10 speeds or altitudes of 20 or more miles.

This vital R & D mission, which was formerly accomplished by the joint efforts of Armament and Electronics Divisions, has been merged in the Avionics Division to include a wide variety of electronic functions. Among these are ground station telemetering and instrumentation; guidance systems; warheads; fusing and launching of guided missiles; fighter attack systems; airborne early warning systems, and many others.

To coordinate the many programs under its jurisdiction, the Division has established a "Project Manager" system of organization. This system provides maximum streamlined operation and facilitates industry contacts as well. The personnel of the Avionics Division thus are enabled to develop with maximum facility the incredible electronic equipment needed by today's and tomorrow's aircraft and missiles. With their special knowledge and far seeing outlook, they will make certain that the new higher speeds, altitudes and ranges of aircraft are utilized to full effectiveness.

◀**FJ-3 Fury goes aloft from one of the after catapults of the U.S.S. Forrestal. An F2H-3 Banshee is in the foreground. Electronics developed by BuAer's Avionics Division provides planes such as these with their highly effective weapons and control systems.**

▲
**Engineer at Ford Instrument Company opening salt spray chamber in which equipment for BuAer is being subjected to environmental test.**

This is one of a series of ads on the technical activities of the Department of Defense

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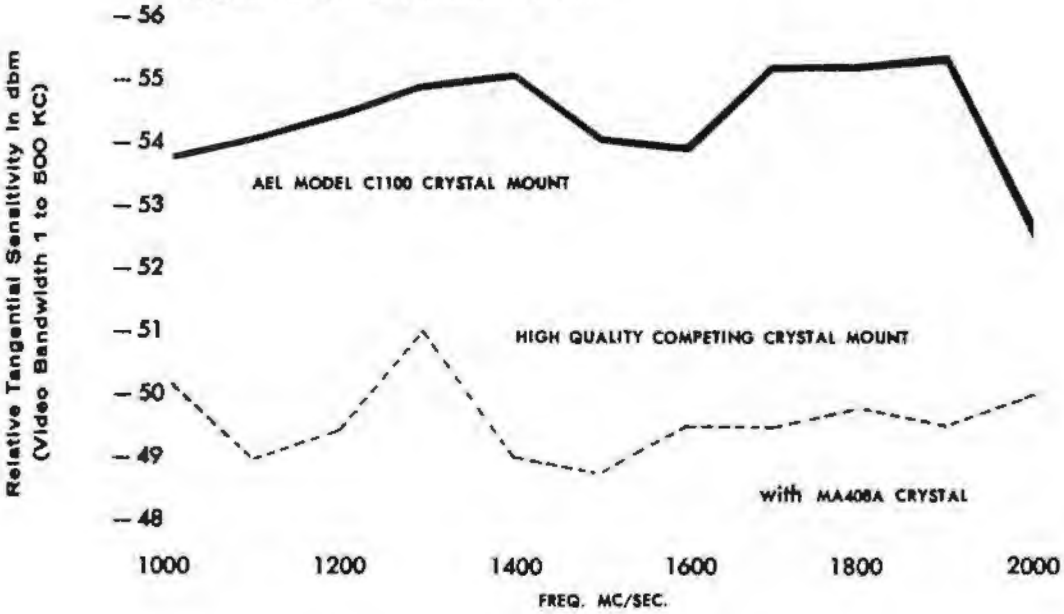
Typical tangential response curve:



**NOTE:**
Tangential sensitivity is defined as the power level of the incoming signal at which signal plus noise equals twice noise. "TS" is read when the bottom of the noise inside the pulse is tangential to the top of the noise outside the pulse. It is measured in – n dbm, where "n" is the power level of the signal in db below one milliwatt.

Model C1000
500 – 1000 MC Band
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Max. VSWR 6.6
Relative improvement over the band in tangential sensitivity over best available competing crystal mounts: 0 to 5 db
Weight: approx. 4¾ oz.

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Max. VSWR 7.2
Relative improvement over the band in tangential sensitivity over best available competing crystal mounts: 3 to 6.5 db
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2/3 actual size

**AMERICAN ELECTRONIC LABORATORIES, INCORPORATED**

121 N. SEVENTH STREET
PHILADELPHIA 6, PENNSYLVANIA

# COMMUNICATIONS IN THE NUCLEAR AGE

by James E Dingman
Director of Operations Long Lines Dept
American Telephone and Telegraph Co

## A New Dimension

GOOD COMMUNICATION SERVICE is dependent upon many things—research, design, construction and even so intangible an item as the communication man's pride in performance. But no single effort or objective is more important than reliability, or continuity of service. For a communication facility that fails, particularly in time of emergency, is of questionable value to the user.

### *Constant Vigilance Required*

Protecting vast and complex nationwide communication networks against interruption requires constant vigilance and is a never-ending task in the Bell System. Interruption may stem from many sources, some natural, some man-made. The capricious, uncontrollable forces of nature, in the form of floods and hurricanes, are good examples. The curious phenomenon of sun spot activity with its disruption of international radio communications is another.

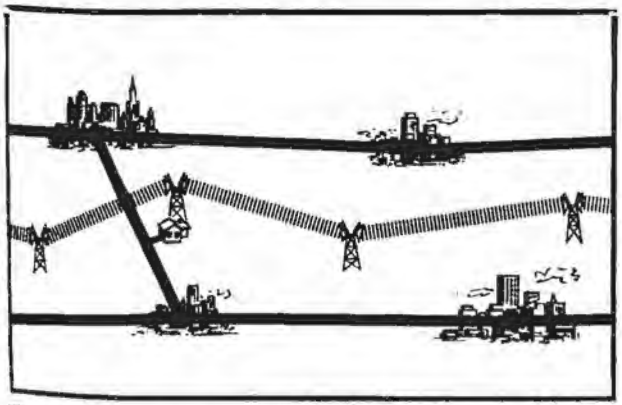
There is also man himself; a typical example is the farmer who cuts a transcontinental cable while planting a fence post, or a contractor who rips through a cable while bulldozing a roadway. Both unwittingly terminate television programs, hundreds of telephone conversations and all other information that may be routed through the cable they have severed.

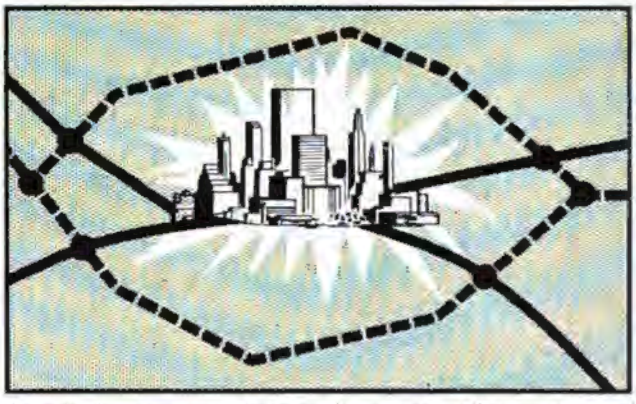
Fortunately, the Bell System's national network of communications is basically comprehensive. Telephone people have always been mindful of the need to protect services by diversifying facilities. Because of the scope and flexibility of long distance routes and interconnecting lines, services can be routed easily around a single trouble area, or several major metropolitan centers if necessary.

### *This Nuclear Age*

*In recent years, however, telephone engineers have been confronted by a new concept, brought on, as one might suspect, by the pervading influence of the nuclear age. The nuclear family of weapons, with their awesome potential for destruction and devastation, has introduced scores of new problems to the overall job of maintaining communications. They have, in fact, brought a new dimension to the task of planning and constructing communication plants.*

The Bell System has an answer to the many plant protection problems thrust on us by the dawning world of atomic energy and all of its known ramifications. We have launched—and have half completed— the construction of new facilities that will enable us to maintain communications across the length and breadth of the country in the face even of





The radio relay express route (left), like a modern express highway, cuts through the open area between large metropolitan centers and provides an interconnection point for existing communication routes. A typical large city (right), considered a potential target area, is bypassed by radio relay or cable facilities. The route forms a complete ring around the city, allowing for several interconnection points with existing through-city lines.

severe, large scale attacks with nuclear weapons.

These facilities are known simply as "express" and "by-pass" routes. The express routes are direct communication highways that span long distances and avoid critical target areas. One such route runs from Maine to Southern California, and doesn't go through a single major population area.

The by-pass routes form a partial or complete ring around cities or towns. These provide access in and out of the by-passed area and give a trouble-free path around the city when necessary.

### *Present Communication Network*

But, before getting into a detailed discussion of the current protection program, let's review the development of Bell System facilities prior to the advent of the atomic bomb.

Since the earliest days of telephone expansion, the plant that was built to provide facilities between widely separated communities was also used, as a matter of economy, to service intermediate communities along the same route. As the communication network expanded, several different pathways usually have become available between any two cities. Thus, only the worst and most widespread storms and floods have more than local effect on the Nation's communications.

The town-to-town concept of communication systems has given birth to the one major hazard, however—the heavy concentration of circuits and terminal installation in the big cities. To alleviate this condition, circuits that did not have to be routed through the large metropolitan centers have now, in many instances, been routed around them. This was made possible by the construction of large capacity routes which avoid such locations as New York, Philadelphia, Washington and Pittsburgh. To a great extent these routes, linked to switching centers outside the big city areas, minimize the possible effect a bombed-out city would bring to bear on the nation-wide communications network.

### *Expansion of Express and By-Pass Routes*

The increased demand for long distance communication in recent years has exhausted the capacity of many of the older routes. This, plus the chilling knowledge of what an aerial attack could do to this country, prompted telephone management to review and re-draft plans for the protection of service.

And now, well under way, are the express and by-pass routes previously mentioned. There are many individual links, of varying lengths, totalling some 6,000 miles. When completed in 1958, they will skirt, by substantial margins, all of the country's larger cities, military installations and generally congested areas which might be attractive bombing targets.

The new routes will have a nominal capacity of about 3,000 circuits. As the first groups of circuits go into service, they will be able to carry all military traffic and much civilian traffic.

Express routes are so-named for their similarity to the super-highways and toll turnpikes that are beginning to interlace the Nation. These express routes have branches and interconnections with existing cables and microwave systems which provide access to the cities and towns they avoid. Whenever necessary, terminating traffic can be routed "in" and orginating traffic routed "out" of these towns.

By-pass routes are intended for situations where existing routes passing through a town or city are adequate for present needs and for substantial growth. In these instances express routes are not justified. By-passes are for circuits which do not terminate in the town, but merely pass through and which can therefore be routed around the town—well outside of the potential danger area.

At certain interconnection points along both the express and by-pass routes, radio relay main stations like the one pictured here, will tie new routes into the network.

### *Engineering Objectives of Express and By-Pass Routes*

In shaping this program of express and by-pass routes several objectives have been kept in mind.

1. All the telephone message circuits between two cities should not be carried over the same route. They should be divided among different routes, so that all circuits will not be exposed to the same hazards. At least one of the routes between any two cities in the country should not pass through any target area.

2. Similar dispersion should be provided for essential civilian and government private line circuits. There should be adequate capacity along the various routes so that if one or more is completely destroyed, service may be restored quickly over other pathways.

3. Suburbs of large cities should be provided with connections to the by-pass and express routes so that communication between the fringes of possible disaster areas and the rest of the Nation can be maintained.

### *Connection of Fringes to Express and By-Pass Routes*

So far our attention has been focused principally on the protection of intermediate sections of inter-city circuits. If a city is bombed, however, it will be necessary to establish immediate communication to the fringes or suburban sections of the damaged area. In the past, inter-city communications were routed largely through the center of the city and, consequently, would be severed if the city were destroyed. To assure continuity of service to suburban areas which might be expected to remain unharmed, cables are being constructed to connect fringe areas directly to the by-pass or express routes without going through potential damage zones. Some of the circuits from suburban areas to other cities can be operated regularly over the new routes.

In addition, facilities are being provided at many interconnection points on the express and by-pass routes to permit the rapid creation of totally new circuits with direct connection to outlying points in case of disaster.

### *Types of Facilities Used*

Radio relay systems and coaxial cables are being used in most of the new construction because they can provide the large quantities of circuits needed.

The points where the express and by-pass routes interconnect with other routes have been carefully selected from the standpoint of accessibility and housing of personnel. At many of these locations, continuous coverage is necessary. In some cases, where the location of the building or its relative importance justifies such treatment, buildings are blast-resistant. A minimum number of windows have been built into the structures and careful air-filtering will give added protection against radioactive fallout. Water supplies have been provided which can be maintained free of radioactive matter.

### *Emergency Power and Rapid Restoration Plans*

To insure continuity of operation in the event of commercial power failure, all stations are equipped with battery power plants. In addition, emergency engine alternator units of sufficient capacity to carry the entire station load are installed. These emergency units start automatically when commercial power fails.

If service were interrupted due to the destruction of a radio relay station, rapid restoration has been made possible through the use of truck-mounted radio units, located at strategic points across the country. Each mobile unit consists of transmitting and receiving microwave radio equipment, associated power and testing equipment, waveguide and antenna equipment, emergency engine alternator and a scaffold type tower. This unit can restore one transmitting and one receiving broad band radio channel. The radio, waveguide, antenna and testing equipment are mounted on the vehicles in such a manner that the entire unit can be quickly placed in service. The power generator is trailer-mounted.

### *Meet The Challenge— A Bell Policy*

In line with its long standing policy, the Bell System will continue to take any and all reasonable measures to assure continuity of telecommunication services. Its record in designing plants that will provide this service has been good. While the possibility of nuclear bombing with the simultaneous destruction of many large cities has introduced another challenge, this challenge is being met with a program of by-pass and express routes. The extent to which these methods provide the protection necessary for the communications vital to the Nation's defense is the subject of never-ending study and evaluation, and we are keenly aware that survival may be the reward of vigilance.

This mobile unit is capable of replacing damaged radio relay stations. Placed at strategic locations around the country, one of these could be rushed to any trouble area.

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# TRANSISTORS . . . a revolution in electronics

**by Daniel E. Noble**

**Executive Vice-President, Motorola, Inc.**

THE REVOLUTION IN ELECTRONICS has started, and the tiny transistor is the impetus behind the change. Wherever transistors can be used in electronic equipment of all kinds, they offer the potential for new dimensions in reliability, in packaging, and in power consumption. To characterize the transistor, it is a tiny slab of mono-crystalline germanium or silicon, which has been modified by alloying or diffusion techniques to make a device capable of amplifying current, in a suitable circuitry arrangement.

It may be interesting to compare this bit of solid material (which has no moving or delicately suspended parts, and no power-consuming cathode) with the vacuum tube. Compare the vacuum tube micro-dimensioning and micro-spacing of plates, grids and cathode, and the electric furnace to heat the cathode, with the transistor which is essentially a vibration-proof, shockproof, heaterless slab of solid semiconductor material. Fundamentally, the structure of the transistor is so much more rugged and reliable than the structure of a vacuum tube that the difference requires no emphasis.

The advantage of the transistor over the vacuum tube in terms of increased reliability is not, however, the simple advantage of the rugged mechanical structure; it goes far beyond this. The vacuum tube generates heat and it frequently operates with voltages of 180 or higher. It utilizes condensers and resistors in circuitry subjected to very substantial voltage and current values, even in low power level circuitry configurations. Consider the heat factor.

The digital computer, utilizing vacuum tubes, requires the addition of a refrigerated air-cooling system, even though the counter tubes work at low power levels. The same computer, utilizing transistors, requires only a fraction of the power input and no refrigeration. A point of note is that the failure of equipment using vacuum tubes is not only the failure caused by tube defects or tube malfunctioning, but it is also the failure of circuit components which have been subjected to the excessive heat, the excessive currents, and the excessive voltages which characterize vacuum tube circuitry.

### *Practicability*

In comparison, for transistor low power level circuitry, low voltage and low current is all that is needed. 6, 9, 12, 14 Volts may be used with transistors at one's convenience, and where necessary the total circuitry for a multiple transistor device may be limited to microamperes or to a few milliamperes. Thus, in transistor circuitry, with 12 Volts as the maximum voltage and with no significant heat generation, the components are not challenged by power supply needs which can destroy or limit the life of condensers and resistors.

If an electronic equipment is to serve as a useful tool, it must be reliable, and the maintenance procedures must be practicable. No matter how beautiful the scientific embodiment of the device may be, it is worthless for industry application if it is unreliable and if the maintenance is a headache in field operation. In the simple device, the maintenance is simple, but as the devices get more and more complex, the maintenance problem rises and rises until there seems to be no easy solution. Witness the rise in the complexity of consumer goods broadcast receiver equipment from the ordinary home radio set, to black and white TV, and now to the supercomplexity of the color television unit. There seems to be a natural law of nature, for technological devices at least, prescribing a path leading ever upward toward greater and greater complexity. Unless we rationalize each successive complex design for sensible maintenance procedures, we will eventually reach a saturation of complexity where maintenance will be impossible.

In military electronics, as well as in industrial and commercial electronics, there is a trend, I hope to see accelerated, toward the design of devices with unit or module and submodule construction, and wherever possible, toward sealed modules which will be replaced but not be repaired in the field. This design trend offers two distinct advantages toward improved usability of equipment. (1) The sealed module will prevent undisciplined tinkering on the part of the over-zealous maintenance man. (2) The module and sub-module configurations will permit routine servicing measurements to be made to locate the sub-assembly which is at fault.

This routine location of the faulty sub-section reduces immediately, the *total* complexity of the whole equipment structure, to the *limited* complexity of the single faulty module or sub-module. The competent serviceman can then either locate the faulty part in the sub-module or replace any sealed module with a standard replacement unit.

All this would seem to be a digression from the main subject of transistors, but you can be assured that it is not. Modular and sub-modular construction, and sealed modules, had very limited practicability as long as we were faced with the need for vacuum tubes which are plug-in consumable devices and which contribute a nearly unsolvable problem of heat control.

### *Modular Construction*

Now, with transistors, with low heat generating characteristics and with low voltage operating requirements, it is possible not only to design printed circuits using transistors and other components in a replaceable assembly, but it becomes possible also to seal an entire functional circuitry configuration in a module. This sealed module may be expected to have a life expectancy equal to that of the life of the total equipment. Actual module replacement would be limited to a small percentage of defective units. With transistors, modular construction becomes practical.

One of the revolutions inherent in the application of transistors is an accelerated move toward modular and sub-modular construction for easy servicing, for flexibility of design changes, and even for retro-fitting where the modernizing of a unit becomes possible through the change of a module. Modular construction, sealed modules, printed circuitry, and simplified servicing are all part of the pattern which will be accelerated by the wide application of transistors and semiconductor devices.

Now a lot of nice things have been said about the transistor, but nature has a habit of mixing a suitable proportion of negative factors with the positive, even when the positive ones are dominant. It is a mistake to assume that the transistor is simply a substitute for a vacuum tube. The transistor, in terms of functions, will oscillate and amplify as a vacuum tube will, but its characteristics and its operating parameters differ widely from those of a vacuum tube. In meeting the requirements of the design of equipment utilizing transistors, a substantially new approach must be made.

### *Applications*

The transistor is a rugged, reliable device capable of exceptionally long and successful performance, but it must be emphasized, that it should not be called upon to work in circuitry configurations for which it has no talent. For example, the transistor is not a high impedance input device. It is possible to arrange a combination of transistors to produce the equivalent of a high impedance input, but in general, the simple transistor consumes power even in the input circuit, and energy is required to drive it. The output and input of a transistor triode are rather closely coupled, and variations in the load will reflect back into the input.

The transistor is also temperature sensitive, with substantial parameter variations with temperature changes. So far, we have no transistor with the equivalent of the screen grid isolation, commonly associated with vacuum tubes. High frequency transistor amplifiers must be neutralized. Also, the transistor does not perform importantly as a stable d.c. amplifier.

With all its faults, the transistor is still a magnificent device. By the use of compensating circuitry and inverse feedback circuitry, it is possible to adjust the circuit parameters to produce exceptionally reliable results despite the limitations. The vacuum tube is no paragon of all virtues, but we have learned to compensate for its faults, and we must learn to do the same for the limitations we find in transistors.

The transistor has been rather slow in moving into commercial equipment and the wide variety of electronic applications. Many of you who have not made a study of the subject are undoubtedly wondering why industry has been so slow in adopting the transistor.

### *Availability*

First of all, remember that for a number of years the transistors in production and available on the market were essentially audio amplifying levices. They were suitable for hearng aid applications and for minor udio amplifier construction. There vere no suitable power transistors on he market, and there were no satisactory radio frequency transistors vailable in suitable quality and uantity.

In the last few years, there has een a change in this situation. Tranistors are rapidly becoming availble commercially for applications up o about 12 megacycles. In the laboratory, transistors have been made or successful oscillation and amplification applications as high as 400 negacycles, and in a few isolated intances, as high as one or two thouand megacycles.

Shown above: Motorola "Power Voice" mobile speaker has a built-in transistor amplifier which provides up to 10 watts audio output when fed by the usual mobile communications receiver with 1.5 to 2 watts audio output.

You have probably noted that hybrid car radio broadcast receivers are on the market, utilizing tubes operating with 12 V. plate supply in all the preliminary stages, and employing power transistors for generating the audio power to drive the speaker. Tiny, transistorized, portable broadcast radio receivers have also hit the market in the past couple of years.

### *Potential Not Realized*

But, with all of this activity, there is still no substantial pattern of transistor application to industrial and commercial equipment, either in mobile communications, in the digital computer, or in other electronics fields. Why? The answer to the question is covered in three sections.

(1) R. F. transistors satisfactory in performance and price are just coming on the market in quantity, and a substantial history of performance and characteristics has not yet been established. There is always a substantial delay between the availability of a component and the release of the component as a part of a matured commercial device. There has not been time enough to pass through that cycle.

(2) The problem is not one of simply substituting transistors for vacuum tubes, and new circuitry configurations. New compensation means and optimum circuit design must be developed to utilize the best characteristics of the transistor and to neutralize the negative factors. It takes time for the engineers to become familiar with all the idiosyncrasies of transistors in the great number of circuitry applications.

(3) The germanium transistor, which is the only one available in quantity and within commercial price range, has a definite heat limitation of a nominal 60°C. environment, with an upper limit not exceeding about 80°C. If it had been possible simply to put a few transistors here and there in existing vacuum tube equipment, the rise in the application of transistors to modern electronic circuitry would have been accelerated. This was not practical because vacuum tube equipment generates excessive heat, and the transistors would have been subjected to temperatures beyond reasonable operating tolerances. Note here that, when equipment is completely transistorized and the vacuum tubes, with their inherent furnace characteristic, are removed, there is no heat problem, but the placing of transistors in the usual high temperature vacuum tube equipment is not a sound approach.

### *Silicon or Germanium*

The question will immediately be asked as to whether or not silicon transistors should be used instead of germanium transistors. The answer today is emphatically "No." In general, it may be said that it is possible to make better transistors, as well as lower cost transistors, using germanium, when the temperature can be held under 80°C. At present, the silicon transistor is a high cost specialized device with characteristics especially suited for operating temperatures above 100°C. In the great majority of industrial and commercial electronic equipments, there is no need for an equipment environment specification exceeding 60°C., if you do not build heat-generating devices such as vacuum tubes into the equipment along with the transistors.

### *A New Field*

The transistor and semiconductor field is new. We are only at the threshold of a revolutionary new structure in the electronics art. A substantial, continuous and accelerated flow of new semiconductor devices from the laboratory into the market over the next five year period is anticipated.

While the application to radio and conventional electronic devices will be substantial, there may be an overwhelming rash of applications in fields never before exploited in an electronic sense. The breadth of transistor applications should exceed that of vacuum tubes and by 1960, there should be more transistors sold and placed in new equipment than vacuum tubes.

The characteristics of semiconductor devices will be extended. The time will come when we will have new transistor or semiconductor amplifier configurations which will isolate the input from the output, others which will give us high impedance input circuits, some of which will give us very substantial power output, and some really practical devices working at frequencies as high as 400 megacycles and above. Transistors are in the future. You will use them in your homes, offices, factories, trains, automobiles, airplanes, communication systems, and in a multitude of durable consumer goods and industrial gadgets and control devices.

Illustrated are three of the new transistorized Motorola Handie-Talkie portable radiophones. From left to right are: the lightweight maximum portability version including handset-type microphone and standard dry battery power pack; the speaker and microphone version with extra-duty battery power pack or rechargeable nickel-cadmium wet cell-6/12 volt power pack, and the high-powered pack version with rechargeable nickel-cadmium wet cell power pack or extra-duty dry battery pack.

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***The United States has become "budget conscious" and the taxpayers are extremely concerned with receiving value for money paid. Economy-minded men at the Bureau of Ships are at work increasing the value of the Naval dollar as it is applied to defense contracts. The following article points to the benefits and potentialities of a "Value Engineering" program as developed by the Navy in the field of electronics.***

# VALUE ENGINEERING

***by S. C. Bregman***
***SIGNAL Staff***

A BRAND NEW CONCEPT CALLED Value Engineering" is impressively eing put to work at the Bureau of Ships, Navy Department. Designed to bring the manufacturer in as part f a defense team working with the military, the new concept emphasizes he "second look" in the design of lectronic equipment, including a critical appraisal of Government pecifications.

Precisely, Value Engineering is deined as, "an objective appraisal of all elements of the design, construction, procurement, installation and mainenance of an equipment, including he applicable equipment specificaion in order to achieve necessary function, maintainability and reliability of an equipment at minimum cost." This sounds like a large assignment, but it has a winning, constructive, common sense approach to the problems of outmoded contract specifications.

### *Specific Examples*

During an interview, Mr. Albert Sikorsky, Electronics Assistant to Captain John M. Waters, the Director of Value Engineering, adequately pointed out the necessity for such a study with some rather startling examples of monetary waste. He displayed what looked like an ordinary capscrew, and added that the military was charged $2.11 for it instead of the usual three cents paid for the standard capscrew. The reason—its design was about 3/32 of an inch longer than the standard. This item necessitated special tooling where the standard capscrew would have sufficed. Mr. Sikorsky also showed us a waterproof washer, not as large as a lifesaver, which could be purchased at a local hardware store at the rate of 20 for one dollar. The Navy pays one dollar for one. Why? Because the standard specification requires that it should be wrapped individually for special overseas shipment; and so the small washer is shipped in several foldings of protective paper and metal foil. These are not extreme examples, and even these illustrations of monetary waste can easily be eliminated, once Value Engineering reaches all manufacturers involved in defense contracts.

The problem lies in the fact that the engineer writing the military specifications cannot predict resulting complexities or cost until the physical product is obtained. The contractor, on the other hand, invariably considers the written specification as law though he realizes that it may not give full value to the customer. Therefore, the "second look" at design and specifications provides a two-way outlet for both parties concerned. It involves a feedback information loop from the manufacturer to the Bureau. In fact, it is a Value Engineering study by the contractor. It is intended that changes in specification, resulting from Value Engineering, would be made prior to production, avoiding any changes in the contractor's schedule once the production line is in operation.

### *Two Main Areas*

The Value Engineering program is broken down into two main areas around which it evolves—Research and Development, and Production.

In R & D a thorough study of an experimental model and its governing specification is made by the contractor and proposals are submitted to the Bureau. Too often, in R & D, the engineers are concerned with "making it work" and run too hurriedly over production and material details involved. Engineers making the second study are called the "Value Engineers." Preferably, they should not be the same ones who participated in the product's original design since personal attachment often prevents an engineer from making proposals for change. The background of these Value Engineers should be comprehensive; not only should they have a broad knowledge of design, materials, and costs, but they should have the added ability of relating the cost of a design to the production version. Diplomacy in their endeavors to make and sell their proposals is vital because they continually work across many organizational lines. Admittedly, engineers of this caliber are not easily found, however, extra effort in this direction should develop a sufficient number of them in a few years.

In Production, the Value Engineering study is to be made during the pre-production engineering phases of the contract. An incentive is incorporated into this type of contract, i.e., if any saving results, the contractor is allowed a share of that saving. The Bureau pays all costs of the Value Engineering services in both R & D and Production type contracts.

Since maintenance costs are usually many times the cost of the original equipment, the manufacturer may find it necessary to propose an increase in the initial expenditure, but reduce the maintenance outlay. In this case, greater economy is ultimately achieved.

### *Job-Plan*

Stressing efficiency and competence in all facets of Value Engineering, a job-plan has been drawn up that systematically breaks down the operation of the study into phases.

1. *Information phase:* The Value Engineer gathers the most complete and detailed information pertinent to the item. In order to provide adequate background information, the Bureau will arrange discussions with the contractor's Value Engineers on the operational, maintenance, and design aspects of the Bureau's specification. In addition, the Bureau will indoctrinate these engineers with some of the more important techniques of Value Engineering.
2. *Speculative phase:* The creative imagination is given more freedom as new and different materials, processes and procedures are explored. It is in this phase that the hardware is trimmed to necessity.
3. *Planning phase:* The extensive research and imagination synthesize in determining the most advantageous course of action.
4. *Execution phase:* Designs undergo necessary tests and design specialists are contacted. Not only must the item be technically sound, but it must be backed by cost figures and able to "sell" itself.
5. *Reporting phase:* Value Engineering proposals are written and submitted to the Bureau of Ships for approval. They will be acted upon within 30 days, and the approved proposals will be incorporated into the production equipment.

The outlined plan is flexible and is designed to serve as a guide to action without dogmatically specifying procedure. Its systematism indicates the thoroughness with which the idea of Value Engineering was conceived.

### *Two Obstacles*

Before this ambitious goal is realized, two rather sizeable obstacles must be confronted. One is to preserve the incentive during renegotiation, and the other exists in getting the Navy to change present specifications. Both of these problems are understood and are being met by the men at the Bureau. (Hence, diplomacy and salesmanship become valuable aids to the program.)

The Renegotiation Board is expected to publish a statement which will assure manufacturers that their allowed share of the savings will not be refused in renegotiation. In redeterminable types of contracts, such assurances will be provided directly into the Bureau's contract schedule.

In regard to a Value Engineering effort in electronics, the Navy can look to the Army Signal Corps for a precedent, where such engineering studies have been made on a case by case basis, i.e., radio receivers already in use.

It is true that Value Engineering thrusts a new burden on the manufacturer, but not without rewards. A notable example of Value Engineering in the shipbuilding industry is cited when a particular landing craft was reduced in cost from $36,000 to $21,000—no essential requirements cut. The General Electric Company, forerunner in "Value Analysis," reports a multi-million dollar annual savings. Because of such profitable illustrations, industry cannot long ignore the benefit of this program.

An enthusiastic appraisal of the Bureau's Value Engineering program has prompted some private firms to set up Value Engineering in their own plants. One company has established, in each of its defense operating departments, a similar Value Engineering function "for the purpose of reviewing our designs and our manufacturing processes in order to reduce cost." Saluting the Navy leadership in the matter they express "thanks for the stimulation which it has offered in putting such a program into effect."

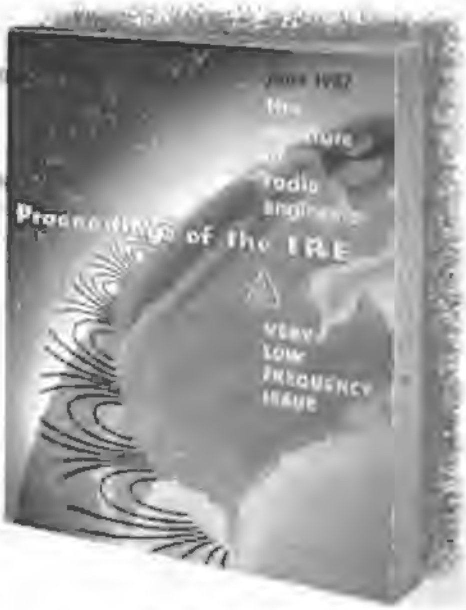
Similar responses should certainly be forthcoming from all phases of industry participating in the program as the valuable results of industry and Navy, working as a defense team to emphasize function, maintenance and reliability at minimum cost are realized. The whole idea of the Bureau can be summed up as a search for simplicity and value.

The electronics program does not stand alone in this new streamlining process. Similar programs are underway in Naval architecture, marine engineering, electrical engineering and mechanical engineering.

### *The Future*

Those working on the project at the Bureau of Ships are Captain John M. Waters and his assistants, Lt. Commander A. T. White, A. Sikorsky, and R. B. Bussler along with other staff members. Captain W. I. Bull, Assistant Chief of the Bureau of Ships for Electronics, gives strong support and guidance in this effort and M. L. Roylance, in charge of Value Engineering coordination for Captain Bull, will work with private contractors in the performance of the Value Engineering specifications.

We see a bright future for rapid development of this challenging program. The military, like private industry, seeks an improved, economical streamlined business. The Navy feels that by utilizing the production experience of its contractors, it will accelerate improvements in specifications to provide a more reliable and maintainable equipment, at lower cost to the taxpayer. As several evaluations of the program from industry and defense have observed, "That is GOOD business." Our annotation—it is Common Sense.



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This year, the Boulder Laboratories of the National Bureau of Standards and the IRE Professional Group on Antennas and Propagation co-sponsored a Symposium at Boulder, Colorado, on the propagation of very low frequency radio waves. From the papers given at this important meeting the editors of *Proceedings* have chosen those of broadest interest for publication in the June, 1957, issue.

Typical of the service offered members of IRE is this VLF report — to be used now and referred to for years to come. If you are not a member of *The Institute of Radio Engineers* be sure to reserve a copy of the June *Proceedings of the IRE*, today!

## Partial Contents of this VLF Issue:

**"A Technique for the Rapid Analysis of Whistlers,"** by J. K. Grierson, Defense Reserve Board, Ottawa, Ontario, Canada.

**"VLF Radiation from Lightning Strokes,"** by E. L. Hill, School of Physics, University of Minnesota.

**"Some Recent Measurements of Atmospheric Noise in Canada,"** by C. A. McKerrow, Defense Reserve Board, Ottawa, Ontario, Canada.

**"Intercontinental Frequency Comparison by Very Low Frequency Radio Transmission,"** by J. A. Pierce, Croft Laboratory, Harvard.

**"The Mode Theory of VLF Ionospheric Propagation for Finite Ground Conductivity,"** by James R. Wait, National Bureau of Standards, Boulder, Colorado.

**"The Geometrical Optics of VLF Sky Wave Propagation,"** by J. R. Wait & A. Murphy, National Bureau of Standards, Boulder, Colorado.

**"Characteristics of Atmospheric Noise from 1 to 100 Kc/s,"** by A. D. Watt & E. L. Maxwell, National Bureau of Standards, Boulder, Colorado.

**"The Present State of Knowledge Concerning the Lower Ionosphere,"** by A. H. Waynick, The Pennsylvania State University.

**"Noise Investigation at VLF by the National Bureau of Standards,"** by W. Q. Crichlow, National Bureau of Standards, Boulder, Colorado.

**"Reflection at a Shapely-Bounded Ionosphere,"** by I. W. Yebroff, Stanford University.

**"The Attenuation Versus Frequency Characteristics of VLF Radio Waves,"** by J. R. Wait, National Bureau of Standards, Boulder, Colorado.

**"The Waveguide Mode Theory of the Propagation of VLF Radio Waves,"** by K. G. Budden, University of Cambridge, England.

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# Small Business in The Electronic Age

*by Robert Goodman, AEL*

Special Yagi Antenna developed by the American Electronic Labs

**Conrad J. Fowler**
**President**
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THIS IS A BRIEF STORY of how a small business can come into being and prosper in a technical age and an environment of free enterprise. The parameters for success are simple to enumerate: brains, determination, integrity, imagination, a considerable amount of imagination . . . and some money.

While the parameters are simple to state, their utilization is a more difficult matter to discuss. The initiation of a small business in electronics today is not recommended for those who would rely completely on the defense effort nor for those who are not willing to make the necessary personal sacrifices required in the early and painful years of the operation. The future stability and profitable function of a young business today cannot be purchased with money alone. All the other requirements are essential.

In 1948 three of twelve engineers, who were discussing the possibility of setting up an electronic laboratory, discovered that much of their thinking was complementary. These men, Conrad Fowler, Robert Goodman, and Leon Riebman—all members of the Research Staff at the Moore School of Electrical Engineering, University of Pennsylvania—drew together and began to plan an enterprise in earnest. They studied ways and means to raise capital. They investigated reasons for successes and failures of many electronic firms—both large and small. They laid out a skeleton organization which was to be flexible and expandable. They searched for a "jump-off" point so that they and their families would somehow be able to weather the tremendous strain—both financial and emotional which was anticipated. Throughout this period many of the faculty at the Moore School were helpful and sympathetic with their advice and interest. This program of careful study and search continued through 1950.

Late in 1950 an essential "break" occurred. The three young engineers were able to interest John Stern, President of the Radio Electric Service Co. of Pennsylvania, in their plans. Consulting arrangements for one of his enterprises resulted in the establishment of a small laboratory minimally equipped with necessary test equipment. On November 28, 1950, American Electronic Laboratories, Inc., (AEL), was incorporated in the State of Pennsylvania with a capitalization of $500.

For a period of a year thereafter planning, searching, and development progressed. In this period, the workday consisted of doing a thorough job at the University and then going to work at AEL each night and of course, all day Saturday and Sunday. A manpower pool was set up comprised of technical associates and friends who were similarly intrigued with the task of developing a new organization. Technically, this early period saw the beginning of development on an oximeter for clinical use with characteristics generally considered a virtual impossibility at that time.

### *Starting-Friction*

During 1951 the three men concluded that any measure of success in launching AEL could not be attained by chance or part-time effort. They decided to leave the security of the University and bend all their efforts to AEL. The decision made, they left the academic halls behind, bearing with them the good wishes of their colleagues. For months with the help of a part-time staff, they worked at the lab bench building electro-medical research apparatus as products and visiting as many industrial and Government laboratories as possible to find some source of initial income to get them out of the area of "starting-friction." Everywhere, and understandably, the answer to their queries was the same: "We have a winning combination, why should we change or add to our vendors, and particularly with a young company with no history?"

Early in 1952, the Office of Naval Research presented AEL with its first contract . . . a contract based on AEL's own initial development of a new and stable oximeter. The substance of the problem was to produce an Anoxia Warning System for safeguarding jet aircraft pilots. The confidence of ONR in the integrity and technical ability of a tiny group of engineers was rewarded by a successful demonstration of the electronic device in late 1954. Since that time further refinement has been undertaken and physiological studies are progressing which it is believed will result in not only equipment to safeguard our aircraft crews, but instruments of immense value to hospitals and doctors all over the world. AEL can never forget its first contract nor the significance of the confidence expressed by the technical people of ONR.

The staff at AEL began to grow at this point and by the end of 1952 sixteen men and women were members. Since no time or money existed for errors, all staff members had to be both competent and dedicated. It was further quite clear that dedication and loyalty to any goal could not be bought . . . these attributes had to be earned by management. Since this sort of thinking was completely consistent with the initial planning of the organization and its philosophy, it presented no problem. A clear statement of company policy was written and given to every staff member . . . and every employee, irrespective of his job title, is a staff member. Training groups were initiated to prepare essential technical personnel for management and administrative functions. Objective personnel review methods were designed and incorporated, and organizational information channels set up.

Slowly, by the standards of the staff, and with fantastic speed, by the standards of its fiscal and legal advisors, AEL began to grow. In 1953 sales volume was increased over the previous year by 257%, in 1954 by 9.2%, in 1955 by 52.8%, in 1956 by 157%, and in 1957 it will increase again. In this same period plant area increased from approximately six hundred square feet to twenty-five thousand and total annual sales from approximately $90,000 to $1,500,000. With the help of its bank, the Provident-Tradesmen's Bank and Trust Company as represented by a responsible Vice President, Mr. F. J. Hermann, enlightened financing along with cooperative federal agencies eased the fiscal path of what was now a dynamic operation. Through stringently planned internal controls and thoroughly understood operations, the necessary links between the financial sources and the technical ends of the operation were maintained. Finally, with the aid of the progressive and reputable investment banking house of Spencer Trask & Co. of New York, AEL moved firmly into normal banking channels.

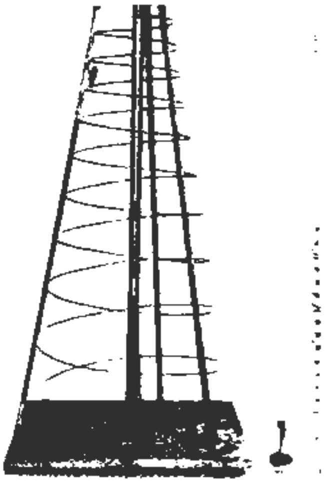
### *Expansion*

In this period it was also recognized that a narrow technical specialization could lead to disaster and a poor balance between production and engineering could be equally hazardous. These observations again fitted neatly into the original organizational planning: "no field of endeavor is foreign to the operation so long as *the staff is competent* in that field and so long as expansion into that field will *not adversely effect the stability* of the overall operation."

Careful planning, a fine staff, excellent advisors, successful productivity, and a certain amount of good fortune have brought a staff of about 150 untiring men and women to the year 1957, a year in which AEL is actively engaged in:

- the manufacture of a growing line of precision instruments for the medical researcher, instruments which are being used all over the United States and a dozen foreign countries.
- the manufacture of a line of unique communications and industrial test gear from pulse generators to high-powered transistor curve tracers.
- the initiation of manufacture of a line of advanced clinical apparatus for universal sale.
- the establishment of a complete external sales organization network through manufacturers' representatives covering the entire United States.
- continuous specialized production and technical subcontracting to key industries for the Department of Defense.
- direct prime contribution of technical know-how and production effort to our Defense Establishment in the fields of antenna design (from LF to over 40,000 Mc), countermeasure total systems, solid state studies, microwave devices, control systems, specific computers, detectors of various kinds for human safety control, etc.
- environmental evaluation of electronic components in its own completely equipped laboratory.

None of these pleasant advances in operation have lulled either the management or the staff at AEL into a sense of well being. The environmental economy and technology is dynamic. Continued existence, growth, and profitable return for staff and shareholders alike will be based on the zeal to plan . . . to discover . . . to know . . . and to move quickly and decisively. Some typical examples of the results of teamwork and planning are the tapered conical helix which represents a basic advance in specialized antenna design, the coaxial crystal detector mount—a remarkable improvement in crystal holder efficiency, the Anoxia Warning System—the most stable photo-electric oxygen saturation detector yet built, etc. All these devices represent true contributions to the Government and industry alike.



Conical Helices—Early development models illustrating possible size variations, 36 inches compared to 4.5 inches.

### *Defense and Creativity*

At AEL it is believed that all industry has a responsibility not only in its contribution to the Defense Effort, but in its general creativity for the specific welfare of people everywhere. These are not idle words of the idealist, but represent a good part of the driving force behind a dedicated staff. This philosophy properly oriented has attracted the support and enthusiasm of AEL's financial sources, shareholders, advisors, and customers alike. AEL has few, if any, customers who doubt either the integrity or competence of the operation.

In this dynamic era of atomics and electronics, it is our unshakable conviction that small business can come into being and grow. The road is difficult and the essential parameters for success must be carefully administered. In the final analysis, the decency, intelligence, and determination of the people involved will write the story of failure or success. Free Enterprise is a difficult taskmaster and no compromise with mediocrity is possible.

## Our Readers Write

SIGNAL Magazine

DEAR SIR:

I wish to thank you for the copy of your very fine magazine, containing the article on our safari to A.E.F. It was a fine article and much appreciated. I only wish that it had all come true. By now, I'm sure you must have learned that my DC-3 flight had to be cancelled out at Gander due to very adverse weather conditions. The two lads I had asked to fly the ship over for me were brokenhearted, of course, because they had to turn back, but they ran into conditions that were pretty rough.

The rest of the safari went off amazingly smoothly. Air France carried us to Fort Archambault and I flew General LeMay from there to our camp 120 miles due east on the Aouk River in the helicopter.

The Eldico equipment worked beautifully and, with it, we not only kept in daily touch via RCA Communications on Long Island with our CBS network, but also kept the 20-meter amateur band humming and kept General LeMay in constant touch with his own outfit.

We also carried three 2-meter Gonset Communicators with us with which we were able to keep in constant touch with the base camp from the helicopter. The third one was carried by one of the jeeps when it was out in the bush and helped us to keep in daily contact with it by 'copter.

All in all, the safari was a tremendous success and proved the efficiency of low-powered high-frequency communications.

Thanks again very much for your kindly interest.

Most sincerely,
ARTHUR GODFREY

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The following is an extract from a letter received from Ray Meyers, Lockheed Aircraft Corp., Burbank, Cal.

"Just received the April issue of SIGNAL and must congratulate you on the first item published—*Radio Interference*. We have a number of top flight people in our Cooperative Interference Committee (CIC) that are prospective members of AFCEA and wonder whether or not you have a limited number of extra copies of the April issue that could be mailed when I arrive for the annual Convention in D. C."

*Note:* Ray, who with Al Parker initially developed the CIC in 1954 in Southern California, did contact us at the Convention and we had the magazines. He mentioned that many requests had been received for his chapter's 1957 brochure on CIC as a result of the "Radio Interference" article. Ray also mentioned that anyone could contact him direct if in need of advice or for a copy of the brochure (717 Anderson Way, San Gabriel, Calif.).

*Added Note:* During your editor's conversation with Mr. Meyers, we talked about the formation of an AFCEA National Headquarters "Ham Radio Net." Ray produced his card-call letters W6MLZ, and being a first booster for this idea, he sees a great future benefit for such an organization.

In a subsequent issue of SIGNAL, it is your editor's idea to enlist the aid of Mr. Meyers, Mr. George Bailey and other prominent "Ham" operators in the formation of an active "Ham Operators Net." The possibilities are unlimited and a great contribution can be made to Civil Defense and the National Security in peace and cases of emergency.

If you are a "Ham" operator, why not send in your card or call letters while awaiting further details. Even your comments would be of value. Mail to: Editor, SIGNAL, 1624 Eye St., N.W., Washington 6, D.C.

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DEAR SIR:

I have to acknowledge, with thanks, your letter of May 14th with which you enclosed the May convention issue of SIGNAL magazine.

I found it most interesting reading and feel very privileged that I was given the opportunity of contributing to it in some small way.

I am sure it will meet with tremendous success and you and your staff are to be congratulated on a very excellent publication.

Yours very sincerely,
D. F. BOWIE
*President*
*Canadian Overseas Telecommunications Corp.*

**TUBE DEPENDABILITY** is vital in this SAGE computer—only a small part of which is shown. IBM engineered and built the huge computer, to operate as the heart of the Semi-Automatic Ground Environment air defense system.

# 7329 G-E 5-Star 6414 tubes in IBM SAGE compute
# show no opens, shorts, or mechanical defects!

AFTER 3000 hours' operation, no shorts, no opens, no mechanical defects—this describes all 7329 General Electric 5-Star 6414 tubes in IBM's first XD-1 computer for the experimental sub-sector of the USAF SAGE system.

In contrast: 17% of removals of another twin triode of earlier design tested in this giant computer, were for one of the three reasons above, any one of which can render a tube inoperative!

Uniformly reliable, the 6414 and other G-E 5-Star computer tubes also have heavy-duty construction that wards off vibration and shocks encountered in military field service. Design features of these 5-star types include special compact, sturdy cages; double mica spacers; a double-staked getter.

General Electric helped pioneer high-reliability tubes . . . was first to design, build, and test special tubes for computers . . . later, developed the first computer types with 5-Star high-reliability performance.

The three G-E 5-Star computer tubes, and 32 G-E 5-Star types for communications and other military applications, offer equipment-builders a choice backed by manufacturing experience not found elsewhere. Ask for a G-E tube sales representative to call! *Receiving Tube Department, General Electric Company, Owensboro, Ky.*

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

182-192

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## — GOVERNMENT —

**SATELLITE" BASE AT BEALE** Beale Air Force Base, California, is the location of the irst West Coast "satellite" base for the Strategic Air Command. A 12,000 foot runay, one of the Nation's longest when completed, is included in the $13 million contruction job. Other projects consist of new permanent-type building, a control ower, taxiways and warm-up aprons, blast pads and concrete overruns, plus a water istribution system. A squadron of B-52 "Stratofortress" jet bombers and supporting C-135 refueling aircraft will be stationed at the base as part of SAC's dispersal rogram. Additional uses are also being considered for Beale such as assignment of ir Defense Command and Military Air Transport Command units.

**ADIO "HEARS" INVISIBLE STARS** The Navy Department and Bendix Aviation Corp., anunced jointly that radio equipment, so sensitive it can "hear" invisible stars, is production by Bendix to track the first man-made moon. The ultrasensitive radio alled "Minitrack" was designed and built originally by the Naval Research Laboratory o track an earth satellite. Along with 11 other receivers under construction by the adio division of Bendix in Baltimore, the "Minitrack" system will be strategically laced up and down the American continents to tune in radio beams from the man-made oon as it orbits in space sometime during the International Geophysical Year. Such ensitive equipment can listen to radio "noise" originating on the sun and detect resence of stars that emit no visible energy.

**RMY TRAINS "INSTRUMENTAL PILOTS"** Approximately 440 rated pilots are undergoing raining in an eight-week course in order to qualify as Army "instrumental pilots." The instruction, conducted in five continental Army Areas, parallels the instrument light training course given at the Army Aviation School, Fort Rucker, Alabama. Each student receives 80 hours of first-pilot instrument flight instruction and participates in 180 hours of associate ground school instruction. Four civilian aviation firms are contracted to offer the instruction at five separate airfields.

**TACTICAL SUPPORT CENTER** The Tactical Support Center (TSC), a new vehicle-mounted communications system, has been developed for the Army in order to give commanders in nuclear-age combat instant control over dispersed tactical support elements. The need for such Centers has grown out of the complex nature and rapid movement of modern warfare which produces problems of liaison between such tactical support elements as artillery, electronic warfare, tactical air support and antiaircraft. The TSC allows a field army commander to weld his highly mobile support forces into a coordinated, power-packed team. Already providing for use of nearly every available communications medium, the concept plans to incorporate an electronic computer into the Center so that target information, priority and selection can be calculated instantly.

**AIR FORCE ORDERS AIRBORNE "BRAIN"** An airborne brain that coordinates a supersonic aircraft's whole "nervous system"—receiving and acting upon all atmospheric information necessary for supersonic flight—has been ordered in volume by the Air Force from Bendix Aviation Corporation. The brains, called "Central Air Data Computers," are compact and will be installed on Republic's F-105 and McDonnell's F-101B. Bendix officials explained that the many complex automatic systems responsible for effective operation of a supersonic airplane require various types of highly accurate information about the air through which the plane is flying. The Air Data Computer calculates and distributes this information. It was developed by the company's Eclipse-Pioneer Division in cooperation with the Flight Control Laboratory of Wright Air Development Center.

'OPERATION SMOKE-PUFF" The first in a series of attempts to establish two-way radio mmunication by bouncing radio signals off man-made clouds of ionized gas, wholly dependent of the vagaries of nature, will be made some time in July in a cooper-ive project between the United States Air Force and the Nation's amateur radio erators. The project, entitled "Operation Smoke-Puff," was announced by the Amer-an Radio Relay League, national association of radio amateurs. Long-distance radio mmunication has always been dependent upon the varying reflective power of veral ionized layers in the upper atmosphere. Now man is attempting to establish artificial reflecting layer by firing a rocket 70 miles into the ionosphere to lease nitric oxide gas.

MY RESEARCH AND DEVELOPMENT TO BE STUDIED Research and development needs of the my for the warfare of the future will be studied for nine weeks at Damariscotta, ine, starting July 1. Scientists and military personnel will be meeting under the adership of Dr. Ellis A. Johnson, director of the Operations Research Office of hns Hopkins University. The agenda will include the effect of atomic weapons on ctics and supply, the tactical refinements required for most effective use of omic weapons, and many problems of mobility, communications and command associated th atomic land warfare. These considerations will be applied to the requirements both general and limited wars.

NTRACT AWARDS The following contracts have been awarded by the AIR FORCE: Ameri-n Bosch Arma Corp., $5,932,985, for bomber fire control systems and spare parts; neral Electric Co., Syracuse, N. Y., $83,000,000 for electronic equipment; Bendix iation Corp.'s radio division, Towson, Md., $6,715,977 for radar sets; Lockheed rcraft Service, Inc., Ontario, Calif., $5,235,704 for inspection, repair, and dification of RC-121 aircraft; Wright Aeronautical division of Curtiss-Wright rp., $2,500,000 for engineering work on a dual cycle propulsion system. NAVY con-acts awarded include: Westinghouse Electric Corp., $8,170,060 to manufacture the in stream propulsion machinery for the nuclear-powered aircraft carrier (CVAN); th Iron Works, $44,045,600, for the construction of guided missile destroyers DDG 2 and DD 953; New York Shipbuilding Corp., $49,123,500, for construction of guided ssile destroyers DDG 954, 955, and 956; Martin Co., $24,000,000 to modernize 80 M-1 Marlin anti-submarine seaplanes; Sperry Rand Corp. (Sperry Gyroscope Co., v.) $168,419, for navigation computer and compass pictorial deviation indicator. MY grants include: Dynamic Electronics-New York, Inc., $89,273 for 23 antennas pe AS-541; Stromberg-Carlson Co., Rochester, N. Y., $49,500 for one light aircraft ta link system; Western Electric Co., Inc., $432,500 for additional services, acilities and materials for twelve months to continue study related to transistors nd transistor-like devices and associated components modification.

## — INDUSTRY —

SODIUM REACTOR EXPERIMENT The Atomic Energy Commission has announced that self-sustaining nuclear fission was achieved in the Sodium Reactor Experiment, a small-scale experimental civilian atomic power project being developed for the AEC by Atomics International, a division of North American Aviation, Inc. This is the first sodium-cooled "thermal" reactor to produce a sustained nuclear chain reaction. The SRE uses neutrons moderated with graphite to sustain the fission process; liquid sodium is circulated through the reactor core to remove heat produced by the atomic fission. Although the design capacity of the SRE is 20,000 kilowatts of heat, during the initial start-up test the reactor operated at a power level of only one kilowatt of heat. No electricity was generated. Future tests will be made to determine the nuclear characteristics of the reactor and to establish the satisfactory operation of all reactor components. The SRE is part of the Commission's program to develop economical civilian power from nuclear energy.

HUMAN LOGIC INTRODUCED IN "ELECTRONIC BRAIN" Engineers at Stromberg-Carlson, San Diego, Calif., plan to build a machine which will enable a human being to tell a computer what to do more often and more easily. A device known as a computer readout and intervention system makes possible the introduction of human logic midway in a problem's computation into the intricate functioning of an "electronic brain." The first readout system, to be produced for Eglin Air Force Base, Fla., will consist of four pieces of equipment for installation: a logic console, a high speed camera recorder, a visual display console, and a Flexowriter. The operator of the computer can watch results of the computation and can intervene directly to feed supplementary instructions by means of the Flexowriter.

**HELICOPTERS USE "ELECTRONIC ROAD MAPS"** Flying by means of "electronic road maps," helicopters can now operate completely on instruments in cities, the open country, or in remote areas, "regardless of weather and visibility" according to flight demonstrations by Bell Helicopter Corp. and the Pacific division of Bendix Aviation Corp. A "self-contained instrument landing system" provides pilots with necessary information enabling them to take off, fly to any spot inside a 100-mile area, make an instrument approach to within 10 feet of the ground and land without looking outside the helicopter cabin. Thus, a new accuracy and efficiency is predicted for the rural and military functions performed by the helicopter.

**HI-FI IN PUERTO RICO** Hi-Fidelity, Inc., has opened a new plant at Playa de Ponce, Puerto Rico, installing a new low cost production process. The new process uses pure vinyl powder and electrically-heated molds, eliminating performed, compound blanks, steam heaters, and high-pressure hydraulic presses, it is reported. The company, with its own plating facilities, is manufacturing seven and twelve-inch records, complete from master to finished product, from tapes supplied by the record companies. John O'Sullivan, President, announced that it will press four to five million hi-fi disks annually for big U.S. independent record labels.

**SUPER-RADARS REVEALED** A long-secret class of super-radars, in service with the fleet for guidance for its Terrier missiles, has been recently revealed by the Navy. Developed by the Sperry Gyroscope Co., the radar antennae have been the subject of speculation since first displayed aboard the guided missile cruiser USS CANBERRA (CAG2). The two SPQ-5 systems aboard the CANBERRA combine many automatic functions in each unit, including the flexible modes of scanning the air space many miles beyond the horizon. Individual targets can be selected from close-flying groups and traced at great distances while the missiles are launched and guided with "extreme accuracy." The massive, turret-like antennae, which resemble gigantic searchlights, have radically changed the contours of the Nation's fighting ships.

**NEW AMERICAN-BRITISH ELECTRONICS FIRM** Organization of a new Company to manufacture transistors and other semi-conductors in England, through the joint efforts of Philco Corp. and The Plessey Co. Ltd. has been announced by Philco Corp. in the United States and The Plessy Co. in London. The new firm, known as Semiconductors Limited will be licensed under Philco semi-conductor patents. Philco Corporation and Philco (Overseas) Limited will furnish technical "know how" and design information, while supervising the new Company's technical programs. The former will also supply the equipment for the mass production of transistors, similar to equipment installed in Philco's new transistor plant at Spring City, Pa. The joint enterprise establishing the British-American Co. was undertaken following a comprehensive survey of the electronic industry in the United States. Production will begin early in 1958, and the initial schedule is expected to be increased sharply within a few years.

**FIRST U.S. AIRFRAME PRODUCTION AUTOMATION SYSTEM** The first airframe production automation system to be built in the United States has been announced jointly by the Martin Company and Bendix Aviation Corp. The new milling unit is an electronically controlled machine tool that will substantially reduce "lead time" in the production of military planes and missiles. Built to specifications for Martin by the Research Laboratories division of Bendix, the new manufacturing system uses electronics to transfer coded information from a blueprint to tape. When the information is "read," the 50-ton milling machine is actuated and automatically turns out finished. precision-built aircraft and missile structural parts.

**A LAMP THAT WILL BURN FOR A HUNDRED YEARS** An electric light bulb expected to burn at least until the year 2057 has been lighted at the General Electric Research Laboratory by Ralph J. Cordiner, GE president. The bulb is a replica of Thomas Edison's first practical lamp which burned for 40 hours in 1879, and is said to have ushered in the modern electrical era. GE has placed the bulb on a desk used for many years by Edison. New materials and manufacturing techniques have made this lamp possible, and a special power source ensures day and night operation of the light throughout its anticipated century-long lifetime.

**ELECTRICAL EQUIPMENT FOR LOW TEMPERATURES** Extremely low temperatures are among the problems confronting suppliers of electrical systems for DEW line and White Alice projects in the Northwest. Hughey & Phillips, Inc., Burbank, California, one of the suppliers, have engineered and fabricated ready-to-install kits. Among the systems designed to function at extremely low temperatures are sleet control circuits, obstruction lights, lamp failure alarm systems and emergency telephone circuits. Delivery of these "top of the world" communication components is now reaching completion.

**CONTRAVES ITALIANA S. p. A.**

ROMA

LUNGOTEVERE DELLE ARMI, 12

Stabilimento: VIA TIBURTINA, 965

GUN FIRE CONTROL SYSTEMS

GUIDED MISSILES

ANALOG COMPUTERS

SERVO MECHANISMS

EASURING INSTRUMENTS

TELEPHONE SERVICE BETWEEN THE U.S. AND VIET-NAM Telephone service is now available between the United States and Viet-Nam, the Long Lines Department of American Telephone and Telegraph Co. has announced. Telephone calls to Viet-Nam will be routed through Japan by radio. The distant terminal is located at Saigon, the Viet-Nam capital. Exclusive of tax, the rate for a three-minute call to Viet-Nam from any point in the United States is $15.

PRODUCING AIRCRAFT WITH NEW "EXPLOSIVE TOOLS" Lockheed scientists have set their sights on a new manufacturing target—how to produce aircraft with the aid of new "explosive tools." Due to constantly increasing speeds, aircraft require high-strength, heat-resistant, absolutely smooth metals to thwart the thermal thicket and insure stability in flight. Explosives may provide an answer for shaping the hard difficult-to-form metals into complex contours devoid of riveted attachments. Such an "explosive-forming" method involves socking metal with forces from shock waves traveling 18,000 miles an hour. Gunpowder, one of the cheapest, most powerful and easily controlled sources of power is being investigated along with a .22 caliber rifle cartridge and an eight-gauge shotgun shell. At Lockheed's Burbank plant a small group of men is working on the explosive-forming development project. Their laboratory is a concrete bomb shelter left over from World War II.

## — GENERAL —

ACCELERATOR MAY ARREST CANCER A 6 million-volt medical linear accelerator at Stanford University Medical School, San Francisco, is being used in an attempt to arrest cancer. The first report shows that 48 out of 74 patients had tumor growths completely removed. The machine, designed especially for cancer therapy, has overcome a major technical problem; by pumping the vacuum out once and sealing it off, the need for a constant pumping system has been eliminated. The machine was built under the direction of Prof. Edward L. Ginzton, director of the microwave laboratory, and Dr. Henry S. Kaplan, head of the medical school's radiology department. Although it is capable of doing both electron and x-ray therapy, only the latter has been tried. The electron phase is expected to begin soon.

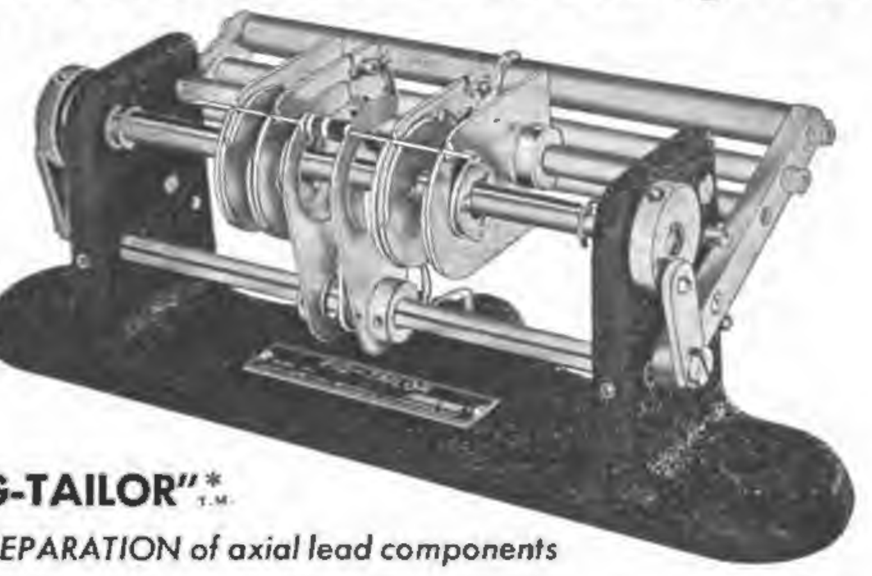
VALUE STUDY OF TRADE SHOWS Alarmed at the rising number of electronics industry exhibits and trade shows, a committee of the Radio-Electronics-Television Manufacturers Association decided to conduct a study in regard to their effectiveness and utility. The study began when the association's trade show survey committee sent a questionnaire to RETMA members asking the number of trade shows in which they could have participated and those in which they did take part during 1955 and 1956. The survey expects to uncover the cost of these exhibits to the manufacturer and form an opinion as to the value of the trade shows.

GOLDEN ANNIVERSARY OF MILITARY AIRPOWER The New England celebration of the Golden Anniversary of military airpower will be held at Hanscom Field, Bedford, Mass., on Saturday and Sunday, June 22 and 23. Feature attraction during the flying part of the program will be the appearance of the world's finest jet precision flying team, USAF "Thunderbirds." In their demonstration, they will fly through every known maneuver at speeds up to 700 miles per hour. Ground displays in four big hangars at the base will supplement the flying show. The event is co-sponsored by the Massachusetts Wing of the Air Force Association and the Air Force Cambridge Research Center.

MUTUAL TELETYPE EXCHANGE A mutual teletype exchange at Chicago has simplified the complicated business of interline reservations for American Airlines and United Air Lines. Reservation information between the two is exchanged via direct teletype message transmission, reducing processing time by shortening telephone calls, and by eliminating relay of reservations information through intermediate offices. Now, the agent simply sends a message via his company's teletype system to the mutual teletype exchange where it is automatically relayed to the communications equipment of the other airline and transmitted to the desired city. Space is confirmed in the same manner.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS The 81st Convention of the Society of Motion Picture and Television Engineers, held last month at the Shoreham Hotel, Washington, D. C., was attended by approximately 700 persons. More than 100 technical papers covering almost every aspect of motion picture and television science and industry were presented at 14 sessions. A Videotape Recording Session and a demonstration at Walter Reed Army Medical Center of closed-circuit television equipment, highlighted by an explanation of the microscopic camera that opens up the field of the subvisual, attracted considerable interest.

# PROVEN-on the assembly line!



**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*

**PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"**

# "PIG-TAILORING"

***. . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.***

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

**"SPIN-PIN"*** T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

*Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-6P*

**BRUNO-NEW YORK INDUSTRIES CORPORATION**
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

# It's June

# I'm 97

***AFCEA extends greetings to the Army Signal Corps and its leader, Major General James D. O'Connell, on the occasion of the Corps' 97th Anniversary. The following article tells of some of the contributions of the Army Signal Corps to the American standard of living.***

***The Editor***

BENEFITS TO THE CIVILIAN economy of America, ranging from increased airline safety to tiny hearing aids, and the world's finest and most advanced military electronics and communications equipment, have sprung directly from research and development by the Army Signal Corps. The Corps has also made major contributions to improving the American standard of living.

A prime example is the printed circuit, and a companion development known as the "Auto-Sembly" of electronic parts. Inexpensive and rapidly produced, it is now almost universally used in the chassis of commercial radios and television sets.

Civilian benefits of the printed circuit are not confined to radio and television. Such circuits are also basic in highly complicated computers, numerous electronic sub-assemblies, hearing aids, and other electronic equipment.

Based on conservative estimates, annual savings to the Government on defense equipment production alone have passed the $4 million mark. At the present acceptance rate this figure may reach $30 million annually as automated electronic assembly or the Auto-Sembly process continues to be adapted to greater numbers of defense equipments.

### *Civilian Savings*

In civilian electronic production too, acceptance of this revolutionary production technique, now in the public domain, has been virtually universal. Annual savings today of upwards of $3 million revert to the consumer as improved and less expensive devices for every day living.

Designing the light, compact and rugged equipment necessary to modern war, engineers of the Army Signal Corps have worked unceasingly in the field of miniaturization to reduce the size, and at the same time increase the reliability of electronic parts and components. All of these technical improvements have been or will be applied to various types of commercial equipment available to the public.

Hearing aids, as well as miniature civilian radio receivers, use transistors instead of vacuum tubes, not only to save space and weight but to reduce power requirements and thereby battery size. Even smaller and more reliable pocket radios and near-invisible hearing aids will soon result from current developments of the Army Signal Corps in the miniaturization of capacitors, resistors and other electronic parts.

Indispensible in miniaturized electronic equipment and medical instruments are small, efficient batteries. The Army Signal Corps is largely responsible for the design and development of an entire family of tiny reliable batteries—such as the mercury, zinc-silver-oxide and nickel cadmium cells. Laboratory research has prolonged the expected life of nuclear batteries to many years and ordinary manganese dioxide dry cells, used in flashlights and radios, from seven to 35 hours.

Even the complex and highly technical field of frequency control research carried on by the Army Signal Corps has a direct bearing on civilian economy. Successful growth of synthetic crystals has so reduced the price of imported quartz that the crystals needed for precise control in color television receivers now cost about five instead of fifty dollars.

Exact frequency control made possible by the development of precision crystals also opened up the UHF television band in addition to numerous new channels for police, taxi, and other high frequency radios. Combined with miniaturization, precision frequency control has improved civilian aircraft radio performance, thereby contributing to aid safety.

### *Leader in Radar*

As a further move toward increased civilian air safety, the Civil Aeronautics Authority has embarked upon an ambitious program to keep all airliners under radar surveillance at all times. The radar equipment to be used is derived from radar sets designed by the Army Signal Corps for antiaircraft work. These radars have a range of about 200 miles at altitudes up to 80,000 feet.

Long the leader in radar research and development, the Army Signal Corps conceived and developed the storm-detector radar, forerunner of all the weather radars currently being purchased by the Weather Bureau, CAA, Navy and Air Force. This remarkable instrument can spot precisely storm fronts and precipitation up to distances of 250 miles.

The ground control approach (GCA) equipment used by the CAA for bad weather approaches to airports depends largely on magnetron tubes developed by the Army Signal

*Corps.* These tubes have another disassociated benefit to civilians. They are utilized in the electronic ovens, latest development in high-speed home and restaurant cooking.

Of importance to civilian defense agencies are the several types of radiation detection equipment designed and developed by the Army Signal *Corps.* A recent radar technique for surveying and mapping is also useful to civil defense agencies in disaster areas.

In the field of photography, the Army Signal Corps sponsored the design and development of plastic paper that can produce photographs in an oven, eliminating the need for a darkroom. Research also led to the development of an optical image evaluation system that allows camera manufacturers to produce efficient lenses without long trial, thereby greatly reducing camera prices. A 16-mm sound motion picture projector developed by the Army Signal Corps has sparked improvements in both sound and picture quality of commercial equipment. A new 70-mm still camera, designed for combat use, is expected to have wide press and industrial use as a commerical camera.

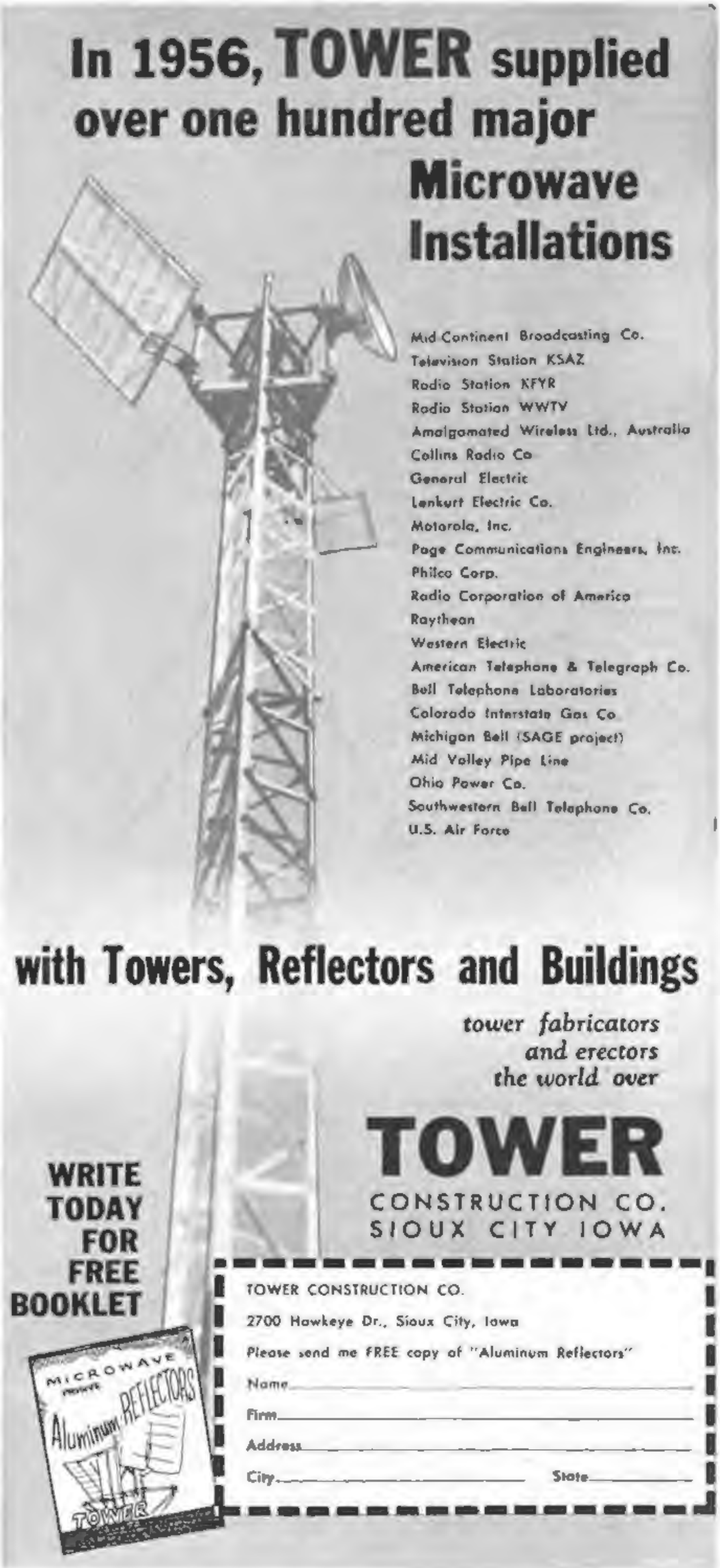
Ethyl cellulose, developed by the Army Signal Corps, is now the basis for flashlight cases manufactured by at least four commercial companies.

Shock and vibration studies undertaken by the Army Signal Corps in order to devise better packing and shipping methods for delicate electronic equipments provide valuable data to railroads and other transportation media in their efforts to reduce freight damage.

There are many more benefits to the civilian economy resulting from Army Signal Corps research and development. These include portable TV cameras, new and improved techniques of microwave radio relay communication, high-power mechanical rectifiers for the electrochemical industry, miniature thermostats for industrial safety equipment, improved polarized relays for railroads and the shipping industry, internally suppressed spark plugs for automobiles and trucks, better telephone repeaters, improved types of wire and insulation, superior radio and TV vacuum tubes, and a variety of others.

In fact, there is scarcely a single area of electronics or communications that does not in some way reflect the many and diversified contributions of the Army Signal Corps toward improving the American way of life.

* * *



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*Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. membership they indicate their readiness for their share in industry's part in national security. Each firm nominates its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in tronics and photographic fields, available for advice and assistance to the armed services on research, development, ma ing, procurement, and operation.*

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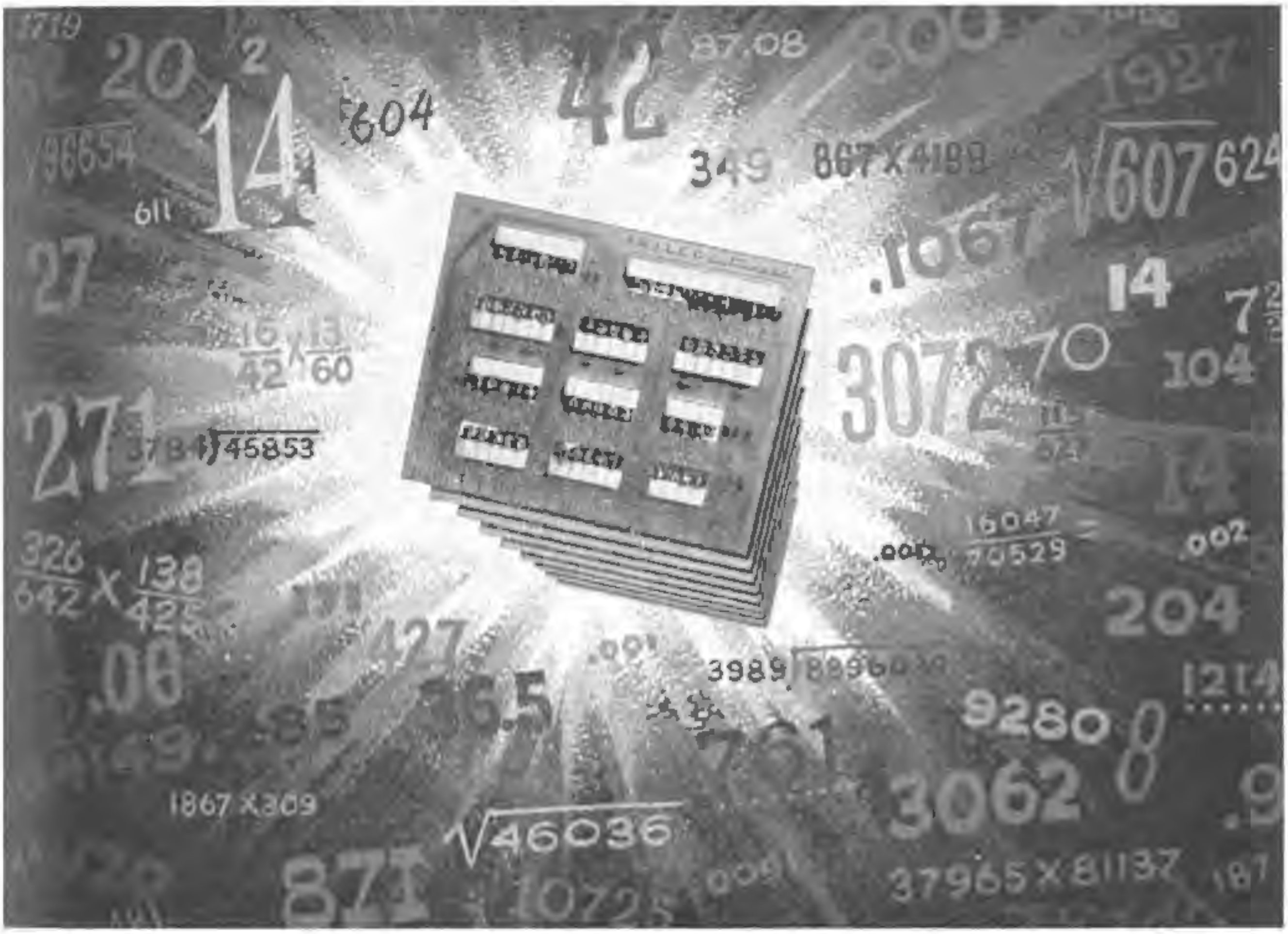

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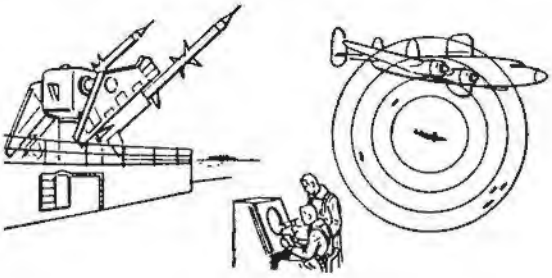

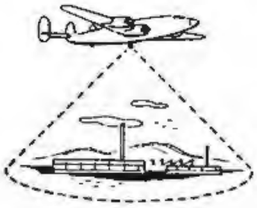

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# Chapter News

### Arizona

"Energy Freed From the Heavens" was the theme of the bi-monthly meeting held in the Non-Commissioned Officers' Annex, Fort Huachuca, on April 23rd. Guest speaker was B. J. "Ponto" Mealey, Arizona Information Manager for the Mountain States Telephone and Telegraph Company, who presented a lecture—demonstration on the practical uses of the newly-developed solar battery.

"Because of the decreasing supply of conventional fuels, the solar system must be tapped," Mealey declared. An eight-party telephone line in Americus, Georgia, has operated on a solar battery for over a year with no breakdowns, he stated. However, he added that the solar battery is too expensive for general home consumption at the present time.

By subjecting the solar battery to light, Mealey turned a clock motor, amplified his voice from a telephone receiver through a microphone, and played a transistor radio. The solar battery is made of pressed discs of silicon, which is merely sand purified to a fantastic degree. Arsenic and boron gas are added in minute quantities. When light hits the silicon, electric current is created.

Included in the crowd of nearly 100 persons were representatives from Fort Huachuca, Radio Corporation of America, Vicer Aviation Company, Palms Radio Company, Armour Research Foundation, the University of Arizona, American Machine and Foundry, and Hughes Aircraft of California.

### Chicago

Henry J. McDonald, Secretary and General Counsel of Kellogg Switchboard and Supply Company, a Division of International Telephone and Telegraph Corporation, was elected president of the chapter at a dinner meeting held at the offices of Illinois Bell Telephone Company on April 25th.

*Chicago*—Henry J. McDonald is the recently elected president of the Chicago AFCEA Chapter.

Other officers elected for the coming year were: Arthur Schmitt, President of Amphenol Electronic Corporation, vice president; Carrington H. Stone of Carrington H. Stone Engineers, vice president; and James F. Weldon, U. S. Army Signal Supply Agency, secretary.

The following members were elected to the Board of Directors: D. K. Chinlund, General Plant Manager, Chicago Area, Illinois Bell Telephone Company; D. H. Deaver, President, Automatic Electric Sales Corporation; Raymond K. Fried, partner, Feinberg and Fried; Captain H. J. Goldberg, Commanding Officer, Electronics Supply Office, Great Lakes; William Hallig Jr., Vice President, Hallicrafters C pany; John R. Howland, Dage Te vision Division of Thompson Produc Inc.; Colonel Melvin Kernkamp, Sig Officer, Fifth Army; Colonel Leroy Lewis, Chief of Chicago Air Procu ment District Air Force; Colonel Ar N. Niemi, Signal Corps Supply Ag cy; Dan Noble, Executive Vice Pr dent, Motorola, Inc.; W. H. Pagenk Director, Teletype Corporation; L. Pereira of L. A. Pereira & Co.; Jo Huarisa, Executive Vice President, Admiral Corporation and G. R. Haase, DuKane Corporation of St. Charles.

### Fort Monmouth

Colonel Clifford A. Poutré, Deputy Commander, U. S. Army Signal Agency, Philadelphia, was the guest speaker at the April dinner-meeting at Gibbs Hall Officers' Club. His subject was "Electronic Data Processing System as it applies to Logistics Operations within the Army."

The Signal Supply Agency and the Army Signal Corps have been using the system with far-reaching results in speeding delivery of Signal supplies over the world. Colonel Poutré is an expert on the subject.

*Fort Monmouth*—Brig. Gen. Stuart S. Hoff, Commandant, USA Signal School (right), greets Col. Clifford A. Poutré, Sig. Supply Agency, Philadelphia, the chapter's guest speaker.

### London

The April 26th meeting of the chapter was held at Taplow Court in Bucks, the home of British Telecommunications Research, Ltd., with its historic associations, where the chapter was given an insight into the activities behind its dignified portal. The chapter is indebted to the group member, Automatic Telephone and Electric Company, Ltd., and to Sir Archibald Gill, Director and General Manager of BTR, for this splendid opportunity.

### Louisiana

The March 27th meeting of the chapter was held at Walther Brothers in New Orleans. Special guests of the chapter were Walter Cowan, City Editor, *New Orleans States;* Dr. W. P. Gardiner, Health Director, City of New Orleans; Rear Admiral Joseph A. Kerrins, Commandant, Eighth Coast Guard District; Father Carl Schutten; Charles G. Glueck and W. P. Craddock.

Highlighting the meeting was a talk by past president, C. C. "Bud" Walther, who outlined the progress of Color Television which he then demonstrated by showing the chapter a color broadcast of the Kraft Theatre.

### New York

The April 25th meeting of the chapter was held at the Belmont Plaza Hotel in New York City.

The guest speaker was Mr. Ben

***uisiana*—Pictured at the March meeting of the chapter are left to right: Father Benedetto, vice pres.; Dr. Joseph C. Morris, vice pres.; C. C. "Bud" Walther, past president; Charles Pearson, Jr., president, and Rear Admiral Joseph A. Kerrins.**

exander. Director of the Electronic stems Laboratory of Federal Telemmunication Laboratories, the rearch division of the International lephone and Telegraph Corporation. : explained in a very non-technical anner the events leading up to the velopment of the "TACAN DATA NK" which has been developed by deral Telecommunication Laboraries in co-operation with the U. S. avy and Air Force. This latest eleconic development provides automatic ro-way ground-air reporting data links hich eliminate the delays inherent in resent-day party line radio telephone iannels used for air traffic control urposes. He explained and illustrated y appropriate photographic slides how avigation data concerning each airlane can be automatically transmitted the ground air traffic control stations nd plotted upon a radar type scope. y means of pushbutton arrangements round personnel can transmit instananeous orders to aircraft for changes distance. bearing, heading, altitude nd speed. The pilot can immediately cknowledge receipt of such ground ation commands and initiate reply essages by pressing the proper button n his control box.

One hundred fifteen members and uests attended this meeting.

The meeting was preceded by a soial hour and dinner. A meeting of the hapter's Board of Directors was held rior to the meeting.

### *lortheastern University*

The following list of activities has een received from this chapter for the pril-June Term.

During April. films shown were "Oprations Crossroads," "Origin of Moion Picture." "Naval Photography and cience." Meetings of various groups ncluding Photo and Electronic Groups ere held; there were two field trips on elicopter flights, and an address by avid M. Owen, Woods Hole Oceanoraphic Inst., on "Underwater Photogaphy."

During May. films were "Weapons of Artillery," "This is your Army," and "Aerial Fire Power." Activities included the annual banquet which was held at Steubens Vienna Room.

All students interested in knowing more about AFCEA were invited to attend along with members.

### *Philadelphia*

The chapter's April 8th meeting was held in the Skyview Terrace Dining Room at the International Airport in Philadelphia.

The meeting was preceded by a social hour and dinner.

Guest speaker of the evening was Professor Francis Davis, Professor of Physics and Meteorology at Drexel Institute, who discussed Meteorological Measurements. He is well known for his broadcasts and telecasts of the weather over WFIL and WFIL-TV.

### *Rocky Mountain*

The chapter's April 11th meeting was held at the Fort Carson Officers' Club.

The highlight of the evening was a presentation on the "Kitchen of Today and Tomorrow." Mr. G. T. Warren. Supervisor of Kitchen Design, General Electric Company, presented a film on Kitchen Design and its effect on the American way of life. In addition, a short discussion on general kitchen appliances ensued.

### *Rome-Utica*

The Officers' Club, Griffiss Air Force Base was the scene of the chapter meeting on Wednesday, April 10, 1957. Forty members were present for the social hour, the business meeting and a lecture-discussion by Mr. Ernie A. Matson, Jr., vice-president, Technical Materiel Corp. His subject was "Technical Materiel Corp., a Small Business with a Large Future." Mr. Matson discussed the progress of the company, its engineering development, and its production of electronic equipments for the services.

Election of officers was held with the following members selected to serve for the year beginning June 1957:

President: Mr. Allan A. Kunze; 1st vice president, Mr. Murray Socoloff; 2nd vice president, Mr. Charles A. Strom, Jr.; 3rd vice president, Mr. William Roberts; treasurer, Mr. Albert D. Reisenberg; secretary. Mr. Darrell S. Kirby.

**_New York_—Gathered together at the chapter's recent meeting are left to right: Brig. Gen. P. C. Sandretto, USAFR, Federal Telecommunication Laboratories president; Mr. Ben Alexander, the guest speaker; Benjamin H. Oliver, Jr., president of the chapter; Lt. Col. R. R. McMillan, chairman of chapter meetings, and Lt. Col. David Talley, chapter secretary.**

# CHAPTER NEWS

## *Sacramento*

Captain Les Williams of the California Highway Patrol was the featured speaker of the March 27th meeting of the chapter held at the Sacramento Signal Depot Officers' Club.

He spoke on "The Communication System of the Highway Patrol," explaining how an All Points Bulletin from headquarters reaches the patrol officers.

Darrell J. McConnell of United Air Lines also participated in the program, showing a short color film of Hawaii.

Refreshments and a social hour climaxed the meeting.

## *Scott-St. Louis*

The chapter held its April 5th meeting at Augustine's Restaurant, Belleville, Ill.

The highlight of the evening was a presentation by Captain Walter E. Smith, Assistant to the General Sales Manager of DAGE Television Div. of Thompson Products, Inc. Captain Smith's subject was "Weather-Vision System" which he supplemented with a film showing an operational installation of the system at Grandview AFB, Mo. As the originator of Weather-Vision, he very ably and capably spoke with unquestioned authority on the subject.

Elections were held and brought into office the following: president, Col. Charles W. Gordon, USAF; vice presidents, A. Lisle Lenny; B. Roger Robards; treasurer, Prosper L. Kinsella, USAF; secretary, Allan L. Eisenmayer, USAF; directors (elected for two-year term), Lt. Col. David W. Baugher, USAF; Capt. Paul M. Cowley, USAF; RAdm. Robert E. Melling, USN (Ret.); Walter W. Van Skiver, USAF and Clifford G. Wassall; director (elected for one year, completing unexpired term of Lt. Col. W. J. Trigg) Lt. Col. John L. Jernigan, USAF; directors (with one more year to serve) James G. Blain; Lt. Col. Charles H. Colman, USAF; Harry L. Cooper and Louis E. Dechant.

***Tokyo*** — **Dr. N. Tanaka, Nippon Electric Co., was the chapter's guest speaker in March.**

## *South Texas*

The April 30th meeting of the chapter was attended by sixty members who heard representatives of the Civil Aeronautics Administration speak on air traffic control. Speaking at Fort Sam Houston, Mr. James Evans, a Senior Controller at the San Antonio Air Route Traffic Control Center, had as his subject, "En Route Traffic Control." Mr. Donald S. Blatchford, Air Traffic Control Consultant described "Terminal Control Facilities and Operation." A short sound film illustrating the traffic control operations was also shown.

## *Southern Connecticut*

The May 16th chapter dinner-meeting was held at the Wonder Bar Restaurant in Bridgeport, Connecticut.

A showing of new developments in the communications art was lined up by the chapter. The display, entitled "Telepnone Magic," demonstrated working models of such advanced electronic equipment as solar batteries, micro-wave transmission, transistorized equipment, etc.

## *Tokyo*

"Industrial-Military Relationship" was the theme of the chapter's quarterly meeting held on March 1st at the U.S. Army Signal Supply Center, Far East. Three hundred guests at a buffet luncheon and business meeting heard welcoming remarks by Brig. Gen. Harold G. Hayes, SigO, USAFFE/8 Army (R). Highlighting the meeting was an address on "Microwave Developments" by Dr. N. Tanaka, Nippon Electric Company.

"Exicited by the news from the U.S.A. on the amazing progress in the development of long distant microwave link at AT&T (4000 MC TD-2 System), we started our real research project of microwave links in 1949 utilizing our past experiences," Dr. Tanaka stated. "In this system, several unique technical ideas of which we are very proud were applied. For instance, a microwave repeater uses only one microwave tube, one Travelling Tube, which acts as the receiving and transmitting oscillator and the transmitting amplifier simultaneously, while the broad band microwave repeaters in foreign countries, as regards to one repeater, use more than two microwave tubes usually. This minimization of microwave tubes should contribute to the saving of maintenance cost and the case maintenance."

Afterwards the guests were divided into groups and given escorts through outside exhibits, an electronic repair line and the static exhibits. A total of fourteen Japanese electronic manufacturers were invited to display their equipment. The Signal Supply Center also exhibited various types of Army communication equipment including radar and an ACT vehicle showing the installation of the AN/VRC-30.

***Scott-St. Louis***—**Officers and Directors elected at the April 5th meeting of the chapter are: (seated, left to right) Prosper L. Kinsella, treasurer; A. Lisle Lenny, vice-pres.; Col. C. W. Gordon, president; and A. L. Eisenmayer, sect'y. Directors: (standing, left to right) Lt. Col. D. W. Baugher, L. E. Dechant, Lt. Col. C. H. Colman, Capt. P. M. Cowley, RAdm. R. E. Melling, H. L. Cooper, J. G. Blain, and Walter W. VanSkiver, retiring president.**

Tokyo—Officers view displays at the recent meeting of the chapter which was held at the U.S. Army Signal Supply Center, Far East, Yokohama, Japan.

### Washington

The March 29th chapter meeting was held under the sponsorship of AFCEA and the Society of Motion Picture and Television Engineers in recognition of he International Photographic Exposiion which was the first of its kind ever o be held in the United States.

Dr. C. J. Staud, the chapter's guest speaker at the Willard Hotel, spoke on "Some Aspects of Photography in Communications and Electronics." Dr. Staud, Vice President and Director of Research, Eastman Kodak Co., said: "Photography by means of pictures has been used on the ground, at sea, in the air to afford intelligence and in that way to communicate information and ideas. . . Those of us concerned with research and development in the photographic field have put forth our best efforts to provide and to afford the highest quality materials and the most suitable processes to facilitate the work of the Armed Forces in their use of this means of communication. Work on the science of photography has been widely applied to the technology as represented by the pictorial, document reproduction, graphic arts, x-ray, and other forms of photography to be of service in a wide variety of fields." Continuing, he spoke of photography's role in recording the performance of guided missiles. He stated: "Schlieren photography and 'shell-burst' photography might be mentioned in this connection. We have therefore been enabled to obtain some general background which is now being turned to use in the more complex and more difficult problems associated with guided missiles traveling at very high speeds and remote from the camera."

Distinguished guests at the head table were Comdr. W. G. Matton, USN, Exec. Off., Naval Photographic Center; Mr. Keith Lewis, Washington Section, Chairman, SMPTE; Lt. Col. R. L. Cochran, USMC, Head of the Aviation Electronics Branch, Div. of Aviation; Mr. E. S. Lindfors, V.P., Bell & Howell Co.; Col. W. W. Lindsay, USA, Chief, Army Pictorial Center, Signal Corps; Dr. C. J. Staud, V.P., Eastman Kodak Co.; M. C. Richmond, president of the chapter; Mr. John A. Whittle, Mgr., Govt. Sales, Eastman Kodak Co.; Col. E. G. Lawton, USA, Asst. Chief of Staff, Intelligence Training Div.; Mr. James E. McGhee, V.P., Eastman Kodak Co.; Capt. C. D. Simonsen, USN (CNO), Air Warfare Div., Head Air Intelligence & Photographic Branch and Mr. H. A. Schumacher, V.P., Graflex, Inc.

The Willard Hotel, Washington, D. C. was again the scene of the chapter's meeting on May 2nd. Rear Adm. Joseph N. Wenger, Director, Communications-Electronics, Joint Chiefs of Staff, presented an especially interesting address on "Teamwork in Military Communications and Electronics and Their Relation With Industry." Adm. Wenger also described the Joint Communications-Electronics Committee organization and the manner in which it functions. In his remarks, he said: "While the JCEC is dealing with a large variety of matters, its major concern is the co-ordination of communications planning and operations. It has long been a basic tenet of the Services that communications are the instrument of command. . . . Accordingly, each Service maintains an essential minimum of Service-operated and contrulled communications facilities. These are supplemented by facilities leased from commercial carriers or provided by the other military Services. The Service systems are fully interconnected and mutually supporting. The apparent parallelisms between them suggest unnecessary duplication, but constant effort is made to prevent it."

In speaking of the international aspect of military teamwork, Adm. Wenger said: "For those who may entertain misgivings about three-Service cooperation, let me point to the situation in NATO where the problem has been multiplied by the number of nations involved. With so many different interests at stake, it is a miracle that anything at all has been agreed upon. Yet a vast communications-electronics program is in progress throughout the NATO countries of Europe. There, U.S. and other NATO military Services, working together and with European Civil organizations, are developing the military C & E structure necessary to defend the free world. They are also rebuilding, expanding and modernizing the civil communications facilities to strengthen the economy of Western Europe and provide a vital asset for war."

At the head table for this meeting were the following distinguished guests: Capt. J. R. Dennis, USN, Head, Naval Security Group, OCNO; Maj. Gen. James Dreyfus, USA, Chief, Procurement & Distribution, Office of Chief SigO; Maj. Gen. W. Preston Corderman, Deputy Chief SigO; RAdm. H. C. Bruton, Director, Naval Communications Div., OCNO; Maj. Gen. A. L. Pachynski, Director, Communications-Electronics, DCS/O; Maj. Gen. J. D. O'Connell, USA, Chief Signal Officer; Maj. Gen. F. L. Ankenbrandt, USAF (Ret.); Mr. Percy Black, National AFCEA President; Mr. M. C. Richmond, Pres., Washington chapter; RAdm. J. N. Wenger, Director, Communications-Electronics, JCS; Hon. Dudley C. Sharp, Asst. Sec. of Air Force; Vice Adm. B. L. Austin, USN, Director, the Joint Staff, JCS; Mr. R. H. Hughes, Director of Production, Communications & Mobilization Planning (Asst. Sec. S & L); RAdm. E. N. Parker, USN, Chief, Armed Forces Special Weapons Project; Maj. Gen. A. G. Hewitt, USAF, Director, Maintenance Eng., DCS/M and Mr. Paul Goldsborough, Staff Director, Communications (Asst. Sec. S & L).

# ITEMS OF INTEREST

## From Government, Industry and the Services

### DORSEY NAMED TO SUCCEED CASWELL

Captain Jack S. Dorsey, formerly on duty in the Office of the Chief of Naval operations, has been named Assistant Director, Naval Communications, succeeding Captain Gordon L. Caswell, who retires after 30 years of military service.

Capt. Dorsey has held many key positions in military communications. After top assignments during the war, for which he was awarded the Legion of Merit, he took over the duties of Navy Department Communication Officer, Office of the Chief of Naval Operations. Later, he served for three years as Head of the Communication Department at the Naval Post graduate school, and from 1952 to 1954, was the Chief of Communications, Joint Staff, Commander in Chief, Caribbean. He is a graduate of the U. S. Naval Academy.

Capt. Gordon L. Caswell, a graduate of the U. S. Naval Academy, has served in the Navy for thirty years. He is widely known in the communications field for such outstanding accomplishments as the instigation of a committee, which he chairmaned, to study the art of radio propagation predictions and forecasts; he wrote the present U. S. Navy Communication Instructions which, with only minor changes, is still the Bible of naval communications today.

In 1945, he served as Assistant Communication officer on the Staff of the Commander in Chief, Pacific, where he had the responsibility for the radio frequency and circuit planning throughout the entire Pacific area. His activities in the field of international communications are particularly noteworthy and exceptional. In 1947 he attended the World Conference of the International Telecommunication Union where he headed the U. S. team assigned the task of formulating a new international frequency list. In 1954 he served for four months as communication advisor to the Secretary of Defense, and then assumed his most recent position as Deputy Director, Naval Communications.

Both are members of AFCEA.

### NEW SIGNAL CORPS ASSIGNMENTS

New assignments for Army Signal Corps senior officers have been announced by Maj. Gen. J. D. O'Connell, Chief Signal Officer of the Army.

Maj. Gen. W. Preston Corderman, Deputy Chief Signal Officer, will go to Ft. Monmouth, N. J., replacing Maj. Gen. Victor A. Conrad, Commanding General, who has been named Chief Signal Officer, SHAPE, Paris, France.

Brig. Gen. Ralph T. Nelson, now Commanding General of the Signal Training Center, Ft. Gordon, Ga., will become Commanding General at Ft. Huachuca, Ariz. He will be replaced by Col. David P. Gibbs, who is presently Signal Officer of Continental Army Command, Ft. Monroe, Va.

Brig. Gen. William M. Thames, Ft. Huachuca, is to be assigned as Commanding General to the U. S. Army Combat Surveillance Agency, Washington, D. C.

Col. E. L. Littell, Comptroller, Officer of the Chief Signal Officer, will become Commanding Officer, U. S. Army Signal Supply Agency, Philadelphia, Pa. (USASSA).

Brig. Gen. William D. Hamlin, presently commander of USASSA will be assigned to U. S. Army, Europe.

Effective immediately, Brig. Gen. Kenneth F. Zitzman who was Chief, Personnel & Training Division, OCSigO, became Asst. Chief, Combat Development & Operations Division, while Col. W. B. Bess, who was with the P & T Division, became Chief of the Personnel Division.

### Accelerometer Measures and "Senses" Speed of Vanguard

A specially designed "integrating accelerometer" is being built by the Dynamics Corporation of America subsidiary, Reeves Instrument Corp. to "sense" and measure the speed of the Vanguard Launching Vehicle for an earth-circling satellite during its second and third phases. It will be able to measure and integrate a satellite's acceleration with an accuracy never before achieved by this type of mechanism.

While the path of the launching vehicle is predetermined and such factors as distance, weight and atmospheric conditions are all taken into consideration before launching, headwinds and thrusts from the rocket motors and the drag from other forces encountered by the flight up to that point, will exert pressures upon the vehicle which cannot be computed in advance. During the second stage of an attempted satellite launching, the Reeves' instrument, by "sensing" and measuring the increasing speed, will detect the uncalculated deviations. This information is needed by a computer to calculate the "coasting time" of the rocket.

The two major parts of the accelerometer are a gyroscope and a pendulum. The "sensing" and measuring device consists of 350 tiny parts most of which have to be assembled by white-robed technicians working under microscopes in an antiseptically clean laboratory.

### Mack Electronics Names Director of Engineering

Wendell E. Phillips has been appointed Director of Engineering for Mack Electronics Division, Inc. Plainfield, N. J. He will head all research and engineering activities of the Division which is a subsidiary of Mack Trucks, Inc.

Mr. Phillips has held engineering positions with the Lavoie Laboratories, the Federal Television and Radio Corporation, and Air Associates. He is a member of AFCEA, and I.R.E. and presently serves on the Advisory Committee on Electronics at Farleigh Dickinson University.

(Continued on page 42)

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## IGY World Warning Agency

Beginning July 1, 1957, the National Bureau of Standards radio forecasting center at Fort Belvoir, Va., will serve as the focal point of a world-wide communications network for the International Geophysical Year. From this point, warnings will be flashed to scientists throughout the world to redouble their observational efforts.

The warnings will be based mainly on world-wide observations of the surface of the sun and on the soundings of the ionosphere, the electrically charged upper portion of atmosphere. When the surface of the sun erupts, shooting flames for hundreds of thousands of miles, the earth's atmosphere is showered with vastly increased quantities of particles from outer space. The solar bombardment not only causes magnetic compasses to misbehave but also produces brilliant displays of Northern Lights and causes changes in radio communication through its effect on the ionosphere.

In addition to the NBS station at Fort Belvoir, the international network includes the radio teletype network of the World Meteorological Organization, virtually all of the commercial communications facilities throughout the world, government facilities (such as CAA), and special messages broadcast by the NBS radio propagation forecast channels and their counterparts in other countries. No matter how remote the site, IGY scientists can conduct their experiments simultaneously.

A series of Regular World Days has been selected in advance for more detailed simultaneous observations. However, there will be supplementary alerts when major solar-terrestrial disturbances are expected.

The forecasting center in Virginia will also serve as the Western Hemisphere Regional Warning Center. In the U.S. itself, messages will be put on the U.S. Weather Bureau communications system so that each local weather station can inform IGY field stations in its area.

## A Bigger "Boom" in TNT

How to put a bigger "boom" in TNT explosions is the secret being sought by scientists of the Navy's Ordnance Laboratory, Silver Spring, Md. Using a giant camera, manufactured by the Beckman Whitley Co., the laboratory's Explosives Research Department is conducting detailed studies of the propagation of small explosions.

A new Reserve Unit, the 262nd Signal Co., was activated in a ceremony held in the Office of the Chief Signal Officer. Maj. Gen. J. R. Pierce, Deputy Commander, 2nd Army, presents new guidon to Capt. J. J. Gancie, Company Commander as dignitaries look on. L to R: Maj. Gen. J. D. O'Connell; Mr. B. M. Grimes, Supt. Washington Office, American Cable & Radio Corp.; Maj. Gen. Pierce; Capt. Gancie; RAdm. E. W. Stone, Pres., American Cable and Radio Corp.; and Mr. and E. J. Girard, Asst. Vice-Pres., Federal Telephone & Radio Co.

The studies aim at finding out where, when, why, and how an explosive explodes, and what happens to the air around it and metals near it. With the information gained, scientists will be able to produce bigger explosions on the part of mines, rockets, guided missiles, and other weapons being developed at the Ordnance Laboratory.

The camera, a striptype, using a revolving mirror to reflect an image through openings onto a film, has electronic devices which precisely control the camera timing and the explosive detonation. The hydraulically driven mirror can make 10,000 revolutions per second. Coupled to a bombproof "doghouse," the camera takes photographs through ports in two-feet thick concrete walls of a blast chamber. The "doghouse" can withstand five-pound explosive blasts.

## U.S. Exhibits at Paris Trade Fair

"The Atom and Life" was the theme of the U.S. Central Exhibit at the 46th annual Paris International Trade Fair (Foire de Paris), May 25-June 10. For the third successive year, the United States was represented at the Fair, and this year some 200 American firms had individual displays.

The Central Exhibit gave a practical demonstration of the constructive uses of nuclear energy as applied to medicine and surgery, to agriculture and in factories, homes and power stations. Production of radio isotopes were demonstrated using a 27' x 18' actual size animated model of a graphite reactor.

Exhibited for the first time outside of the United States was the only set of electronically controlled "Hands" in the world. The "Hands" are considered to be the most advanced general purpose manipulator thus far developed.

An animated model of one of the power reactors in the U.S. explained how an atomic plant can generate electricity. There were also other exhibits of tools of the atomic age with laboratory equipment, protective clothing, handling equipment, and recording and measuring equipment.

## Powerful Radio Transmitter To Be Installed in Pentagon

A powerful new short wave transmitter which can beam vital defense messages to any spot on the earth, even through severe interference, will be installed for Pentagon use, the Army has announced.

Called the World Spanner, the transmitter was designed for use as part of the Army's world-wide communication network by the U.S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., and by Continental Electronics, Inc., Dallas, Texas. Almost 50 times more effective than the loudest commercial broadcasting station, the set owes its tremendous power to single sideband design.

Simplicity and compactness are salient characteristics of the World Spanner. By just turning a single switch, an operator can go on the air at any one of ten previously set frequencies. Despite immense power, it is completely safe to operate.

The World Spanner can transmit at any frequency in the short wave spectrum from 4 to 30 megacycles. A second version will cover the range from 20 to 65 megacycles.

## Infantry Division Reunion

The 94th Infantry Division Association, Inc., is holding its 8th Annual Reunion at the Hotel New Yorker, in New York City, July 18-21, 1957. All information can be obtained by writing the Secretary, A. E. Rodriguez, 614 Oakdale Ave., Chicago 14., Ill.

## ir Force Has New Research Aircraft

The United States Air Force has nnounced progress in development f a new research aircraft. Wind mnel tests are nearing completion nd fabrication of the X-15 rocket-owered research airplane, scheduled fly higher and faster than any other anned aircraft, has begun at the os Angeles plant of North American viation, Inc., under contract with e Air Force.

Although specifications are classi-ed, the engine's thrust will be greater an the thrust rating of the Air Force -1 and X-2 series aircraft which ir Force pilots have flown at speeds f more than 1650 miles per hour and ltitudes of 90,000 feet or more. New esign techniques have resulted in onsiderable weight and size savings.

The X-15 project was initiated ollowing preliminary studies by the ational Advisory Committee for eronautics to determine the feasi-ility of developing a research air-lane to extend exploratory investiga-ions beyond the flight regimes of the X-1 and X-2 research aircraft. A oop-program between the Air Force, Navy and NACA was established.

When North American delivers the aircraft, it will be used at the Air Force Flight Test Center in a pro-gram of flight research by the NACA in cooperation with the Air Force and Navy Bureau of Aeronautics.

## Two Chicago Engineers Win Fellow Awards

Fellow Awards, the electronic engineer's counterpart of the Nobel Prize, have been won by two Chicago engineers. Dr. Rinaldo De Cola, Director of Engineering at Admiral Corp. and member of AFCEA, and Dr. Eugene Mittelman, Consulting Engineer, are the honored recipients of the awards.

The Institute of Radio Engineers annually presents these honors for major contributions to the field of Electronics. Dr. Mittelman was honored for "pioneering in the field of industrial electronics," while Dr. De Cola's award was for "contributions to the fields of Military Electronics and television receivers."

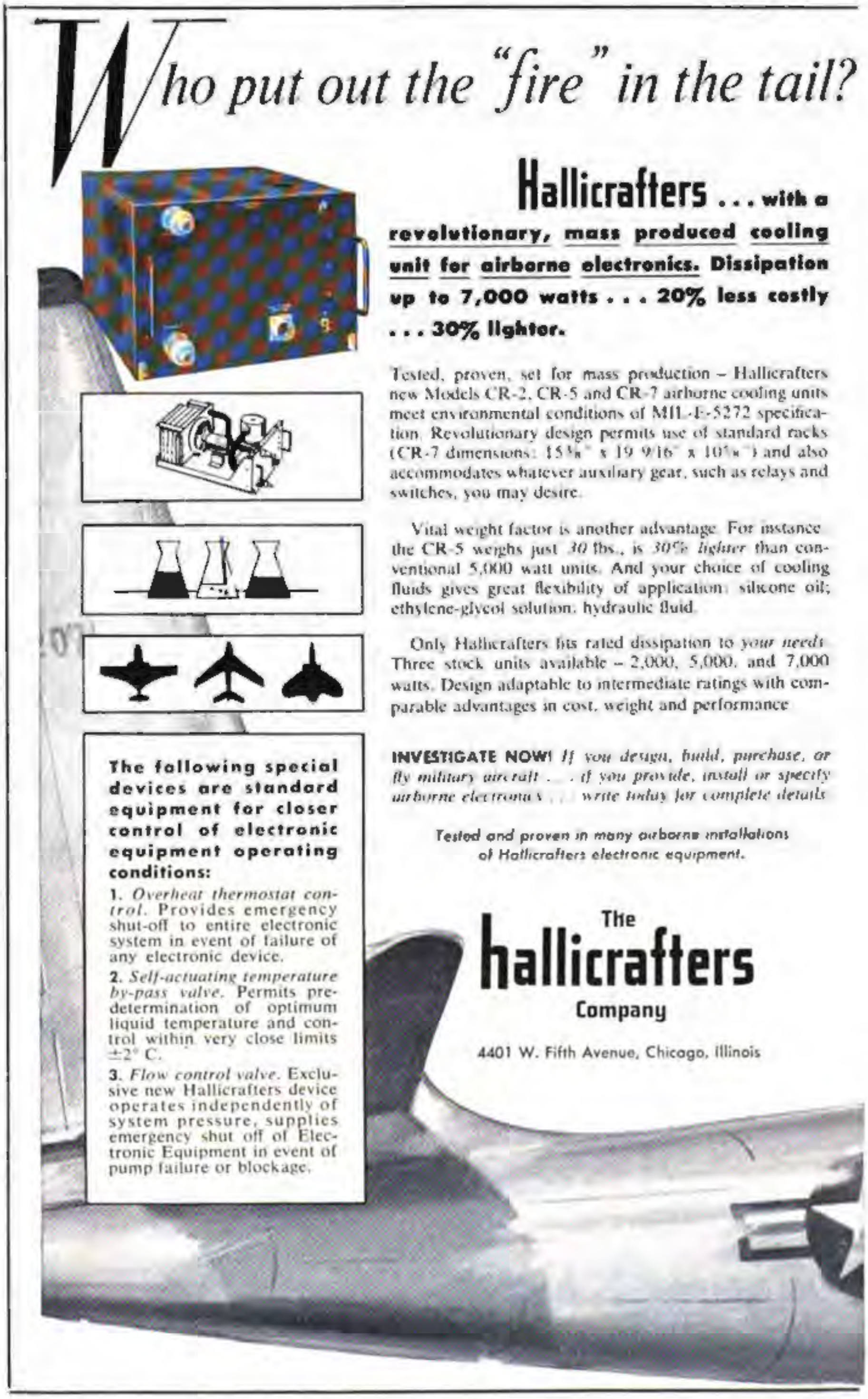
## Naval Observatory Under Construction To House Radio Telescope

Construction has begun on the Maryland Point Observatory of the Naval Research Laboratory, near Riverside in southern Maryland, the Navy has announced. When completed later this year, it will be the largest radio telescope installation in the U.S. and the largest known equatorially mounted installation in the world.

Designed by the D. S. Kennedy Co., Cohasset, Mass., it will consist of an 84-foot dish-shaped antenna mounted at the top of a large steel supporting tower. The antenna, built primarily of aluminum, will have a precise parabolic surface, permitting investigations of radiations from outer space at wave lengths as short as 10 centimeters. Mounted with one axis parallel to the earth's axis, the antenna permits tracking of any celestial object with a simple clock drive. Thus, the detection of fainter sources of radio signals, as well as a more detailed study of intense sources is made possible.

The Maryland site was chosen because it provides an excellent view of the horizon and low radio interference.

Radio astronomers at NRL will use the new instrument in the continuing program of research on radio radiation from the sun, moon, and planets. They will also carry on studies of the composition and physical processes occuring in interplanetary, interstellar, and intergalactic space.



## Tiny Microphone Placed in Heart Picks Up Heart Beat and Blood Flow

A tiny microphone, so small that it can be passed through an artery or vein directly into any part of the heart, promises to aid heart specialists seeking to diagnose and determine the exact location and extent of heart defects. The development of the heart microphone and the technique of using it has been a joint project of Gulton Industries, Inc., Metuchen, N. J., and Mount Sinai Hospital, N. Y.

The microphone, measuring only 1/20th of an inch in diameter and ¾ths of an inch in length, is inserted into the tip of a standard cardiac catheter and connected by cable to an oscilloscope. Passed into the heart through a vein or through an artery, the device can be manipulated by the physician to the appropriate location. By picking up precise sounds of the heart beat and the blood-flow, the natural inaccuracies inherent in the indirect stethoscope method are eliminated.

Sound energy, picked up by the Gulton microphone shows a visual pattern of heart sounds on the oscilloscope. Trained physicians can interpret the patterns to determine the exact sounds taking place at the point of microphone location within the heart.

A minute diaphragm located in the tip of the catheter is connected to a pressure measuring device which converts blood pressures into electrical energy. These pressures are also shown on the oscilloscope. An electrocardiograph hooked into the circuit shows the physician simultaneous oscilloscopic pictures of the heart sounds, the blood pressures, and the electrical impulses generated by the heart, all of which are of extreme importance in diagnosing the type of heart defect and its exact location.

## Two Atomic Combat Army Units

The Department of the Army has announced that two additional U.S. Army divisions, the 4th Armored at Fort Hood, Texas, and the 4th Infantry at Fort Lewis, Washington, have begun reorganization as atomic combat units.

The Pentomic Infantry and Airborne Division—a division with a pentagonal structure, geared to fight under atomic conditions—is the result of studies and actual field exercises conducted by the Army in recent years. It represents a division organization of five combat unit forces incorporating the maximum capabilities for sustained combat, air-transportability, battlefield mobility, and control.

The capability of absorbing new weapons and equipment into the new Army divisions has been developed in their structure. The divisions will have the capacity of rapid concentration, equally rapid dispersal, and increased action during periods of reduced visibility. Increased use will be made of organic and supporting aircraft.

Within the next two years all of the Army's divisions—Infantry, Armored, and Airborne—will be tailored to fight wars in which atomic weapons are introduced, while still retaining their firepower and general effectiveness for successful non-atomic combat.

## Britain's Fastest Submarine

Britain's fastest submarine, *Explorer*, is "a strong contender" for the title of the world's fastest submarine. This was announced by the English Parliamentary Secretary to the Admiralty when the *Explorer* was reported to have exceeded 25 knots under water.

Entirely unarmed, the *Explorer* is Britain's first high-test peroxide submarine. Her purpose is to act as a fast target to train the Royal Air Force in the latest tactics against high-speed underwater raiders.

Having a displacement of only 780 tons and an overall length of 225 feet 6½ inches, she is very maneuverable and only the readings on the instruments and a tremor on the depth gauge suggest the high speed.

She differs chiefly from other submarines in that she is completely self-contained. The engines which drive her at speed when submerged are powered by turbines driven by combustion of oxygen from high-test peroxide and diesel fuel. The direct manufacture of oxygen is unique to the submarine, making it entirely independent of the outside atmosphere for its supply.

## Air Associates Becomes Electronic Communications, Inc.

A thirty-year-old name in aviation manufacturing receded into the background when Air Associates, Inc., officially changed its name to Electronic Communications, Inc. (ECI).

According to F. W. Godsey, Jr., President of ECI, the new name was chosen because it "more accurately describes the future aims of our company." Henceforth, Air Associates, Inc., will be the name of the widely-known aviation supplies division of ECI.

## Revolutionary TV Screen

The Naval Research Laboratory has developed a revolutionary television screen which permits viewing of television in bright daylight with little loss of contrast, the Navy has announced. The new screen also provides a simplified approach to color TV, and is expected to lead to the development of three-dimensional viewing.

The basis for the new screen is a process for depositing phosphor on the face of the tube in the form of thin transparent film in place of opaque white powders now used. The new films are brighter, sharper, and more rugged than preceding types.

Improved daylight viewing of black and white TV is brought about by contrast obtained with transparent films. Sunlight goes through the film and is lost in the darkened interior of the tube so that contrast is maintained. The elimination of the scattered grains of light on the conventional screens results in the sharper picture.

The transparent film involves a new approach to color television. Films that create different colors can be deposited on top of one another and lighted separately or mixed, by controlling the speed or the direction of the electrons in the tube. By using one film of each of the three primary colors, the complete color spectrum can be obtained through proper mixing. Tubes with all colors are in the experimental stage.

Originally, this work was started for simplifying the operation of jet fighter planes in order to reduce the training time of pilots and help them get the maximum performance from their planes. In part, it involves eventual replacement of the present windshield with a thin transparent display medium. The pilot would get visual and electronic information at the same time and in the same spot. An interim program will utilize a flat transparent television tube installed just inside the wind screen.

## Weather Gun Measures Wind

A weather gun that aims at—and hits—itself with a round-trip bullet is the latest experimental device for measuring low-altitude wind velocity, it was announced by the Army. Designed by physicists of the U.S. Army Signal Engineering Laboratories at Fort Monmouth, N. J., it is officially called "Shooting Sphere Anemometer."

Low-altitude wind velocity must be known precisely at the site of a missile launcher in order to hit a bull's eye; even relatively low winds have a significant effect. The new gun, nicknamed "Breeze Buster," provides fast, accurate measurements of these important winds.

By firing a small steel ball upward into the wind at an angle calculated to make the ball fall back into, or close to, the gun's own muzzle, it determines wind velocity. The gun is angled according to the wind velocity; the greater the wind speed, the more the gun is angled. When a successful firing is made, the operator checks the gun's angle of tilt with a calibration chart to obtain a reading of the wind velocity.

The weather gun has certain definite advantages when compared with small pilot weather balloons. Its small steel spheres are inexpensive; it cannot be spotted and shot down by the enemy; it can be used under poor visibility conditions; it measures wind at the testing point, and gives information faster than its predecessor.

## Improved Aerial Pictures

Improving aerial pictures is one goal of the military photography section at the Kodak Research Laboratories, Rochester, N. Y.

A small scale model village is used in work on new materials and techniques for aerial photography. Use of the model permits haze, clouds, and other conditions to be simulated for controlled experiments.

Research in the field of military photography was set up as a special section of the Kodak Research Labs last October. Reflecting the growing complexity of military photography, the research section also studies problems in radar photography and various forms of instrument recording photography essential to national defense.

## Distinguished Public Service Award

Mr. Donald C. Power, President of General Telephone Corporation, has received the Distinguished Public Service Award given annually by the American Society of Tool Engineers.

The Award was made by Mr. Hartley W. Barclay, Past Chairman of the Greater New York Chapter and Publisher of *Tide* Magazine. He referred to Mr. Power's activities as the "joining of science, education, public service, finance and communications by a man with deep insight into the opportunities in America."

# NEW PRODUCTS FROM INDUSTRY

## *First 3-Speed Transistorized Record Player*

The first 3-speed transistorized portable record player is now offered by the Audio-Master Corp., 17 E. 45th St., New York City.

This unique high fidelity equipment, called the BUTON, is contained in an attractive carrying case measuring 13" x 11" x 5". It is built to rugged luggage specifications and may be conveniently transported. It is specially constructed to withstand jolts and jars, and it is said to perform with concert hall clarity and brilliance.

The BUTON uses four special transistors with an output of 450 mA. The electromotor operates on a 6-volt battery, playing 33, 45 and 78 RPM records. Its frequency range is from 50 to 13,000 cps.

## *New Lightweight Loop Antenna*

A new directional ferrite-core loop antenna, weighing only 7.5 lbs. and using 35% of previous space requirements, has been developed for use in aircraft by the Magnavox Co., Fort Wayne 4, Indiana.

Having a frequency range from 190 to 1760 kc, the new antenna is interchangeable with the loop commonly used with automatic direction finders. It is rotated by a 2-phase motor through reduction gears, which decreases the angular velocity of rotation. A synchro transmitter connected to the rotating antenna transmits the angular position of the antenna to a bearing indicator. A quadrantal compensator corrects errors in bearing indication caused by the aircraft's fuselage in the electromagnetic field.

Flush mounting is readily permitted, and, since the housing extends only 2½" from the aircraft, minimum friction and virtually no airflow damage are possible. Hermetic sealing of components and supporting structures eliminates the need of a dehydrator for moisture control.

## *Germanium Rectifiers Key To Superior Broadcast Transmitter*

A most significant advance in broadcast equipment, a new 50,000-watt AM radio broadcast transmitter has been announced by G.E.'s Technical Products Dept., Syracuse, N. Y.

Maintaining that the key to the transmitter's superior reliability lies in the use of germanium rectifiers, G.E. uses them for the first time to supply high voltage and reduce tube requirements. Dimensions of the new transmitter are 13½' long x 4½' deep. With the use of germanium rectifiers, tube requirements are reduced to 16, weight of the final amplifier tube is lessened to 20 lbs., and only 6 types of tubes are required.

Germanium rectifiers have longer life expectancy than tubes of the present-day transmitters and can be operated at much lower temperatures, allowing the transmitter to be housed in an unheated building.

The new transmitter has built-in provisions for remote operation, although a ruling by the FCC has not yet provided for the allowance.

In addition to the expected lower operating costs, the transmitter's simplicity of design will require much less trained technical skill for maintenance and operation.

## *New Unit Records Continuously for 24 Hours, Unattended*

The SoundScriber Corp. of New Haven, Conn., has announced the successful testing of their compact, magnetic tape recorder/reproducer, the "24," said to be capable of recording continuously, unattended, without tape change, for 24 full hours with the reliable and accurate operation of an electric clock.

Selected by SoundScriber for use in their unit, the DuPont Mylar tape reel measures 3¾" in diameter and 2" wide, holds 300 ft. of tape and operates at the slow speed of 2½" per minute. The tape is calibrated in minutes from 0000 to 1455 for precise place-finding to the second, and is precision-printed in temperature and humidity-controlled surroundings for recording accuracy.

An accessory magnetic tape demagnetizer will bulk-erase a tape reel in 15 seconds, and reels may be quickly changed so as to allow for virtually uninterrupted recordings. Alteration of the recording is said to be impossible without detection.

Designed for use either in a stationary mounting or as a portable unit, the "24" measures 6½" high, 18⅛" wide and 11⅞" deep, weighing only 26½ lbs.

Communications may be monitored through an external headset. Inputs are telephone, line and microphone; outputs are speaker and headset. Operating voltage is 115 volts, 60 cycles, AC.

## *New Norelco Microradiography Instrument*

A new low-cost Norelco contact microradiography instrument for industrial, agricultural and biochemical research has been announced by Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

An image is formed by bringing the specimen into close contact with the emulsion of the photographic plate. After exposure to X-rays for a certain time interval, the plate is developed normally. All details of the specimen are natural size on the negative, but the dimensions can be magnified with a light microscope and photographed. Resolving power is excellent, allowing a magnification of 500.

Geometrical blurring is negligible and very-fine-grain photographic plates are available for a resolution of better than 0.5 mu.

The instrument employs an X-ray tube which produces very soft radiation, a thin beryllium window (50 mu) and voltages limited to 5 Kv and lower.

When the standard film holder is used, the distance from focus to object is about 15 mm, but can be extended by inserting a spacer tube 9 mm long. Provision is made for cooling the X-ray tube during long exposures.

## *New British Quartz Crystal Goniometer Now Available In U.S.*

A new, high precision quartz crystal X-ray goniometer, which permits unskilled operators to orientate crystal surface and lattice planes quickly to accuracy within 30 seconds of arc, has been produced by Hilger & Watts Ltd., and is being distributed here by the Jarrell-Ash Co., 26 Farwell St., Newtonville 60, Mass.

The Hilger goniometer, Model Y-130, is said to provide a fast, simple means of accurately checking plane alignment of cut quartz and other crystals.

Rixon 16-Channel Teletypewriter Multiplex

## 16 Channel Teletypewriter Multiplex

The transistorized 16 channel multiplex terminal equipment for teletypewriter communications, designated AN/TCC-35, has been developed by Rixon Electronics, Inc., 2414 Reedie Drive, Silver Spring, Md.

Using time division techniques, the system places up to 16 coded messages onto a single circuit that has a bandwidth as low as 500 cycles per second. The teletypewriter offers speeds of 60, 75 or 100 w.p.m.

Along with transistors, the equipment features miniature magnetic "memory cores" whose high residual magnetism allows them the same storage function as obtained with an Eccles-Jordan (flip-flop) circuit. Occupying very little space, the cores are encapsuled in protective epoxy resin and approximately 1300 are used in the set.

Simplification of servicing results from "potting" standard circuits in expendable plug-in units; 80% of the data-handling circuitry has been standardized into 8 such circuits. Mounted in articulated hinge modules, the chassis is easily accessible from either side of the unit.

A built-in test oscilloscope monitors operation and detects any deteriorating components before failure, thus enabling the system to approach 100% long-time reliability.

Synchronism is automatic within 15 seconds, and is maintained for over 24 hours if the communications should fail. Any binary data in teletypewriter form can be handled.

## World's First Linear Accelerator for Industrial Radiography

A 5 million electron-volt linear accelerator (5 Me V), recently produced by Mullard Research Labs., Mullard House, Torrington Place, London, England, is said to be the first of its kind designed specifically for Industrial Radiography.

Supplying more X-ray output and greater energy than any machine previously used for radiography, the linear accelerators also compare favorably with multi-curie radioisotope sources, such as Cobalt 60.

The 5 MeV machine has been designed to render extremely good definition. Despite high energy and the large output of over 500 roentgens per minute at 1 metre, the electron beam which creates the X-rays has a diameter of only 2mm when it strikes the target. In addition, the polar diagram of the output tends to be flatter than is normally associated with such a high energy beam due to a special new magnetic focusing device in the X-ray head.

Only 9 ft. in length, the accelerator has a high degree of mobility which permits movement into the best position for obtaining a radiograph, thus eliminating any need for moving the bulky specimen. Other features include the rotation of its X-ray head, and the ability of the entire machine to be tilted from vertical to horizontal, to be turned laterally through 180°, to be raised or lowered 8 ft., and to be mounted on an overhead rail so that transverse and longitudinal movements are obtainable over the room which houses it.

## Use of Color TV Increases X-Ray Readability

The new Exicon research tool, recently developed by Philco Corp. of Phila., Penn., and Einstein Medical Ctr., is said to enable technicians to see trouble spots in X-ray photographs which were often obscured under conventional methods of negative viewing.

Converting shades of contrast into color, the system shows a multi-hued photograph on a TV screen in which different colors represent shades of gray on the negative. Thus, diseased tissues, ordinarily showing up in an X-ray as an almost indiscernible shadow, are more easily identified with the use of full color.

"Exicon," meaning expanded image contraster, uses mainly TV equipment, and consists of monochrome and color monitors, an operators' console and a flying spot scanner.

Widespread industrial application is expected of the system for future uses such as exposing flaws in metal castings, forgings or welds. Other uses under study include aerial reconnaissance, air traffic control and various industrial techniques in chemistry, pharmacology and metallurgy.

## Pocket-Size Mobile Radio Receiver

An RCA-developed pocket-size FM radio receiver for commercial mobile communication service was shown for the first time recently.

The fully transistorized, 10-ounce instrument is designed to provide extensions of several miles for radio systems now operating on the 150-megacycle band. In addition, it is constructed for operation on any frequency in the 148-to-174 megacycle band, assigned by FCC for communications applications by numerous Federal, municipal, industrial, and utility services, including the petroleum industry.

Later this year, following nation-

(*Continued on page* 48)

## NEW PRODUCTS

wide field tests, the microminiature radio will become commercially available.

### Radar Tamed for Private Protection

"Radar-Eye," a motion detection instrument developed by Radar-Eye Corp., North St., Natick, Mass., now provides industry and business with a new method of protection against burglary or intrusion.

Within an operating radius of 25 ft. in any direction from its antenna, the Radar-Eye is extremely sensitive to any movement. Invisible radar waves instantly turn on floodlights and set off a screaming alarm which will operate as long as any motion continues including one minute thereafter. Tamperproof wiring sounds the alarm when any attempt is made to open the unit or cut off its power. In addition, the Radar-Eye shuts off and resets itself automatically.

This portable unit can be installed behind non-metallic walls, and a remote control key switch permits control from outside the premises. For added protection, an accessory fire detection circuit and alarm may be obtained.

Using less current than a 60-watt bulb, the unit operates on 115V. AC, 60 c.p.s. single phase. Its compact dimensions including antenna are: 17¼" long, 10⅞" deep and 25¾" high.

### High Temperature, Low Capacitance Teflon-Air Dielectric Cable

An entirely new teflon-air-dielectric miniature coaxial cable has been developed by The Tensolite Insulated Wire Co., Inc., 198 Main St., Tarrytown, N. Y.

Having a nominal overall diameter of .220", the cable is available with a choice of outer jackets of teflon, such as lacquered nylon braid and silicone impregnated glass braid. The conductor is #30 AWG, 7/38 silver-plated copperweld.

Its low attenuation makes the 10 MMF cable particularly serviceable for high frequency, low level applications and as a low capacitance probe cable. Capacitance values of less than 10 MMF, having somewhat larger diameters, are available on request.

Featuring excellent flexibility, the new coaxial cable has the added advantages of solderability, light weight, small size, and ready adaptation to a variety of connectors.

### New Hermetically Sealed Inductive Components

Now offered by Electro-Tech Pacific (ETP), Box 455, Goleta, Calif., is a new line of hermetically sealed inductive components which feature high inductance, small physical size, low harmonic distortion and great stability under wide temperature ranges.

Provided with the best shielding available, these inductive components are insulated to withstand potentials of high orders of magnitude, and designed specifically for very low frequency performance. Humbucking construction is used on all ETP inductors and transformers, along with varnish vacuum impregnation. All units are tropicalized and hermetically sealed.

In all, it is claimed that these features insure circuit elements having exceedingly long life and exceptional stability.

### New 24-Hour Multiple Operation Time Switch

Completely automatic control of intermittently operated equipment is provided by the versatile 24-hour time switch recently developed by Zenith Electric Co., 152 W. Walton St., Chicago, Ill.

Handling as many as 48 "on" and 48 "off" operations a day, the switch can be used in control of oil wells, heating and air conditioning equipment, stokers, oil and gas burners, etc.

Running periods are set by sliding self-contained, nonremovable trip levers in or out on a control dial, scaled in 15-minute graduations. A daily operating schedule can be set up to repeat automatically each day, or a calendar cutout device, available as an accessory, can make the switch selective for each weekday, including provision for non-working days.

Powered by a heavy duty, synchronous industrial motor lubricated with low-temperature oil, the mechanism capacity is rated at 1000 watts, 60 cycle AC, and the action is single pole, double throw.

## New Literature

### "Battleground U.S.A."

Entitled "Battleground U.S.A.," a 117-page publication has been issued by FCDA, proposing a plan for the operational readiness of civil defense agencies in the event of enemy attack. Supplemented with 21 maps, the guide details every phase of civil defense actions necessary within a hypothetical target area, and emphasizes the need for adjusting the plan to the peculiar laws, administrative arrangements, readiness, and geographical characteristics of each political jurisdiction.

The FCDA plan covers operations of the metropolitan target area's defense forces during a tactical alert, the attack itself, and the immediate post-attack period. To clear way for civil defense operations, the State's emergency legal powers are also identified.

### Tape Wound Core Catalog-Design Manual

"Performance-Guaranteed Tape Wound Cores," a 28-page catalog-design manual compiled by Magnetics, Inc., of Butler, Penn., features a comprehensive section for engineers and scientists interested in applications of high permeability magnetic materials.

The manual supplies information on magnetic terminology, design equations and material characteristics of tape wound cores together with detailed methods of testing and core matching. Also included are tables devoted to basic units and conversion factors and the properties of nickel-iron alloys with their magnetic values. Finally, a bibliography is offered.

Listing all standard and many non-standard sizes, the catalog describes the advantages and construction of the tape wound cores and contains a section given to the ordering and matching of cores.

### Teflon Superior to Mica For Capacitors

Obtainable from OTS, U. S. Dept. of Commerce, Washington 25, D. C. is a 79-page report describing the use of Teflon in electronics where capacitors of the polytetrafluoroethylene material were found superior to those of mica.

A revolutionary dry lubricant and preservative for metals, Teflon met or exceeded all requirements for replacement of mica capacitors under temperatures from —60 to 200 C., excepting the r-f current rating which was unapplicable to metal-cased units due to overheating.

*Development of Subminiature High Temperature Capacitors*, PB 111729, reveals two remaining obstacles before Teflon capacitors could replace mica units in any application: stabilization of capacitor elements and encasement for radio-frequency operation.

### LECTRONICS IN INDUSTRY, 2nd Edition, *by George M. Chute. McGraw-Hill Book Co., New York, N. Y. 431 pages, $7.50.*

This textbook is designed for en-ineering students and for men in he electronics industry who use and ervice industrial electronic circuits nd equipment.

Uses of vapor or gas tubes are tressed. The tube circuits presented n this volume are commonly used n practical industrial equipment, and he text deals exclusively with equipment designed and built for indus-rial applications.

The revised edition has been brought up to date with an additional chapter on simple closed-loop sys-tems for a background of feedback controls. Recent designs of industry have revised these controls.

### THE ART AND SCIENCE OF PROTECTIVE RELAYING, *by C. Russell Mason. John Wiley & Sons, Inc., New York, N.Y. 410 pages, $12.00.*

This volume is an outgrowth of notes used in the Power Systems Engineering Course given by the General Electric Company. It assumes no prior knowledge of protective relaying. The student needs to know only the fundamental principles of electrical engineering. The included material, which has been tested in the classroom, is not only an introductory guide for the novice but also serves the practicing relay engineer with a storehouse of refresher information on principles of relay design and application.

The text deals with fundamental relay-operating principles and characteristics, including a description of the various types of relays. The relation of relaying to other power-system elements is discussed. Instructions on interpreting relay response are included.

The concluding chapters discuss line protection with relays of the overcurrent, distance, and pilot types.

Complete references to basic source material are given.

### NIGHTMARE OF THE INNOCENTS, *by Otto Larsen. Philosophical Library, Inc., New York 16, N. Y. 240 pages, $6.00.*

A Norwegian fisherman, for no discoverable crime, had been arrested by the Russians and sentenced to 10 years hard labor in the slave camps of the Soviet Union. Now, in this book, Otto Larsen tells the terrifying story of his experience in that world of nightmares.

The author's laconic words bring through the anguish of his stark chronicle with a penetrating fervor. Revealing the intense fear animating the Soviet Regime together with the extraordinary stupidity common to such despotisms, he presents a vivid record of man's inhumanity to man.

Having found the narrative impressive in its unadorned truthfulness and wealth of illuminating detail, Bertrand Russell calls it "quite extraordinarily moving."

### RESONANT CIRCUITS, *ed. by Alexander Schure. John F. Rider, New York, N. Y. 72 pages, $1.25.*

Volume 16 in the paper-bound Electronic Technology Series is concerned with resistors, capacitors, and inductors which are found in various series, parallel, or series parallel resonant combinations in electronic circuits.

The essential theory related to resonance is reviewed and followed by discussions on the theory of series resonant circuits, delineating the computations relating to resonant frequency, the voltage relationships, and the role of the figure of merit (Q) in these circuits.

Similar analyses for the elements comprising parallel resonant circuits and the circuits themselves are included.

The rest of the theoretical material treats resonant coupled circuits, including the coupling coefficient, reflected impedance, and the effects of coupling upon resonance.

A few basic applications are described. These are typical of the general uses of the circuits and give an understanding of general circuit arrangements.

### LINEAR TRANSIENT ANALYSIS, *Vol. II, by Ernst Weber. John Wiley & Sons, Inc., New York, N. Y. 452 pages.*

This volume presents a college graduate course in two-terminal-pair networks. As a sequel to Volume I of *Linear Transient Analysis,* it presupposes knowledge of the functions of a complex variable and familiarity with simple lumped circuits. However, the appendices provide mathematical background which helps make the work self-sufficient.

Also included is a brief review of the Fourier and Laplace transforms. Their uses in analyzing fourpoles and transmission lines are emphasized. An unusually comprehensive treatment of the two-terminal-pair network is presented in simple matrix algebra.

Although the book is essentially a mathematical discussion, it offers numerous practical applications.

### RADIO AIDS TO AIR NAVIGATION, *by J. H. H. Grover. Philosophical Library, Inc., N. Y. 138 pages, $6.00.*

Stressing performance, capabilities and methods of operation of the different types of navigational radio equipment, this author has fully covered the most important civil systems in current use in Europe and America, with a minimum of technical description.

After an introductory chapter on general principles, M.F. and V.H.F. systems are described. Two chapters are devoted to important hyperbolic aids, followed by a discussion of pulse systems, aids to traffic control, aids to approach and landing. In addition, future aids and trends, charts, documents and regulations are included. Finally, two appendices, table of radio aids, and formulae and conversion factors are offered.

This volume provides the student preparing for his civil license examination with all the basic knowledge required regarding radio aids to air navigation. For the qualified navigator and pilot, it will serve as an excellent reference guide.

### AN INTRODUCTION TO JUNCTION TRANSISTOR THEORY, *by R. D. Middlebrook. John Wiley & Sons, Inc., New York, N. Y. 296 pages, $8.50.*

This study provides a background for the electronic engineer who is interested in transistors and how they operate. It serves as a connecting link between the physical processes in semi-conductors and the circuit properties of a junction transistor.

The text is divided into three parts. The starting point is a discussion of crystal structure and the motion of electrons in crystals. Upon this foundation, a continuous development of the basic theory of transistor action is presented.

The major purpose of the study is to develop basic junction transistor theory. It introduces a new equivalent circuit, based on this theory, which can be used in practical applications.

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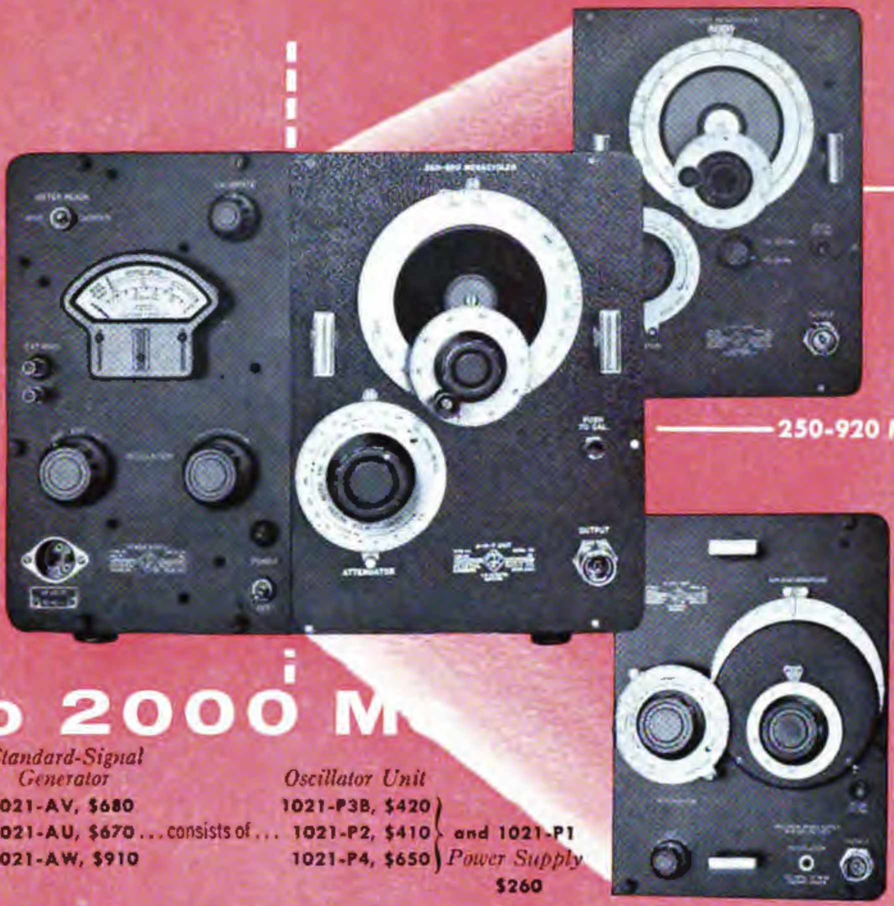

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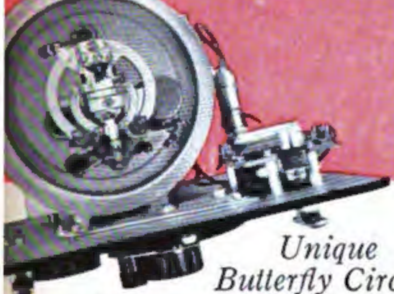

*Unique Butterfly Circuit*

akes possible the unusually wide tuning range of this 920 Mc oscillator — sliding contacts and varying nd currents through the bearings are avoided.

☆ ☆ ☆

**Frequency Calibration:** direct reading to ±1%

**Output Voltage:** continuously adjustable, 0.5μv to 1.0v, open circuit

**Output Impedance:** 50Ω ±10%

**Output Meter:** voltage indications accurate to better than 20%; meter circuit can be calibrated against accurately known 60-cycle line — switching permits reading of percentage modulation applied.

**Amplitude Modulation:** 40-250 Mc and 250-920 Mc oscillators adjustable 0-50%; Internal 1000c; External, flat within 3 db from 30c to 15kc — 900-2000 Mc unit may be square-wave modulated over 100-5000 cycles from external modulator.

**Shielding:** stray fields and residual output voltage are sufficiently low for measurements on receivers of 1μv sensitivity.

**Television Picture Modulation** is readily produced at any frequency from 40 to 2000 Mc with the Type 1000-P6 Crystal-Diode Modulator ($40) and the video output from a standard tv receiver. With the Type 1000-P7 Balanced Modulator ($200), 100% amplitude modulation is readily obtained, and pulsing with fast rise times and short durations is possible with a high degree of carrier suppression.

This GR **Standard-Signal Generator** is built in two units for flexibility and economy. The power supply, modulator, and metering system make up one unit — one of three readily interchangeable carrier-oscillator units fits in the other side of the cabinet.

The two lower-frequency models have wide-range butterfly circuits in which tuning is achieved by simultaneous variation of inductance and capacitance without use of sliding contacts. These two units deliver one volt, open circuit. The highest-frequency model with an output of 0.7v is tuned by adjustable transmission lines. Double shields enclose the oscillator units, and power lines are well filtered. All three instruments feature good stability and low drift.

Simplicity, economy, and reliability were important considerations in this design, and the resulting instrument is moderately priced, compact, light in weight, and durably built.

## GENERAL RADIO Company

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*Increases engineering space to 861,000 sq. ft.*

Ultra-modern Wayland Engineering Laboratory is an important new landmark in the development of Raytheon "City"—a rapidly growing community of electronic centers extending from Massachusetts to California. Here are the vital statistics:

**POPULATION:** 2,000 scientists and engineers; 22,000 skilled men and women in all.

**BUILDINGS:** 21 plants and laboratories.

**WORK AREA:** 861,000 square feet of engineering space; a total of 4,062,827.

**ACTIVITIES VITAL TO NATIONAL DEFENSE:** Missiles—Navy Sparrow III and Army Hawk; Radar for the Air Force's B-58 and B-52; DEW line radar; tubes, transistors, counter-measures.

**REPUTATION:** World-wide.

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*Excellence in Electro*

**RAYTHEON MANUFACTURING COMPANY**
**Waltham 54, Massachusetts**

Communications—Electronics—Photography

July 1957

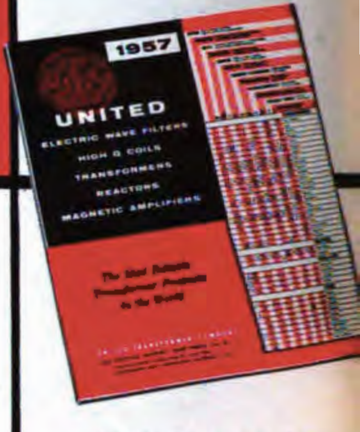
# SIGNAL

## AFCEA CONVENTION REPORT

Flight of The HAWK

See Page 3

# The Transformer for Your Application ..FROM STOC

Three hundred **hermetic items proved to MIL-T-27A** . Filters, high Q coils, power, plate, filament, pulse, audio transformers. Eliminates costs and delays of initial MIL-T-27A testing. Seven hundred stock items for virtually every application in the electronic field . . . each with **UTC Reliability, highest in the field.**


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HIGH Q COILS
TRANSFORMERS
REACTORS
MAGNETIC AMPLIFIERS

***Write for your Copy of Latest Catalog.***


**VARIABLE INDUCTORS**
Standard,
Hermetic MIL-T-27A


**LOW FREQUENCY INDUCTORS**
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**PERMALLOY DUST TOROIDS**
Hermetic, MIL-T-27A
Highest Q, accuracy and stability


**LOW PASS, HIGH PASS, BAND PASS FILTERS**
Hermetic, MIL-T-27A


**AUDIO COMPONENTS**
Hermetic, MIL-T-27A
for every application


**POWER COMPONENTS**
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Power, Plate, Filament Transformers,
Filter chokes


**MAGNETIC AMPLIFIERS**
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**DECI-OUNCER**
Transistor transformers .1 oz.
Hermetic, MIL-T-27A

**PULSE TRANSFORMERS**
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Audio and
Transistor


**OUNCER AND PLUG-IN**
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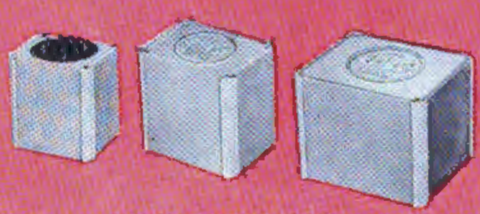
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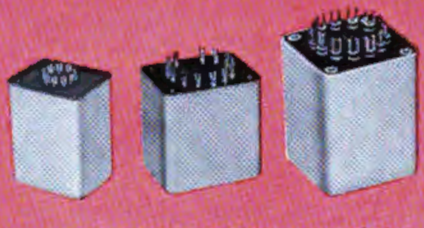
Highest Fidelity Audio Units


**HIPERMALLOY AND ULTRA COMPACT**
Broadcast and Hi-Fi Favorites


**COMMERCIAL GRADE**
Power and audio units for industrial service


**VOLTAGE ADJUSTORS . . . STEPDOWN and ISOLATION TRANSFORMERS**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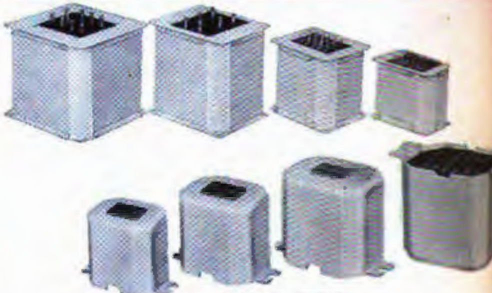
**SPECIAL SERIES**
Units for every amateur application.

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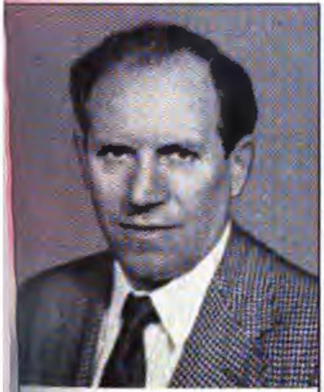
PACIFIC MFG. DIVISION, 4008 W. Jefferson Blvd., Los Angeles, Cal.

**WALTER H. BRATTAIN.** One of three winners of the 1956 Nobel Prize in Physics for investigations on semiconductors and the invention of the Transistor, the tiny device which has created a new electronic era in communications.

**H. F. DODGE.** Awarded Shewhart Medal by American Society for Quality Control, for original contributions to the art of statistical quality control—used by Western Electric in making millions of items of telephone equipment.

**H. T. FRIIS.** Awarded Medal of Honor, Institute of Radio Engineers and Valdemar Poulsen Gold Medal, Danish Academy of Technical Sciences for important work in application of short and ultra-short radio waves.

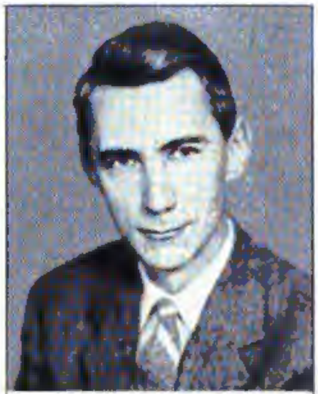
**AXEL G. JENSEN.** David Sarnoff Gold Medal, Society of Motion Picture and Television Engineers, for technical contributions to television; Hagemann Gold Medal for Industrial Research, Royal Technical College, Copenhagen.



**R. KOMPFNER.** Awarded Dudell Medal by the Physical Society of England for his original work on the traveling wave tube. This new amplifier makes it possible for long distance microwave highways to carry more telephone conversations and TV programs simultaneously.

**WARREN A. MARRISON.** Awarded the Tompion Gold Medal, Worshipful Company of Clockmakers of the City of London, for pioneer work on quartz crystal oscillators as precision standards of time. This control of electrical vibrations is used to send many voices over the same telephone line.

**W. G. PFANN.** Awarded the Mathewson Gold Medal by the American Institute of Mining and Metallurgical Engineers for discovery of and pioneering research in zone melting. This provides the extraordinary purity of silicon and germanium needed in the manufacture of transistors.



**CLAUDE E. SHANNON.** Awarded the Stuart Ballantine Medal by the Franklin Institute for contributions to a comprehensive theory of communication. This greatly illuminates our understanding of how communications systems handle information. It points to new ways to improve service.

# Partners and Pioneers in Progress

On this page are some of the Bell Telephone Laboratories scientists and engineers who have been honored recently for outstanding achievement in the sciences that bear on telephony.

We are proud of this fine recognition of their work and the contributions of the many other engineers and scientists who are helping to make telephone dreams come true.

For always there have been dreams and high hopes in the telephone business. Growth begets growth. Research reveals new vistas. The words of thirty years ago are even more true today. "The future of the telephone holds forth the promise of a service growing always greater and better and of a progress the end of which no one can foresee."

A considerable part of that prophecy has been fulfilled. But great as the progress has been, there is still greater progress to come.

Never have there been so many opportunities for wholly new developments in telephone service and so much well-rounded research to put behind them. All that has been done is just the beginning.

***Working together to bring people together . . .* BELL TELEPHONE SYSTEM**

# *in an instant* — THE KILL

Twelve seconds ago, this hostile aircraft came in range of a Navy interceptor. Ten seconds ago, a little black box took control of the Navy craft's weapons system. Four seconds ago, it unleashed a salvo of deadly rockets. Two seconds from now the intruder will explode into a ball of fire.

The little black box that takes credit for the kill is the Mark 16 airborne fire control computer designed to make split-second decisions in high-speed aerial warfare. Credit for the black box goes to the Navy, to Lenkurt and other cooperating manufacturers. Developed to achieve a specific military objective, it is one of the unpublicized but highly important marvels of this electronic age. Everything else about it is classified.

But it can be said that Lenkurt's facilities are uniquely suited to undertaking "black box projects" for government and military agencies, for research, development, and precision production of telecommunications equipment.

Lenkurt equipment — carrier, microwave, and complete communications systems — is in round-the-clock use in many of our most vital defense installations. To see how Lenkurt may help on your next project, call in your Lenkurt representative or write direct.

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# SIGNAL

**Communications-Electronics-Photography**

Journal of the Armed Forces Communications and Electronics Association

**VOLUME XI** **JULY 1957** **NUMBER 11**

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***Appearing in the August issue: The convention symposium on Scatter Propagation by RAdm. Joseph N. Wenger and representatives from the Army, Navy and Air Force.***

### Cover

SIGNAL's *cover picture is the Army's new "Hawk" guided missile, a graceful 16-foot long missile only 14 inches in diameter. It is designed to help guard against enemy sneak attacks at all altitudes, and at distances far enough away to protect defended areas.*

*The Hawk's radars can detect and track the low flyers in the blind zone of conventional radars and can be used at fixed installations and by fast moving combat troops. Raytheon Manufacturing Company is the prime contractor.*

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BPA

# Electronics & Communications Engineers:

Sixty-foot paraboloidal-reflector antenna, typical of those tested and operated by PAGE for Lincoln Laboratory, M.I.T.

## PAGE HAS DESIGNED AND CONSTRUCTED

# 9,000 MILES of scatter communication circuits since 1951

***Page has worked with Lincoln Laboratory, M. I. T., the National Bureau of Standards, and the Western Electric Company in the development, or installation and operation, of 10,000 additional miles of scatter communications circuits. Current contracts call for 7,800 miles of new circuits. A pioneer effort unmatched by any other organization.***

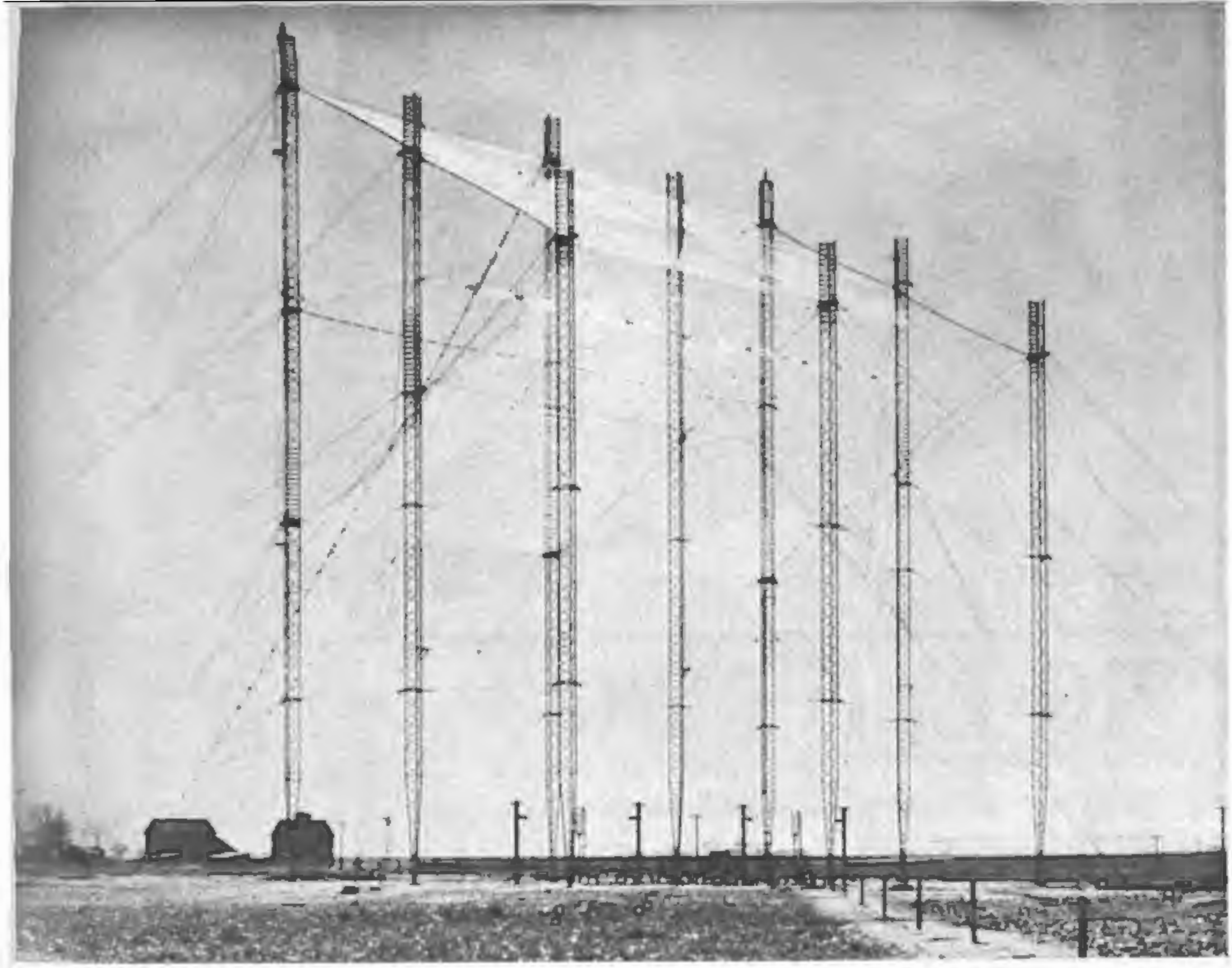
## ATTENTION COMMUNICATIONS ENGINEERS:

We offer a sincere apology for a typographical error in a recent advertisement in SIGNAL!

***Engineering accuracy necessitates this correction.***

**The copy read "current contracts call for 78,000 miles of new circuits." Obviously, this should be 7,800 miles.**

**Science fiction in electronics often turns out to be fact! Probably a few years from now, when this organization's services on scatter communication circuits have progressed farther, we will smile about this error because our headline might then easily read, "PAGE has designed and constructed 78,000 MILES of scatter communication circuits since 1951." But for the sake of accuracy, of course, we must correct the figure. And to help you identify our original message the complete two-page ad is repeated. We hope you will find it interesting.**



High-gain corner-reflector antenna, designed, installed and test-operated by PAGE for Western Electric Company, under subcontract for DEW-Line project.

PAGE Communications Engineers, Inc. cordially invites you to visit our organization whenever you are in the Nation's Capital. Our work is internationally known and of increasing interest and significance. During the past seven years as pioneers in the design, construction, testing and operation of scatter and other advanced radio communications systems, PAGE has played responsible and challenging roles in the building of multi-million dollar telecommunications networks.

Members of our organization are working closely with representatives of the U. S. and foreign governments and industries in the development of such systems. Challenging assignments take our engineers to many corners of the globe.

Due to the increased demand for PAGE-designed, installed, tested and operated systems, we now offer a few exceptionally interesting positions in our Washington, D. C. office as well as overseas.

Engineers who elect to locate in the Washington, D. C. area will find it offers outstanding educational, cultural and recreational facilities. As a center of Government-sponored engineering and research laboratories, it is particularly attractive to the engineer intent upon pursuing advanced studies. Urban and suburban housing is readily available in all price ranges and easily accessible to PAGE's main offices in the heart of downtown Washington.

Write for further details to:
Mr. J. P. Gaines
or phone EX 3-1523

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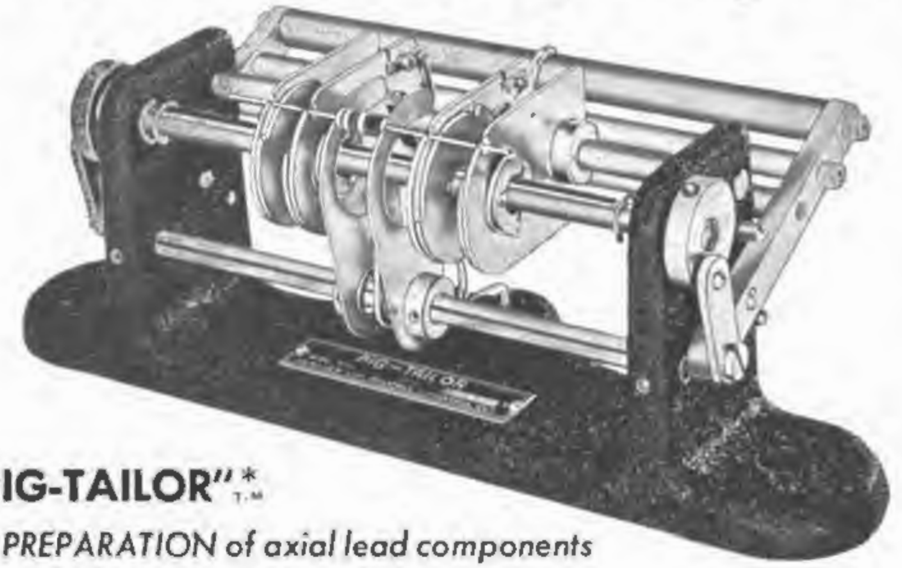
# PROVEN-on the assembly line!

**PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"**



**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*

# "PIG-TAILORING"

*. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.*

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. **Invaluable labor saving.**
10. **Immediate cost recovery.**

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
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6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. **Excessive lead tautness!**
10. **Haphazard assembly methods!**

**"SPIN-PIN"*** T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

***Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-7P***

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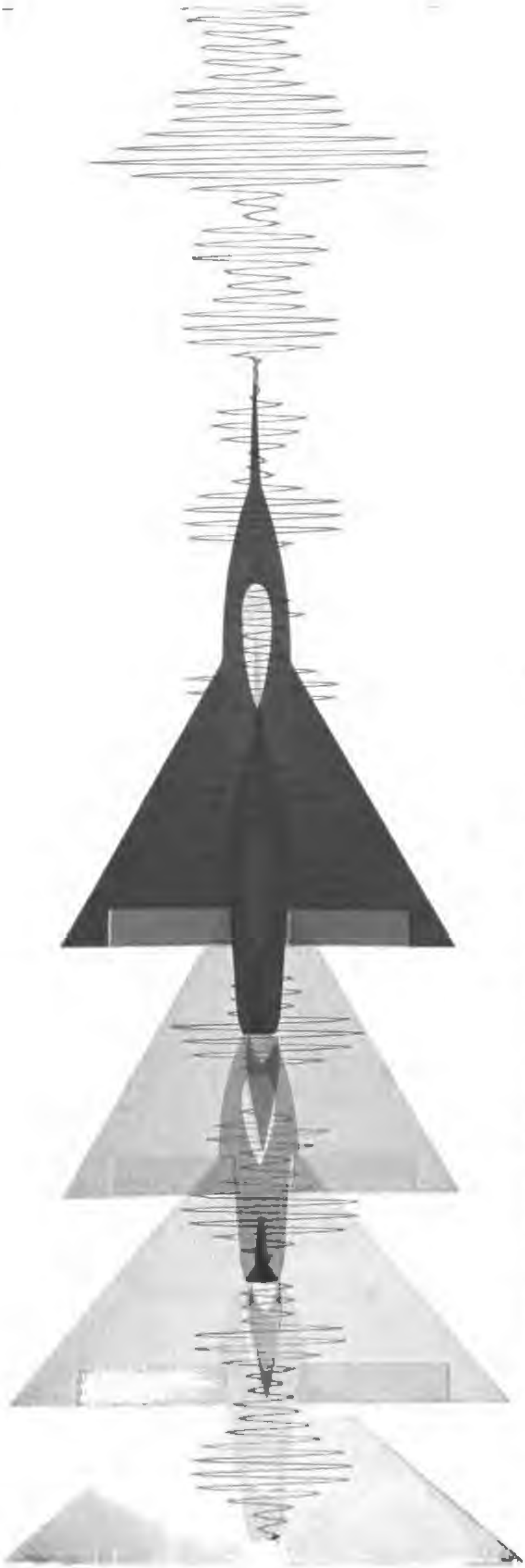

# KEEPING INSTRUMENTATION A STEP AHEAD OF SPEED

## AVIONICS IN ACTION AT BURROUGHS: FROM RESEARCH AND DEVELOPMENT TO PRECISION MASS PRODUCTION

Today's dramatic new developments in aircraft performance demand equally dramatic new developments in flight *instrumentation*. And Burroughs is assuming ever greater responsibilities in this field through its work in the brand-new science of *avionics*.

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We have, too, the capabilities and facilities for further research and development in this fast-moving field. And in all areas of our proved responsibility and competence—not only instrumentation but control systems, electronic computation, communications, data processing and others—we stand ready to see defense contracts *all the way* through. Yes, from preliminary research to installation and field service.

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**BURROUGHS** Burroughs

**THE FOREMOST NAME IN COMPUTATION**

# NEW IRC *FLUOROPLY* LAMINATE

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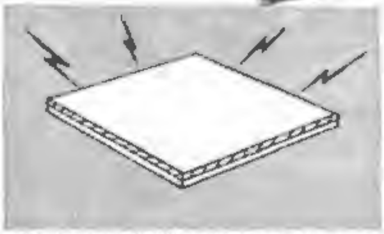
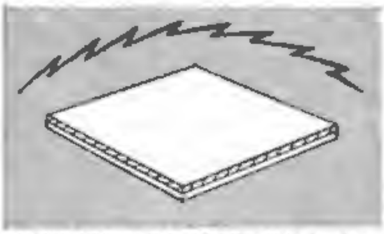
In FLUOROPLY Laminate Type F, IRC has succeeded in bonding copper foil to a plastic base with superior insulating qualities and unsurpassed resistance to heat and moisture. This base, a special fluorocarbon plastic, offers a combination of properties not found in any other laminate. Because it absorbs no water, it also solves the problem of humidity and surface leakage. FLUOROPLY offers all this at a low cost for the advantages provided.

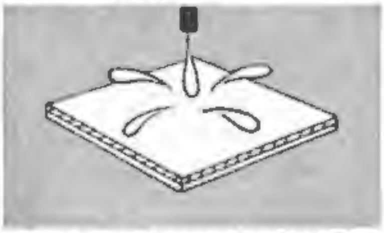
FLUOROPLY is now available in 12″ x 12″ sheets with copper on one or both sides. Standard thicknesses are .031″ to ⅛″ for the base, 1, 2, 3, 5 and 7 oz. for copper foil. Special thicknesses can be supplied. Write today for complete details.



**EXCELLENT ELECTRICAL PROPERTIES**—High surface and volume resistivities, high dielectric strength and good high frequency characteristics.



**SUPERIOR ARC RESISTANCE**—Arc resistance of more than 360 sec. makes FLUOROPLY superior in high voltage and high humidity applications.



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Insulated Composition Resistors • Deposited Carbon Precistors • Power Resistors • Voltmeter Multipliers • Ultra HF and Hi-Voltage Resistors • Attenuators

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# 1957

# AFCEA NATIONAL

# CONVENTION HIGHLIGHTS

## *editorial*

The 1957 AFCEA National Convention lived up to its advance billing as the largest and most spectacular show yet conceived by the Association. With eight months of pre-convention coverage in SIGNAL, coupled with pre-advertising and a superior job of selling by William C. Copp and Associates, the Convention set a new record with 150 exhibits and attendance of over 3100. Considering that the AFCEA Convention is a "closed show," this performance is truly par excellence. From the Association viewpoint, the show must be called a hit. Included in the attendance figure were foremost industrialists and executives, top-flight military leaders from all services, governmental officials, educators, scientists, management experts, university students and many other distinguished representatives from other areas of our national society such as procurement and contracting agencies of Government. This type of representation meant much to the exhibitors and provided contacts of value.

National headquarters recognizes that a success of a convention depends on many factors and principally upon the efficient execution of sound planning and long hours of hard work. On behalf of the Convention President, Percy G. Black, and the AFCEA membership, the Association wishes to express its appreciation to Admiral Joseph R. Redman, Convention chairman, and the various members of his committee whose sterling contributions left nothing to be desired. Those to whom special recognition is due are: Social Committee—John Gilbarte; Publicity—Roland Davies; Technical Sessions—Francis Engel; Transportation & Tours—George Sheets, and Ladies Activities—Mrs. Frances Engel.

### *Convention Toastmaster*

The Association is especially indebted to Mr. George W. Bailey for his contribution as the convention toastmaster. Mr. Bailey, in his own refreshing style, filled this position with ease and perfection.

The convention was honored in having student representation from colleges and universities in and around the Washington area and from Boston, Mass. Of particular significance was a large representation of students from the highest military college, the Industrial College of the Armed Forces, Fort Leslie J. McNair, Washington, D. C. These students included representatives from the Army, Navy, Air Force, Marine Corps and the civilian agencies of Government. Following the graduation from the Industrial College last month, many of these students have been assigned to key positions in the fields of production, procurement and contracting in the Nation's Capital.

Last, but not least, hats are off to Colonel Olmsted, Mrs. Godfrey, Mr. Martins and the representatives of the administrative and editorial staff of National Headquarters for their long hours of work before and during the convention. Along with the personnel of Mr. Copp's staff, they served untiringly to make the 1957 show the success it was.

### *Ladies Activities*

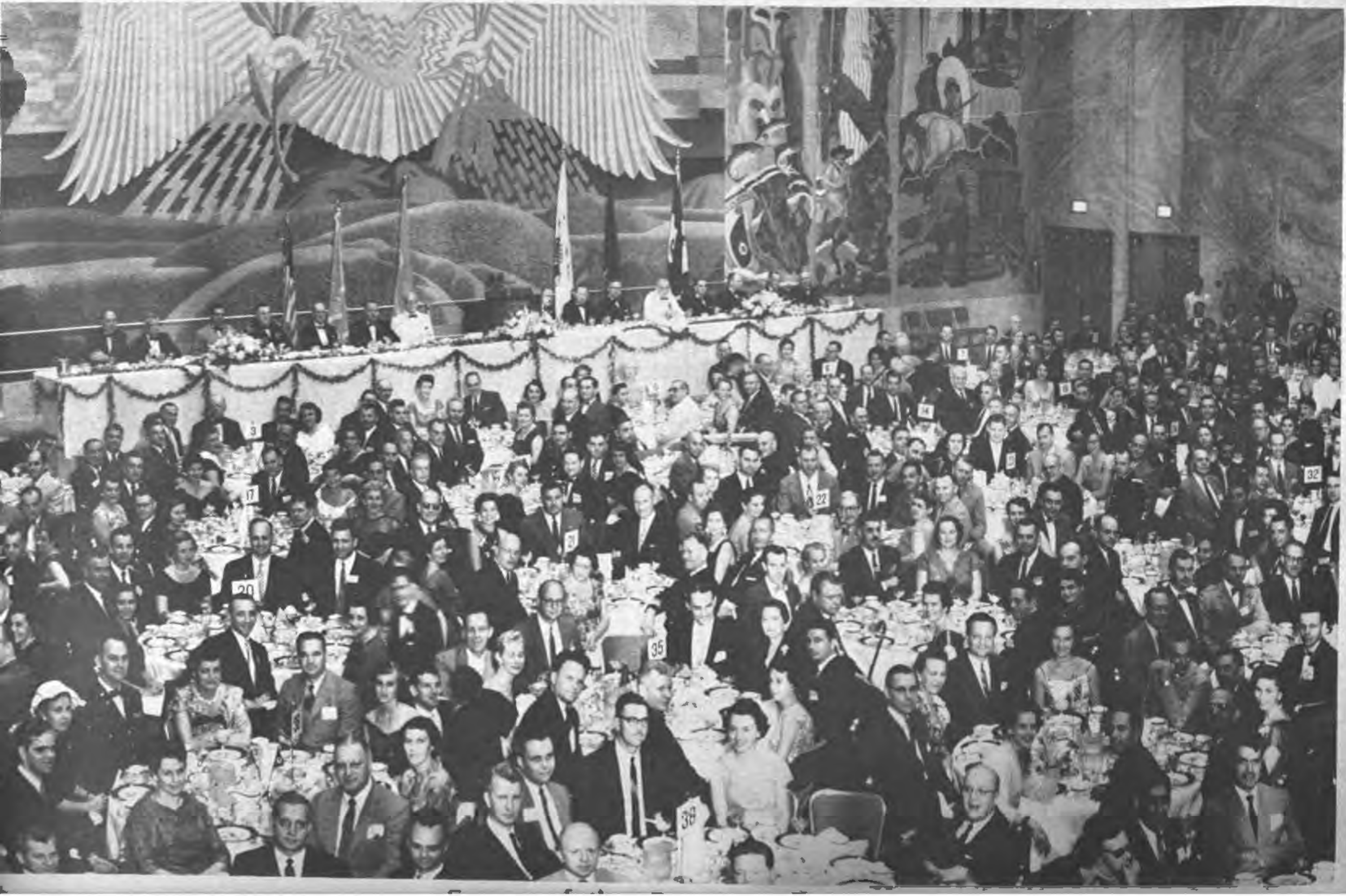
Under the capable direction of Mrs. Frances C. Engel, Chairman of the Ladies Committee for the AFCEA Washington, D. C., convention, the visiting ladies to the Nation's Capital enjoyed a program of entertainment that will be long remembered. The sincere compliments which were received from many of the ladies attending the convention is an indication of the excellent planning by Mrs. Engel and her committee.

Approximately 54 ladies registered from locales outside of the Washington, D. C. area and were joined by an equal number from the District.

Before the opening breakfast at the Sheraton-Park Hotel and a briefing of events by Mrs. Engel and Mrs. Redman, Mesdames Saddler, Clark and Finlay acting as hostesses performed a fabulous "get-acquainted" service. Following a review of plans for ladies activities, the group departed for Fort McNair where they were received at the home of Mrs. James D. O'Connell. After a social hour at Mrs. O'Connell's, approximately 100 ladies attended a luncheon at the Fort McNair Club where they were entertained by the talented singer, Sylvia Merrill, and her accompanist, Mrs. Rucker. Other activities which highlighted the ladies' program consisted of a tour of Georgetown and its historic homes under the direction of Mrs. Percy Black; a visit to the National Capitol conducted by Mrs. Finley, and a visit to the National Gallery of Art which was arranged and conducted by Mrs. Wenger.

The ladies convention committee was most appreciative for the cigarettes which were furnished at the social events by the Philip Morris Company. Also, a vote of thanks is due Mrs. Jacocks for having arranged for special favors which were presented by Julius Garfinckel & Co., Frank R. Jelleff Co., the Chesapeake & Potomac Telephone Co. and the First Federal Savings and Loan Association.

National Headquarters of AFCEA is profoundly thankful and appreciative to Mrs. Engel for her unselfish devotion to a difficult task but one which, we understand, she enjoyed no end. The following is a list of members of the ladies committee: Mesdames Engel (chairman), Black, Clark, Finlay, Finley, Jacocks, O'Connell, Redman, Saddler, Wenger.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Frederick R. Furth, Rear Admiral, USN (Ret.)
*Director, Research and Development*
*International Telephone & Telegraph, Corp.*
National President, AFCEA

# Welcome Aboard

Rear Admiral Frederick Furth, a native of Seattle, Washington, received his appointment to the U. S. Naval Academy, Annapolis, Md., in 1920. Following graduation from the Academy, he served as a junior officer aboard the battleship, *USS Mississippi*. In 1926 he reported for duty aboard the *USS Sacramento* and, while attached to that vessel, participated in the Yangtze Campaign and in the armed landing at Canton, China. He served consecutively on the *USS Smith Thompson*, *USS Chase* and *USS Dent*, units of Destroyers, Battle Force, U. S. Fleet, until May 1930.

In that year, Admiral Furth proceeded to Annapolis for postgraduate instruction in Communication Engineering, following which he continued instruction at Yale University, New Haven, Conn., where he received his Master of Science degree in June 1932.

He was then assigned to the *USS Tennessee* as Radio Officer, and in June 1933 became Division Radio Officer on the staff of Commander Battleship Division Three. He served in this capacity for two years, when he was ordered to duty in the Office of Chief of Naval Operations, Washington, D. C. In 1937 and '38, he became Communication Officer on the staff of the Commander, Battle Force, and later was on the staff of the Commander in Chief, U. S. Fleet.

Between 1940 and 1945 Admiral Furth served in the Office of the Chief of Naval Operations. He was one of the two Navy members of the U. S. Radar Mission to the United Kingdom. For his wartime contributions to the development of radio, radar, sonar, and other electronic equipment, he received the Legion of Merit. He was promoted to the rank of Rear Admiral on July 1, 1953, while serving as Assistant Chief of the Bureau of Ships for Electronics.

As Chief of Naval Research in 1954 and '55, Admiral Furth directed the expansion and use of new techniques in the Navy's continuing support of upper atmosphere research, a program that has permitted the Navy to move ahead rapidly with the technical portion of the earth-satellite program. Upon his retirement in 1956, he joined the International Telephone and Telegraph Corporation as Vice President, Research and Development of its Farnsworth Electronics Co. division, and is presently the Director of Research and Development for I. T. & T. in New York City. Admiral Furth is a member of the American Society of Naval Engineers (President, 1955); Society of Naval Architects and Marine Engineers; Associate Fellow of the Institute of Aeronautical Sciences; Fellow, American Association for the Advancement of Science; Scientific Research Society of America; Naval Order of the United States; Senior Member of the Institute of Radio Engineers and is now President of the Armed Forces Communications and Electronics Association. AFCEA extends its new Skipper a hearty "*welcome aboard.*"

## Northeastern University receives Chapter of the Year Award

## PRESENTATION

The announcement and presentation of the tenth annual Armed Forces Communications and Electronics Association Chapter of the Year award was made during the convention at the annual banquet, Tuesday, May 21, 1957.

The recipient of this coveted award was the student chapter of Northeastern University. This was the first time that a student chapter has gained this recognition in competition with the other chapters of the Association. In presenting the award to Cadet Wilfred J. Picard, Jr., president of the Northeastern University student chapter, National President, Percy G. Black said: "It is with tremendous pride that I make this presentation to the Northeastern University Student Chapter as the outstanding AFCEA chapter for 1956-57. Their enthusiasm and activities have earned for them this national recognition of accomplishment. Many of you in the audience this evening have become acquainted with the outstanding representatives present from Northeastern University. I am sure that all of you would like to join with me in applauding the "Chapter of the Year."

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### *Address to the University and College Students at the Student Symposium*

### *By*

### *Major General James D. O'Connell, Chief Signal Officer, USA*

General James D. O'Connell, Chief Signal Officer of the United States Army, speaking to the assembled students from the colleges and universities in the Washington, D. C. area and the student representatives from Northeastern University, Boston, Mass., at the annual convention, outlined the aims and objectives of the AFCEA. He also stressed the mutual benefits accruing to industry and military members through their affiliation with the Association. General O'Connell went on to say that "this relationship between industry and the military has come a long way since World War I. Actually, it was immediately following World War I that the full meaning and importance of the civilian-military team concept became a recognized must in preparedness planning and for the strengthening of our national security.

"Today, we cannot overlook the importance of training more students in engineering and mathematics. There is a definite responsibility on the part of our citizens to encourage young men to pursue scientific courses in our high schools and colleges. One of the projects presently being studied by AFCEA is the development of ways and means to encourage and attract more students into these courses. Concurrent with this project is a study directed toward the creation of educational guidance criteria for high schools so that they will recognize the shortage of trained young men in the scientific fields and will do something about it.

"On the military side, we in the Signal Corps, are proud of the opportunity which we offer to college graduates with BS degrees joining the military service. We afford them the opportunity to pursue an educational program for advanced degrees in engineering and other sciences. The military spends time and money on this challenging project and the results are a source of considerable satisfaction. If we are to have competent and trained manpower so necessary for our future security, we must set our sights not only on keeping pace with the U.S.S.R. but on exceeding their increased progress in the development of scientifically educated and academically trained youth. To fall behind the Soviet Union and their program for world dominance in this field would create a serious situation for the U. S.

"I wish to congratulate all the students attending this conference and the panel discussion group, composed of representatives from Northeastern University. Northeastern University is indeed worthy of the highest commendation for the enthusiasm and interest which they have displayed during the past several years in connection with the ROTC activities in communications, electronics and photography. We, in the Army Signal Corps, are proud of the caliber of graduates which we are receiving from Northeastern—they make excellent officers."

Percy G. Black, Colonel, USA (Ret.)
*Assistant Vice President*
*Automatic Electric Company*
Past National President, AFCEA

**Joining the military ranks at reveille near the turn of the century, a son, later named Percy G., reported for duty to the late Maj. Gen. William M. Black, Chief of Engineers, World War I. Percy began his soldiering career after receiving his B.S. degree from the U. S. Military Academy in 1917, followed by distinguished service in positions of great responsibility during two World Wars. After retirement, he joined the Automatic Electric Company, Washington, D. C., and for the past eleven years has served as Assistant Vice President.**

**Among his many decorations, Colonel Black received the Silver Star, Legion of Merit, Bronze Star, Purple Heart, and the Officer's Cross of the Order of Polonia Restituta. During World War I he served with the 76th Field Artillery, 3rd Infantry Division, participating in 5 major combat operations in France. Later, military duty carried him to foreign assignments in Hawaii, Germany, Japan, and China. Of note is Colonel Black's assignment as the Assistant and Acting Military Attache for the U. S. Embassy, in Berlin, Germany, from 1937 to 1940. In this capacity he was in close contact with the European political, military and economic situation, traveling extensively throughout Germany and visiting nine European countries. His reports on the German military and economic preparation of war and his observations of seven German regiments and the German 3rd Corps' invasion of Poland are historical intelligence. He returned to the U. S. in 1940 to present a series of lectures on the German campaign in Poland at the Army War College, Command and General Staff College, and various camps in the Eastern U. S.**

**After duty as G-2 for an Armored Force, Colonel Black was assigned to the Intelligence Division, War Department General Staff, where he pioneered in the study of psychological warfare and organized the Psychological Warfare Section of the Intelligence Division; initiated the organization of the combat propaganda company; supervised studies by Drs. Gutherie and Claude Robinson to devise a method of public opinion research to determine the factors affecting the morale of troops; organized the geopolitical section of the Intelligence Division W.D.G.S.; and initiated establishment of a joint Psychological Warfare Committee of the Joint Chiefs of Staff.**

**The preparation of the Intelligence plan for the invasion of French Morocco (1942-43) was made by Colonel Black and it was during the landing operations that radio was used for combat propaganda for the first time. He participated in the landing at Fedala Beach near Casablanca.**

**In April 1943, Colonel Black was assigned as A. C. of S., G-2 European Theater on General Andrews' Staff, and was later transferred to the Intelligence Division, Chief of Staff Supreme Allied Commander (COSSAC), which prepared the plans for the invasion of Europe. April, 1944, found Percy reassigned to the office of the A. C. of S., G-2 War Department General Staff, where he served as Chief German Specialist and Chief Western European Specialist. After a colorful, prominent military career, Colonel Black retired from active duty in 1946. Always living his Alma Mater's motto of "Duty, Honor, Country," he established a distinguished military record which stands as a challenge for the officer of tomorrow.**

**Along with his busy days at the Automatic Electric Company, Colonel Black enjoys his affiliation with the Army Ordnance Association, Association of the United States Army, Army and Navy Club, 1925 F Street Club and the Chevy Chase Club.**

**For the past year the Armed Forces Communications and Electronics Association has been indeed fortunate to have had the honor of Colonel Black to serve as its National President. He became active in AFCEA affairs in 1948 and has held the positions of Program Chairman, Washington Chapter, President of Washington Chapter, Chairman National Convention, and member of the National Executive Committee and Board of Directors. Colonel Black's outstanding background and capability along with his wonderful sense of humor and enthusiasm are the characteristics that have helped our Association to progress, along the military and civilian lines. SIGNAL salutes our past AFCEA National President who has served us so very well. Bien fait, Percy.**

## CONSTITUTIONAL CHANGE REFLECTS EDUCATIONAL PROGRAM

Colonel Percy G. Black, speaking on the importance of a student educational program, said: "The question of student education goes far beyond the ROTC chapters or the student chapters or the affiliated chapters. It is my conviction that the grass roots of this problem begin at the junior high school level. Here is where we must concentrate our effor The responsibility for this educational program rests solely and squarely on the shoulders of our chapters. The studen educational program is one of the most important responsibilities which we, as an Association, have ever undertaken. strongly recommend that each chapter president get in touch with the Board of Education in his community to see wha can be done in the high school and junior high school to stimulate interest among the students in taking courses whic will enable them to pursue scientific and engineering courses. This is essential in order to bridge the gap which h already widened too greatly if we are to preserve our national heritage."

In furtherance of this educational program, the following addition to the second paragraph of the preamble of th constitution of the Armed Forces Communications and Electronics Association was made at the Eleventh National Co vention to read (addition underscored):

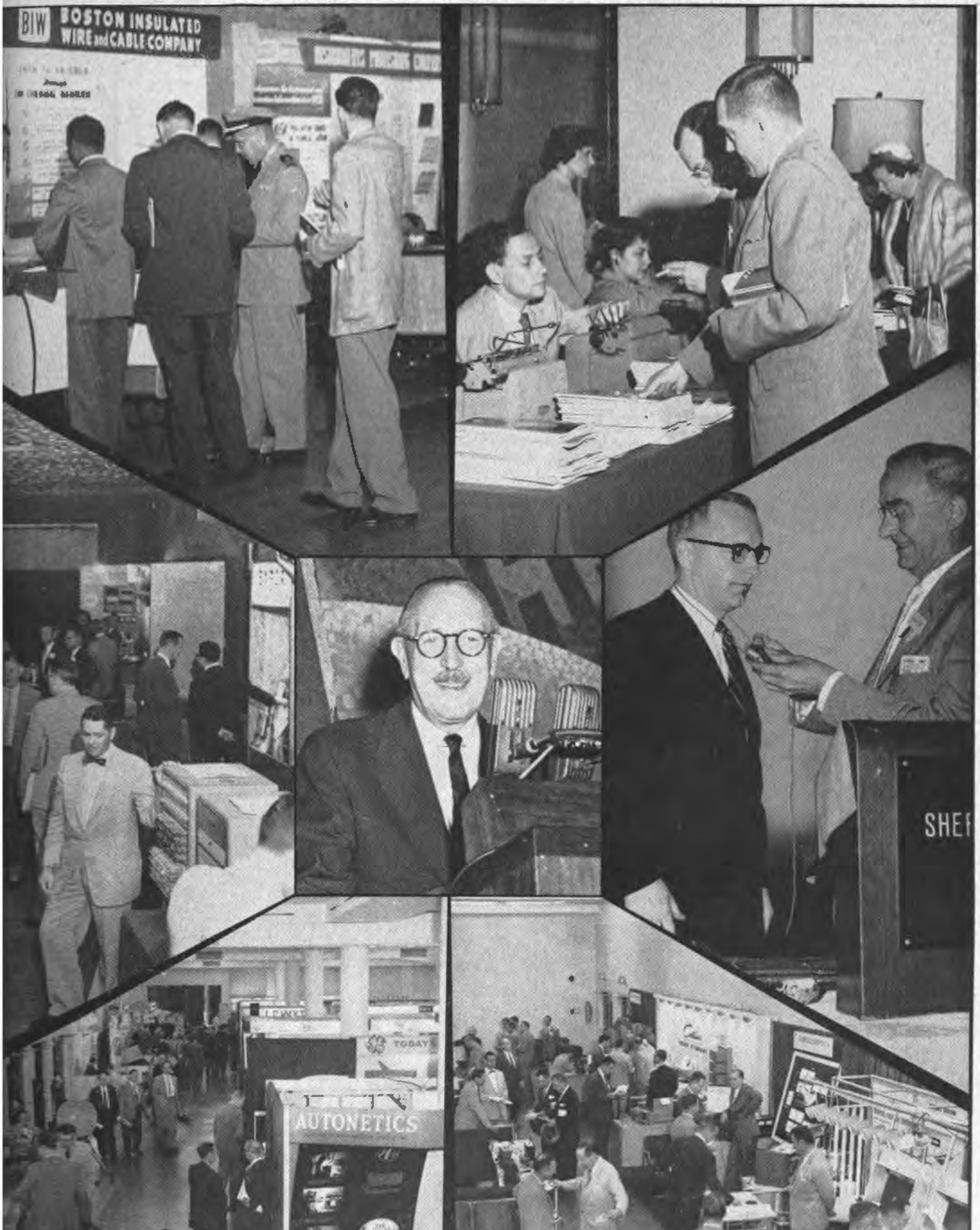
> *"The Association endeavors to maintain and improve the cooperation between the Armed Forces and Industry in communications, and in the design, production, maintenance and operation of communication, electronic and photographic equipment in time of peace as well as in time of war, and, in addition endeavors to foster appropriate measures towards the development of adequate reservoirs of scientists and engineers in the United States of America."*

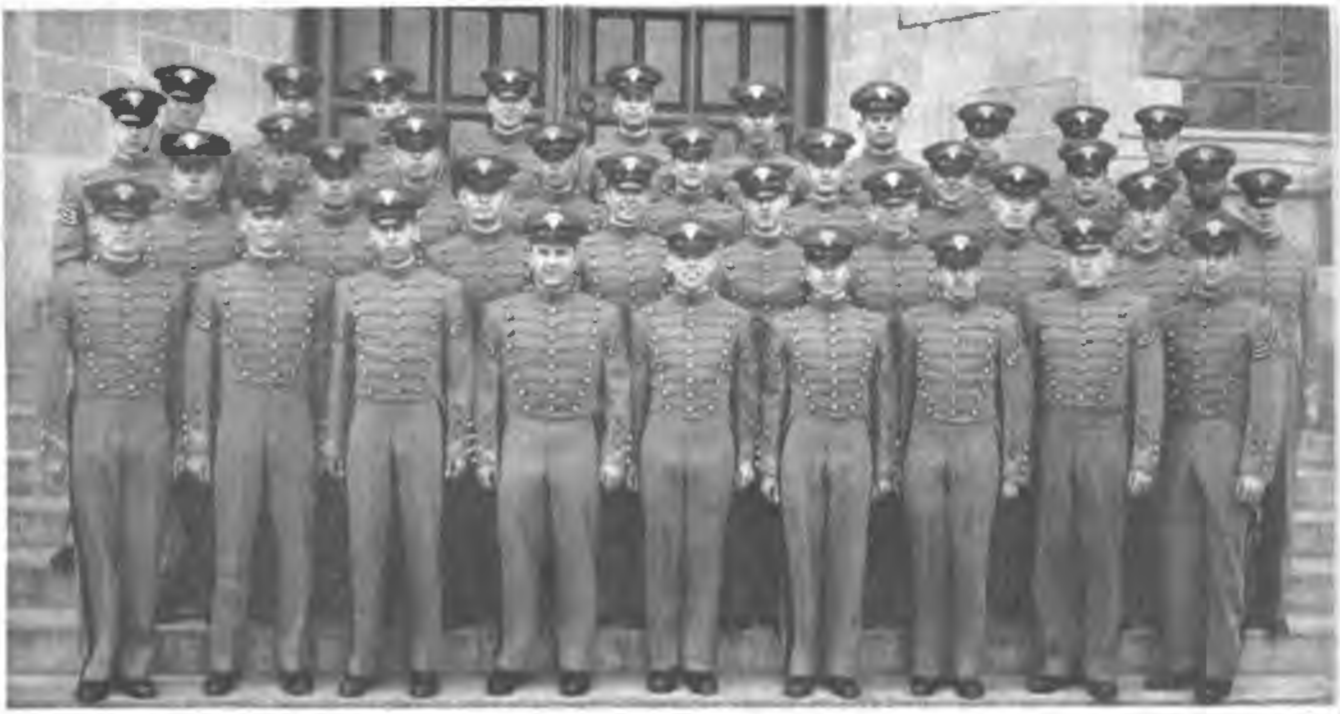
### CONVENTION PHOTOS

Scatter Propagation Panel.

Off for Naval Research Lab.

Chapter representatives at the Chapter Presidents' conference were:
Arizona, Atlanta, Baltimore, Boston, Chicago, Dayton-Wright, Fort Monmouth, Gulf Coast, Kansas City, Lexington, New York, Northwestern University, Orange, Philadelphia, Pittsburgh, Rome-Utica, San Francisco, Scott-St. Louis, South Carolina, Southern California, Southern Co necticut and Washington.


BIW BOSTON INSULATED WIRE and CABLE COMPANY
TODAY
AUTONETICS
SHER



USMA Recent Graduates—Newly Commissioned 2d Lts., Signal Corps, USA.

Col. Black presents AFCEA award to Cadet J. H. Vickers for highest rating in Electrical Engineering.

H. Harriss Robinson (Motorola) presents AFCEA award to Midshipman F. R. Haney for highest award in Electronics.

**Left to Right**

**Front Row**
1. Ketchum, R. E.
2. McDonald, T. B.
3. Marrella, L. S.
4. Bullotta, A. L.
5. Caldwell, R. G.
6. Walton, C. A.
7. Gross, F. W.
8. Stein, M. K.
9. McDaniel, J. L.

**2d Row**
1. Elder, J. F.
2. Fox, B. P.
3. Martin, R. F.
4. Wright, W. K.
5. McLaughlin, J. O.
6. Smith, D. L.
7. Wilhelm, E. A.
8. Bone, A. N.
9. Schumacher, H. J.

**3d Row**
1. Stackhouse, D. R.
2. McEvoy, L. D.
3. Langworthy, R. A.
4. Chittick, P. J.
5. Adcock, T. G.
6. Buckner, D. A.
7. Reget, G. R.
8. Roebuck, T. W.
9. McCullum, C.

**Back Row**
1. Tobin, K. D.
2. Albright, A. F.
3. Howes, R. H.
4. Pearson, T. J.
5. Jenkins, J. R.
6. Salzman, J. D.
7. Erickson, D. J.
8. Head, B. F.
9. Bowes, D. J.
10. Kidd, W. E.

# 30 Years in Electronics

***by RAdm. Dwight M. Agnew, USN (Ret.)***

JUNE 6, 1957. CREI CELEBRATES ITS 30TH!

Thirty years in the Electronics field should merit a corporation the title of being a Pioneer. On June 1, 1927, Capitol Radio Engineering Institute was incorporated. When one considers that CREI's life-span is contemporaneous with the early days of the vacuum tube as well as that of commercial broadcasting, the title of "Pioneer" appears amply deserved.

During the past thirty years CREI, here in the Nation's Capital, has attained the reputation of being one of the leading educational institutions in the electronics field. CREI has maintained this position by constantly shaping its courses to the ever-changing applications of the various basic but inter-related electronic techniques.

The story of Capitol Radio Engineering Institute can not be told without mentioning its founder and president, Mr. E. H. Rietzke. Mr. Rietzke developed the first "vacuum tube course" for the Navy's Advanced Radio Materiel School at Bellvue here in Washington. During the first three years of that school's existence he was its Chief Instructor. At the time, Mr. Rietzke was a Chief Radioman in the Navy.

Realizing that there was no comparable course available to industry, he decided in 1926 to write and market such a course. This he did, incorporating in 1927. As he says, "I started with $250 and a prayer." Today he heads one of the leading electronics educational institutes in the country.

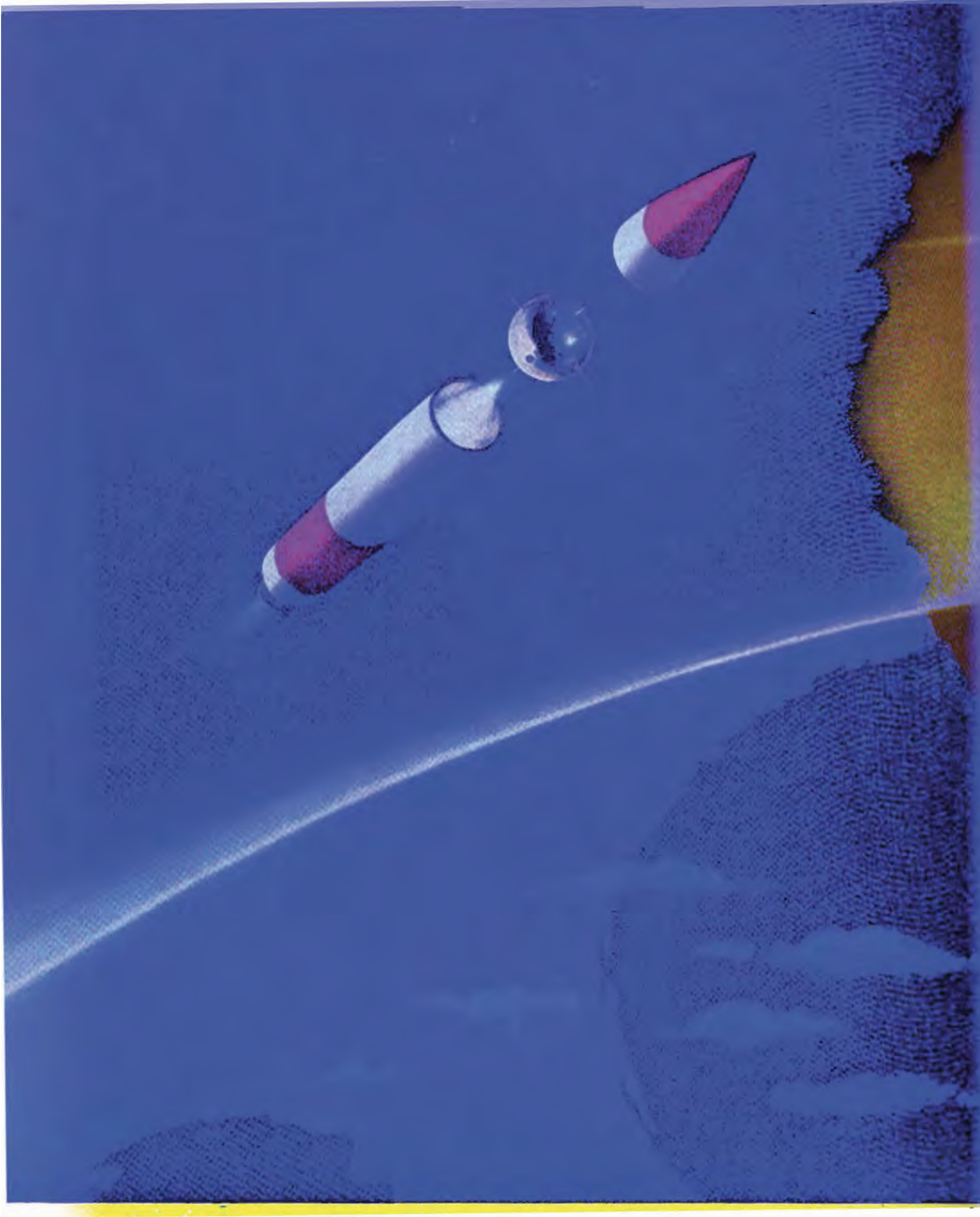
To provide some idea of the magnitude of CREI's effort, the residence school body numbers over 500 students, while its correspondence school enrollment includes over 14,000 active students. Forty-eight States and the Territory of Hawaii are represented in the resident school's student body. In addition, the following foreign nations are represented in the student body: Australia, Canada, China, Colombia, Costa Rica, Dominican Republic, Estonia, Greece, Hong Kong, Indonesia, Iran, Italy, Lebanon, Pakistan, Philippines, Poland, Spain, Switzerland, Thailand, Turkey, Venezuela, and Yugoslavia. Foreign representation in the correspondence division is even more diversified.

On June 6, 1957, CREI celebrated its birthday with a 30th Anniversary Banquet at the Mayflower Hotel. Mr. Everett Corey, Registrar of the Institute, was the master of ceremonies. The Institute's president, Mr. Rietzke, gave his views on "The First Thirty Years are the Hardest." Other speakers included Mr. George Bailey, Executive Secretary of the Institute of Radio Engineers, present director and former president of AFCEA, and Dr. Henry Armsby, Chief for Engineering Education of the U. S. Office of Education, Washington, D. C.

Other distinguished guests included The Honorable Olin E. Teague, Representative from the 6th Congressional District of Texas; Captain Gordon Caswell, U.S.N., representing Admiral H. C. Bruton, Director of Naval Communications; Mr. Edward E. Booher, Executive Vice President, McGraw-Hill of New York; Mr. Thomas E. Whinerey, Vice President Riggs National Bank; Colonel Burnett Olmsted, AFCEA, and Colonel W. J. "Sparky" Baird, AFCEA, editor of SIGNAL Magazine; Mr. Sol Taishoff, President of Broadcasting Pubs. Inc.; Mr. Rome D. Leandri, Chief Vocational Rehabilitation and Education Division and Mr. James Argyropoulos, Chief, Benefits and Facilities Section, both of Veterans Benefits Office; Mr. Boise L. Bristor, Secretary, Veterans Advisory Committee D. C. Board of Education, and Mr. Paul A. Snearling, Administrative Assistant to Deputy Superintendent, D. C. Public Schools.

The Board of Directors, the Institute's executive officers and their staff and the faculties of both the residence and the home study divisions attended. The student body was represented by Mr. Kenneth F. Haddox, student body president.

Happy Birthday, CREI. May the next thirty be equally successful.



# Will today's defense dollars carry man into new worlds tomorrow?

Man has learned—when confronted with things too vast for ordinary comprehension—to stand off and survey them at a distance. This year, finally, man will view his *entire world* in a new perspective—as his newly launched satellite circles earth and reports to man through the miracle of modern communications.

Today's defense needs are bringing science's best minds to grips with the problems of outerspace communications. Avco-Crosley salutes these trail blazers of a new dimension.

Avco-Crosley's own advanced programs in communications and radar already embody much of the knowledge demanded for man's next great undertaking: *to hurl his thoughts, his voice, and even himself* far into the unknown realms of outer galaxies.

As Avco-Crosley sees it, today's great research and development expenditures gain us more than strength in a troubled world; they speed our scientific readiness for the fabulous new world of tomorrow.

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TODAY'S MILITARY SERVICES, WITH THEIR TREMENDOUS TECHNOLOGICAL ADVANCES MADE POSSIBLE THROUGH SCIENCE, OFFER A VITAL, REWARDING CAREER.

***Eleventh Annual Banquet Address***

# Stairway to the Stars

***Donald C. Power***
***President***
***General Telephone Corp.***

Mr. President, Mr. Toastmaster, distinguished guests, and members of the Armed Forces Communications and Electronics Association, I am most honored and grateful for this opportunity of addressing this audience, which I truly believe to be one of the most forward-looking and useful groups operating in the national interest today. These are words of praise, but I do not utter them lightly. Yours is still a comparatively young branch in over-all developments in the art of communications. This is an art which began with the age-old struggle of mankind to span the distances of the earth with channels of intelligence along which ideas and information could move faster than any physical form of travel.

If we go back far enough, we would find that in times gone by governments in all nations have usually been interested in scientific inventions for one of two reasons, either to gain some military advantage or to find something new to tax. Yet, through the ages, some very minor developments have had profound consequences. The map of the world today has been drawn by some of those extra pushes of individual genius, those sparks of initiative which have changed entire channels of human events. As the ancient Chinese proverb puts it, a single pebble may be enough to alter the whole course of a mighty river.

Some historians may sniff at such hindsighted speculation, I know. They call it "if reasoning." Yet, consider what the world's outlook would be today if Cleopatra's nose had been a half-inch longer, or if the Spanish Armada had not been wrecked by sea storms, or if Napoleon's cavalry had the advantage of good weather instead of rain at the battle of Waterloo. We might even go so far as to wonder whether if Plymouth Rock had landed on the Pilgrims, instead of the Pilgrims landing on Plymouth Rock, we would not all be speaking Spanish to each other here this evening.

The point I am making here is that, as practical men, whether in government or business, we have to take things as we find them. And on that basis, the record of accomplishment in the field of military communications and electronics has been one of which you can be justly proud.

The only trouble is that you cannot say very much about that record, for obvious reasons of security. Many of the wonderful things your people have done, and are now doing, may never be known publicly, at least in the foreseeable future. As a businessman who believes in advertising, I am afraid I would find such restrictions frustrating. In private business, trying to get along without advertising is something like trying to wink at a pretty girl in the dark. You may know what you are doing, but she doesn't!

So, all the more credit is due to you people who are in the Armed Forces or must work on classified projects, because you must forego the normal satisfaction of public recognition and must go on blooming like the rose in Thomas Gray's poem, "born to blush unseen and waste its sweetness on the desert air." Of course, it is really not as bad as all that, or we would not all be here tonight at this fine banquet. And if there has been any noticeable blushing around here this evening, it might be due to the blooming of more than one rose—maybe as many as four roses!

I reminded you a minute ago that yours is a comparatively young branch of the communications art. Let us consider briefly the facts on this. A mere hundred years ago, there was no telephone. The telegraph was still a curiosity, first used for military purposes in the Crimean War. It has been less than eight decades since Alexander Graham Bell's discovery of the telephone; less than six decades since Marconi amazed the world with the transmission of intelligence without wires; less than four decades since the perfection of the vacuum tube. The rapid development of radio and television within the past three decades should make us wonder just what will be the state of this art within another mere decade!

### *Miracle in the Making*

Those of you who went over to the Naval Research Laboratory this afternoon to witness the preparations being made there, for the earth satellite Vanguard, saw a miracle of communications in the making—an earth-made moon to be launched during the coming year. After that has been accomplished, it is not too farfetched to suppose that there will be communications of a sort with the moon itself, and with the planet Mars and er celestial bodies in the not too *ant future.*

And so it may very well come to s *that* the span of the communi- ions art "From Marconi to Mars," *ich* I understand is the theme of s convention, will actually be wit- sed within the lifetime of some o are now living, possibly some hin this very room tonight. One the main purposes, as I understand of the earth satellite Vanguard is establish a completely new form of nmunications—to obtain data con- ning temperatures and other con- ions of outer space from which nals of communications will be t back to earth for study and co- lination.

And if the name of the project, nguard, is prophetic, there will be ıer earth satellites. Each will add the sum total of knowledge and ex- rience which may well some day d up to the first space travel of ın himself.

So if we want to look at these de- lopments in such a light, those who ve any part to play in this mar- lous art of modern communications e contributing, each according to ır talents, to the building of these tirways to the stars. It is a truly rilling objective. And I salute this eventh annual meeting of the rmed Forces Communications and lectronics Association on its imagi- ative theme, "From Marconi to ars."

## *Exchange of Ideas Vital*

As one whose own background has een mostly that of law and manage- ıent in the telephone end of the com- ıunications business, I cannot and ill not presume to discuss any of ıe technical matters which occupy our attention during this conven- on. But I would remind you that usiness management has its own du- es and responsibilities in this field. nless business management can co- perate intelligently with those of you ho operate in the realm of scientific esearch and experimentation, the hole future of the art could fall un- ler the shadow of misunderstanding nd languish for lack of practical upport. That is why it is so impor- ant for an organization, such as his, to bring together the various rofessionals and experts and busi- ıessmen for the exchange of infor- nation about what is going on in each theater of activity. In this man- ner, all of us may contribute in forg- ing links of future communications which I have called, somewhat fanci- fully, a "stairway to the stars."

After all, there are all too few meeting places where communications experts, in the armed services, and in the Government civilian services, and in the communications and electronics industries and allied public services, can freely talk with each other in the same language. Yet this also is a form of communications, in the broadest sense of that term, which is most essential. My own job puts me constantly "in the middle" of various professionals, technical experts, and specialists, all trying to work toward the same objective. And for that reason I can well appreciate the value of any forum or common denominator for the mutual exchange of ideas. And that is a role for which this association is particularly suited. We simply cannot afford to lose touch with each other, by neglecting or overlooking the opportunities which meetings of this sort provide.

## *Role of Telephone Industry*

The telephone industry has long been a natural breeding ground as well as a practical testing place for research and development of great importance in many aspects of the art of military communications. There are sound and practical reasons for this. First of all, the telephone business functions in about the same natural range of operating frequencies and circuits. Telephone business research concentrates on compact components, which require only a small amount of activating power. Within these limitations telephone research has constantly striven for longer range, more accuracy, fidelity, selectivity, and all the rest of those qualities which military communications engineers are always seeking. Out of such research have come almost incredible discoveries and techniques admirably suited even for the all-important guided missile program, which stands so high today on the list of our national defense planning.

Aside from this coincidence, in the utilization of similar electronic phenomena, another down-to-earth reason why the telephone industry has become a natural testing ground for building these stairways to the stars is the simple fact that the day-to-day bread-and-butter operations of the telephone industry necessarily involve the very same phases which command the attention of Armed Forces communications and electronics experts. These include research and invention, physical construction, and actual service operations. So, it would be strange indeed, if our telephone people had not long ago discovered a natural affinity with the Armed Services in their respective activities.

The most important reason of all, however, for this close alliance between the telephone industry and our government scientists and armed services has been that well-known truism that communications is our first line of defense. This is one military maxim which has not changed in principle since the days of the Caesars.

This alliance between our telephone industry and our Armed Forces has existed from our very earliest days, when automatic dial switching was being tested and proven in our independent telephone industry operations, right down to the present day when the Deputy Secretary of Defense happens to be a former career official and executive of Bell Telephone Laboratories and Western Electric. I refer, of course, to Donald A. Quarles, who as Secretary of the Air Force spoke to you just a year ago at this banquet session of your 1956 convention.

And just to prove that the good use being made by the government service of telephone industry "alumni" is a two-way proposition, I would like to refer, in passing, to your National Association President, Colonel Percy G. Black. He has for some years, as most of you know, been serving as the Washington representative of the Automatic Electric Company, an affiliate of the General Telephone System. I am honored to be thus associated with Colonel Black in business as well as personal friendship.

As Secretary Quarles pointed out to you last year, on this very platform, there is need for more and more of this close co-operation between our communications industries and government research for defense purposes, if we are going to meet the challenge of competition behind the Iron Curtain. Today, the historic affinity between our communications industry and the national defense goes much further than such specific projects as the networks of submarine cables, the DEW line of radar, and the SAGE system of co-ordinating radar defenses against hostile attack. I would direct your attention to the "built in" defensive network of telephone communications which covers the Nation with over 60 million telephones—a potential alert system which reaches into nearly every American home and business place. It is a system which is already there, in place, and now in working order, spanning the continent and penetrating into the most remote areas. It affords almost complete mass contact with our 170 million American population.

In the telephone business there has always been a strong sense of trusteeship with respect to national defense. The independent and Bell system companies have generally assumed that they had an industrial obligation to help our country win wars and preserve peace.

This co-operation with the national security interest, moreover, has developed along lines which the telephone industry has naturally followed to meet its own technological needs. I can say to this audience that the telephone industry is going to need every feasible idea that communications research people can come up with, in the years just ahead of us. We are going to need new circuit capacities, new appliances, and operating improvements, such as electronic switching (of which we hear so much promise right now). We are going to need the vast additional use of existing circuits likely to become available with the perfecting of those newly developing techniques for compressing information of all kinds into tiny bits or pulses which can be flashed in tremendous message volume within the twinkling of an eye. Only last month Bell Telephone Laboratories demonstrated an experimental device for sending messages over ordinary telephone wires at the rate of a thousand words a minute or 16 times faster than conventional teletypewriters. We are going to need bigger and better trunk cables and more mobile telephone appliances. In fact, any new improvement in the art which will enable our telephone plant to carry more traffic load is going to be put to good use.

### *Cooperation Means Progress*

Our scientists tell us that there is no absolute horizon or limit of what can be done once a given problem is reduced to a rule or an accepted principle. Anything that can be rationalized can be accomplished. Actual demonstration in physical form then becomes a matter of research and application. Our Nation's ability to defend itself against hostile attack is going to depend largely upon advances in the military communications art. Of course, we have some pretty good competition from abroad.

A great deal of concern has been expressed about the strides being made by the Soviets in atomic development, in guided missiles, and other secret weapons of modern warfare. It would be most unrealistic to discount any of this. But I cannot believe that forced contributions of scientific effort and of technical developments and of labor will prove superior, over the long range, to the progress we can make under the cooperative relationship which exists in this country between our Armed Forces and our communications industries.

Our electronic research in this country is not dependent upon foreign scientists who had to be kidnapped as prisoners of war. Nor is it dependent upon virtual slave labor; nor upon the dragooned resources of a population, such as the people of Russia, who only last month saw their life savings confiscated by a callous repudiation from their own government of a solemn bonded debt obligation.

Therefore, the obligation lies upon us that much more heavily to prove that we, as free and independent men and women, voluntarily working with our government services, can produce a better end result in this rivalry of brain power, money power, muscle power, and—above all—will power! Speaking from the standpoint of our private enterprise system, I say to you that we cannot fail, and we will not fail, in this critical test of our American way of doing things.

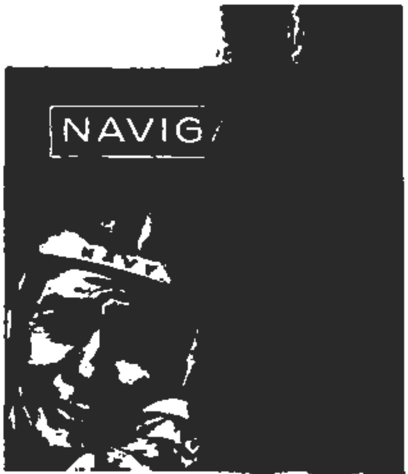
### *Dangers of Satisfaction*

It is certain that we never shall, in our lifetime, see any degree of complete achievement. Things which seem wonderful to us today, will not be good enough tomorrow. We know that the contest must go on and on, in an endless progression of measures and countermeasures and counter-countermeasures.

One of the most useful functions which this Association can serve is to be a safety valve to protect all of our scientists and specialists from falling under the spell of their own achievements. Understand, I do not say there is any such present danger of self-hypnosis. But it is conceivable that it could happen if our research people should ever become too insulated from contact with practical operations.

Sometimes, when we contemplate such superautomatic devices as the so-called "electronic brain," we may even wonder whether we humans will always remain the masters of these magic machines. We know, for example, that if we feed enough accurate and balanced background data into these machines, we can find out things about ourselves that we did

(Continued on page 24)



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not even suspect. We can learn, within a surprising degree of accuracy, such varied information as what our average golf score is likely to be, and how a given political election is going to turn out. But always, our common sense tells us that is no reason why we should give up either golf or going to the polls to vote.

### *Invention Needs a Market*

It is a curious thing that the most fruitful periods of progress in the telephone business occurred whenever a big new idea came along at the same time that a market for exploiting that idea had developed or vice versa. We might compare the idea to a baseball, and the market to a baseball bat. Now we all know that when a bat connects with a baseball, in the right way, the ball generally goes some place. When Bell first discovered the telephone in 1876, and for a number of years after that, it was simply an idea in search of a market. It took quite a little while before the financial and business people, in those days, stopped looking upon the telephone as a toy or a lecture platform curiosity and began to take it seriously as a reliable means of mass communications. But with the expiration of the Bell patents in 1893 and 1894, and with the establishment, almost overnight, of thousands of independent companies in almost every town and village where Bell system companies had not yet been established, there developed a mass market for telephone service and equipment. And then it was not long before we had a market in search of ideas.

More recently, of course, we have witnessed a successive number of hits in the field of radio and television and the telephone industry has tried to "stay on the ball," as it traveled far and wide. And once more, we now seem to be entering a period in the telephone industry where we have markets in search of new ideas, which will enable us to handle more traffic over existing plants, or at least over proportionately less expensive plant facilities.

This little background brings me, finally, to one small meat-and-potatoes portion of an idea I would like to leave with you tonight. I would like to touch briefly on the shortage of trained people so much needed by both industry and government in the electronic and communications field.

In the first place, it must be admitted that nobody can tell a scientist what to discover. Management can only prepare favorable soil and cultivate the more promising plants, and hope for the best. Both government and business management can no more tell an inventor what to invent than a patron of the arts, in bygone days, could tell a Beethoven what kind of music to compose, or a Michelangelo what to paint.

What we can do. I repeat, is to provide the soil and suitable climate. The crying need today is to get more fertile plants, growing in our brain pastures. In plainer words, we must find ways to get more qualified people interested in scientific and engineering careers. It is not one of those problems like a temporary shortage of doctors, or lawyers (if there ever was a shortage of lawyers), or farmers, or skilled mechanics—a problem which always seems to solve itself eventually by the operation of the old reliable law of supply and demand. I think there are three things industry and government can do about this—co-operatively.

One thing is to make certain that whatever amount of technical assistance becomes available, such talents can be fully and completely utilized. Industry should be able to assure these people of interesting and rewarding jobs, where their energies and abilities will not be frittered away.

Steps can also be taken to provide on-the-job training. There are plenty of real opportunities in the telephone industry, I am sure, for scientific and technical "interns," so to speak, to increase their skills and broaden the scope of their abilities by actual experience under responsible supervision.

### *The 3 "M's" of Industry*

And along the same line, we cannot afford to overlook the very earliest stages of selection. I mean the schools and colleges. A good many suggestions have already been made for co-operative support of formal education for qualified students, even in the secondary schools. We cannot afford to wait for these vocations to come along entirely by spontaneous combustion. Many a promising embryonic engineer has been sidetracked into a less rewarding calling simply because nobody was there to point out the detour.

Private industry, of course, cannot do its share without the necessary support from its own financial operations. The telephone business, like other public utilities, has long been under pressure to satisfy a growing need for the three "M's"—manpower, money, and materials. The greatest of these needs is money. Without it, we just cannot hope to get the other two.

I am not going to take your time talking about our financial troubles in the telephone industry, when I know you have plenty of your own. But most of you are aware, I am sure, that both our independent and Bell companies have had to go to our state regulatory authorities repeatedly since the end of World War II, and especially since the Korean War Inflation, to get rate increases. Sometimes we get them and sometimes we do not. Most often we get half a loaf or a portion of what we ask, and we try to get along. Telephone rates in the United States, on the general average, have increased only in the order of 50 per cent over prewar levels, or less than half the increase in the general cost of living for other necessary items. I mention this only by way of pointing out that the private communications industry has problems of its own, in meeting its public service responsibilities. And if we cannot always do as much as we would like, in supporting all proposed co-operative projects, the answer is likely to be found there.

### *Mammoth Task Lies Ahead*

In conclusion, I would like to remind you that we are all in the same boat, so to speak, when it comes to assisting our ship of state to sail on its appointed course in these troubled times. We all have our respective oars to pull, whether we are laboring in the government section or in the business section. If we can all pull in unison — a unison which can come only from understanding each other's tasks and responsibilities—then surely we will have progress.

We might even look at it this way. History has got to happen some place. So, it might as well happen here, perhaps right here at this convention. Whether you realize it or not, all of you members have it within your power to participate, however modestly, in an over-all long-range objective, so dramatically called to mind by the theme of this convention. "From Marconi to Mars." Lives there one among you who would not be proud to make his contribution towards the erection of a mystical structure of future communications, which you will never see completed, one which will have no ending in time nor in space? It is a real man-sized job you have taken on, one which will separate the men from the boys. It is the building of a "stairway to the stars." Thank you all very much.

***Keynote Luncheon***

# SCIENTIFIC RESEARCH AND MODERN TECHNOLOGY

***RAdm. Rawson Bennett***
***Chief of Naval Research***

★ ★ ★ ★

IF A RIP VAN WINKLE WOKE UP day after a sleep of ten years or so, would find that our way of living s been amazingly transformed. He ould be dazzled by the appliances e have in our homes, the cars we rive, our new forms of communica- ons and entertainment, the machines at run our business and industry— l of which have either been vastly nproved or in some cases did not en exist when he last viewed the orld. He would find it incredible at nuclear power, which was then arely a dream, is now a reality not nly in driving ships but in supply- g commercial electric power.

He might also be somewhat horri- ed to learn that there now exists the ydrogen bomb which can sow far reater destruction than the atomic ombs that blasted World War II to n end. On the other hand, I hope he ould be comforted with the knowl- dge that we are now rapidly building Navy of nuclear-powered ships quipped with guided missiles and upersonic carrier-based jet planes hat extend our defenses against nemy attack thousands of miles from ur shores.

His first question would be, what as brought this about in the brief pan of a decade. The answer, in a word, would be science. We would tell him that the explorations of our scientists in the unknown areas of man's environment have produced the advances of the past ten years. But this is nothing new, he might say. Science has always supplied us with new theories that have pointed the way to progress in our civilization. This is true enough. The big difference is that prior to World War II scientific research was comparatively ignored. Today it is big business drawn on heavily by both industry and the military services to produce our current technical triumphs. Recent comparative figures show that in 1941 the amount of money spent in this country on physical science research was about $1 billion, including both public and private. Today the total is more than $5 billion, with private industry accounting for nearly half.

### *Science and Research*

In explaining the change, we must include another factor, more subtle perhaps but just as important. During recent years the military services and industry have become increasingly aware that one can no longer function in isolation from the other nor can they afford to work at cross-purposes. Each is now greatly dependent on the other. The technical superiority of our Armed Forces is in direct correlation to the extent that industry can produce. Conversely, the incentive and support for much of industry's advancing technology come from the needs of the military.

Research or, more precisely, Government support of research on a large-scale basis, has been the catalytic agent that has molded together the military and industry, and the Navy played a leading role in initiating this process. The first major plunge of the Government into research was the wartime Office of Scientific Research and Development (OSRD) which carried through to successful completion the work on the atomic bomb and other important military developments. However, OSRD closed up shop as soon as the peace was signed. At that point the Navy decided that if it wanted to gain any benefit from the important discoveries of wartime research, it must promote continued research in areas of significance to the Navy. When the Office of Naval Research was established in 1946, the Navy found it stood almost alone in the support of scientific research, particularly in the field of basic research which was receiving support from virtually no other source. From the beginning, the Office of Naval Research has operated on the premise that almost any problem solved by the scientist is likely to benefit the Navy. The Navy regards science and research as a cornucopia of knowledge from which we can draw freely to satisfy our technological requirements. For example, improved radar and sonar equipment grow out of the latest theories of the physicist or the metallurgist or the chemist. Work in the esoteric field of solid state physics leads directly to new types of electronic devices, including miniaturized systems.

One of the chief characteristics of our rapid technological progress since the end of the war is that the span of time between theory and practice has steadily decreased. In less than a decade the Navy had advanced from pure theory to the actual production of nuclear-powered combat ships. At present, the time between a theory and a critical experiment may be as short as a week. As a result, we are now developing ideas that were not even theories a decade ago. An example is the idea of rocketing an earth satellite into the upper atmosphere at a speed of 18,000 miles an hour, which will then circle the earth hundreds of miles up while automatically sending back information to us.

### The Groundwork

It should be noted that the genesis of this new development was fundamental or basic research, the exploration of the unknown that is carried on in the universities and in some of the more advanced industrial laboratories. It is this search for the "how" and the "why" that is the essential groundwork of all scientific endeavor and supports all of the technical advances of the future. The product of basic research is new knowledge. The accumulation of this new knowledge forms a storehouse upon which applied scientists and engineers must draw if they are to develop anything really new.

The close alliance of the military and industry carries with it a joint responsibility to make certain that this storehouse is never exhausted. It would be fatal if, in our preoccupation with fabricating a shiny new piece of hardware, we neglected the creative scientist who produces nothing but a piece of paper. The man in the research laboratory cannot give us a new device all wrapped up and ready to be plugged in. He simply turns over to us a new theory or principle that has been carefully worked out by assembling and examining all sorts of bits and pieces of information. But this new theory is likely to be the key to several new devices, some of which we had never thought of before. Essentially this is why much of the work supported by the Office of Naval Research is basic research done under contracts with scientists in universities, in other non-profit institutes and in commercial laboratories.

### Benefits

The payoff in basic research is never immediate, but the wait is well worthwhile, and there is usually a bonus for your investment. Furthermore, it makes sense for industry and the military to have a deep mutual interest in research since both are likely to benefit from the same study. The physicist, the chemist, and the metallurgist by puzzling out and explaining the operation of the basic forces of nature make it possible for the Navy to build better radar sets, design more accurate missile guidance systems, and develop more efficient fuels for jet planes and rocket motors along with the type of combustion chamber required to burn them. The very same principles can be utilized by industry to make striking improvements in communications, provide the push-button homes of tomorrow, and build the more efficient, less complicated cars of the future. Research in mathematics and physics gives the Navy more advanced electronic computers, which are now essential equipment in modern warfare. These same computers are revolutionizing modern business.

### Mutual Interests

Moreover, whether a research project is carried out by a defense agency with a military use in mind or study is conducted by an industrial concern for commercial purposes, it frequently happens that a development important to both results. For example, before the war, a research program in the organic chemistry section at DuPont set out to explore the general subject of polymerization and the general problems connected with the structure of substances of high molecular weight. The result was nylon, which proved to be o tremendous value to the Allies durin World War II.

Recently the Navy initiated a research program to develop a simila aircraft instrument panel. An important component was to be a fl plate television tube. We wanted th tube to be transparent so it coul serve as a windshield through whic the pilot could see while flying unde contact conditions and in bad weathe provide an easy to read synthetic information display. The special transparent film developed by the Nava Research Laboratory for this tube will also provide a commercial television picture capable of a shar clear picture in broad daylight as we as a simpler, more efficient tube for color television. Several televisio manufacturers expressed immediate interest in utilizing this process.

### Value Engineering

There is another important advantage to be gained through the close cooperation of the military and industry. Both of us are concerned over the large amounts of money required to translate theory into practical achievements. This is particularly true in the field of electronic developments. This is an urgent problem for the Navy because electronics is now a substantial, if not major, part of the cost of a combat ship or aircraft, and that figure is steadily increasing. Navigation, fire control, communications, the detection of enemy aircraft and submarines, guidance systems for missiles—all involve electronics. We span the entire electronics field—in depth as well as width.

What this means is that unless we can combine forces to push electronic costs downwards, we shall one day place upon the shoulders of the taxpayers—who include you and me—the final straw that will break their backs. Fortunately, there are ways of sharply cutting these costs if we but expend the effort to utilize them. One of the principal means is simply to decide when something is just good enough for the particular job to be done. The Navy, following the lead of an industrial concern, namely General Electric, has embarked on such a program. Developed by the Bureau of Ships, we call it value engineering. I know that the AFCEA is aware of this program and its potential for producing efficient and reliable electronics equipment that is less complex and less costly.

The Navy, however, cannot do the job alone. We can lift one end, but industry must lift the other. The fact f the matter is that the military enineer in designing a piece of equipient and preparing its specifications not in a favorable position to fore-e its high cost and overcomplexity. his does not become apparent until e contractor actually begins to form e physical product. What we want the contractor, before he begins oduction, to tell us what it will st and how complicated it will be to oduce what we are requiring. In fect, what we are trying to do is to evelop the concept that the manucturer is part of a defense team, orking with the military to develop design which is reliable, simple, nd does the required job without cessive cost—a design we can all e proud of.

### *Making Progress*

Part of the Navy's contribution is o analyze simply the intended use f an item of equipment. Right away his can cut at least ten percent off he price tag. We had hardly gotten ur feet wet in the electronics phase f our value engineering program efore we ran into this example. A ype of Navy radio receiver includes filter, a crystal calibrator, and a complicated arrangement for displayng the dial readings, none of which s necessary. The filter, because it is designed to handle a power supply ranging from 50 to 400 cycles, costs $104. We discovered that this receiver is never used in locations with varying power requirements and that the commercial 60 cycle filter, which we can buy for $2.50, would be perfectly adequate. The calibrator also proved to be unnecessary because its function is performed by several other pieces of equipment on the ship. The dials are lit up by means of a lens reflecting a pilot light off a mirror back onto a frosted glass. This Rube Goldberg contraption costs $200. Here is something that industry could have warned us about in advance. A simple ordinary pilot light would serve the purpose nicely. In fact, the built-in spare pilot light in this equipment is no more than that. The total savings on these items would be $385. When you consider that there are about 5,000 of these receivers in use, that's a savings of nearly $2 million.

When you add to this what can be saved by redesigning the equipment, our value engineering people estimate that 30 percent of the original cost could be sliced off. This would not be unusual but typical of what value engineering can accomplish in electronics. I might add that the Bureau of Ships program, which began in April 1954, reduced shipbuilding costs during its first year by several million dollars, and that does not include electronics equipment.

I believe that the benefit to the Navy and the taxpayer is obvious, but the program is also directly rewarding to industry. Take the case where progress brought about by research was being thrown away until value engineering came along. As many of you know, our early World War II electronics equipment was made of organic materials that required fungicide spraying to prevent growths. Research gave us new inorganic materials, but no one changed the specs that required spraying. The manufacturers were unhappy because the spray got into the wiring and was causing excessive rejects. No one thought to change the specs, until value engineering demonstrated that the spraying resulted in a loss to the Navy of $350,000 a year. That did it.

Actually, the Navy has already received encouraging indications of support from industry. Several electronics firms have recently inaugurated value engineering programs of their own. A few months ago Dan Noble of Motorola wrote the Bureau of Ships that its program appeared to him to be a hard-headed, constructive, common-sense approach to the solution of some of the design, development and production problems which are created by a degree of arms-length specifications and contracting approach. He also notes that this must be a "shared responsibility." He feels that "the implementation must come from the services, and full cooperation from industry will support the program."

This meeting of minds is gratifying. It means that instead of getting further bogged down in the morass of mounting costs and deepening complexity, we can pull at least one foot out of the mud.

Everything costs money these days, including basic research which can hope to get only so much as its share of the defense pie.

If defense costs can come down—or at least no longer continue to shoot up—then everyone will benefit. Basic research certainly cannot afford to be given a smaller share. Without it, our progress would slow to a crawl. It's not just our problem, it's your problem as well. But with the right attitude and the right approach, I think we will have it well in hand. After all, as citizens, what we want is a strong defense, at minimum cost, with honor and reasonable profit.

***Industrial Luncheon***

# DEFENSE

## Research and Engineering

***James M. Bridges***
***Director of Electronics***
***Office of Asst. Sec. of Defense***

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The theme of this National Convention, "Marconi to Mars," is possibly a little premature, but it is nevertheless quite appropriate. It is certainly symbolic of the fantastic things now being accomplished through application of the technology of electronics.

I don't think we have yet established two-way radio communication with the Martians, but it must be because they are not cooperating. Our research and experimentation in the field of radio astronomy should at least have let the little green men know we are here. Surely, the Man in the Moon knows, and so do the meteors blazing their way down through the centuries, because for some time they have been used as "electronic backboards" for our researches into extending communications beyond the limited horizons imposed by the physics of our own planet.

On that day in 1898 when Marconi realized that he had successfully established the first wireless communication circuit in history, I wonder what his thoughts would have been if he had been able to foresee the tremendous impact of his pioneering accomplishment upon civilization within only 60 years. He would undoubtedly have felt mixed emotions, had he realized that the extension of the same basic principles of electromagnetic propagation by which he transmitted intelligence across the English Channel would, in the lifetime of his own children, have such a profound influence upon the advancement of civilization but, at the same time, would provide the potential means for the virtual destruction of that civilization during the darkness of a single night.

A few years ago, it was my privilege and pleasure to act as host and guide to a group of British Naval officers who were visiting this country to review our research and development programs in electronics for application to weapons control. In connection with this mission, we visited a representative cross section of Government laboratories and industrial concerns working in this area and in allied fields. Near the end of our tour, one of the companies demonstrated a new radio transmitter that was being developed for our Navy—a very complex multichannel device with remote control and literally jammed with relays, stepping switches and tubes. After studying the equipment in some detail, one of the British officers casually remarked, "I say, the wireless has a bloody lot of wires these days."

This expressive remark is most pertinent to the situation that today exists across the board in military electronics. Our electronic devices have become exceedingly complex, and in practically every modern defensive and offensive weapons system we do have a "bloody lot" of wires and electron tubes.

### *Electronic Defense*

During the brief span of years since the beginning of World War II, this relatively young technology which we call "electronics" has come to play a vital role in our national security. In less than a quarter-century, electronics in military operations has expanded from its first relatively simple application in radio communications to its present status as a basic ingredient of navigation, target detection, identification, threat analysis and weapons control. The annual military expenditure for electronic equipment and systems is approaching four billion dollars. In 1937, a Navy destroyer's electronic equipment contained about 100 vacuum tubes and a bomber aircraft about 30. Today, the various equipments in a destroyer use well over 5,000 tubes and the bomber, almost that many. In a single location, over 50,000 electron tubes are employed in the electronic systems now being installed for the defense of the continental United States against air attack.

As a result of this phenomenal growth and technological advance in military electronics, the intricacy of equipment and systems has constantly increased. Our imaginations may have run away with us at times when we created devices that were unnecessarily complex. Nevertheless, we must face the facts and recognize that complicated weapons and weapons systems are needed to maintain our national security and that their complexity will progressively increase.

A guided missile system is a good example of this enormous compounding of complexity. A single, long-range, surface-to-air guided missile may require the integrated application of a long-range detection radar, an acquisition radar, a tracking radar, computers, a guidance transmitter and complex communication, display and control devices on the ound, all functioning together in ecise relationship with the missile- rn electronics, which include a dio receiver, a computer, a homing vice, an auto-pilot and a fuze. ery element of this extremely in- icate system has requirements of rformance and environment that ish to the limit the capabilities of e present state of the electronic art.

But this and other guided missile stems are absolutely essential to ir national defense. The gun sys- ms, which are rapidly being re- aced by guided missiles, were con- derably simpler, but they are no nger effective against the high alti- des and speeds of modern military rcraft. We are very fortunate that, rough its technical and industrial sources, this country has been able develop and produce these complex issile systems in time to keep our efense on top of the advances in air- raft performance. Scientists and en- ineers in electronics have had the ughest job in these missile develop- ents, and they can be very proud of heir accomplishments. Tremendous redit is also due to the officers and ivilians in the Services who had the ision and the courage to undertake nd carry on the early guided missile levelopments in the face of almost in- urmountable problems of technology nd funding.

### *The Challenge*

As complicated as these guided missile systems are and as costly and difficult as their development was, these factors are relatively minor when compared with those of some of the weapons and weapons systems now being planned or developed for future use. And this brings me to the main topic of my discussion: How can we, in the military services and in industry, meet the challenge of advancing our electronics technology rapidly enough to fulfill the urgent requirements for these new weapons and to develop, engineer and produce them in time to maintain our weapons superiority?

To all of us who are concerned with research and engineering in the area of military electronics, this is indeed a very great challenge—and we cannot afford to fail. The technical problems are staggering; their solution will call for a greatly increased effort in electronics research and development. We can be confident of our ability to meet the challenge successfully; this country has the greatest and the most progressive electronics industry in the world, and our scientific and engineering talent in this field is second to none. Even so, I must emphasize that we can fall far short of the goal unless we use our great technical capabilities in the most economical and effective fashion.

### *Rising Costs*

It does not appear that the level of defense appropriations will be appreciably increased during the next several years. Secretary of Defense Wilson has stated on several occasions—and I think most of us will agree—that the present level of defense expenditures is about all that the military and civilian economy can tolerate and still maintain its sound structure and balance. Although some increase in defense appropriations may be possible as the national wealth advances, it would hardly be to a significant degree over the next few years.

If this assumption is correct, we face a very serious problem in developing and making available the advanced weapons that we need to maintain our military superiority—even our equality. The cost of developing these complex equipments and readying them for production has risen sharply; for the electronic portions, the cost has skyrocketed to the highest level.

Much of this increasing development expense is due to greater system complexity, higher salaries, rising prices of materials and the continual compression of time scales. But the cost of electronic development has increased so terribly over recent years that we cannot really account for it on the basis of these changes alone. I am convinced that there are other factors associated with our methods of planning and managing military research and development that contribute significantly to the rising costs. If this country is to stay ahead in weapons development without going into bankruptcy, we must find ways to be more economical in the conduct of our programs.

I wish to make it quite clear that I intend no criticism of either the military departments or industry in this respect. All our efforts have been so concentrated on trying to solve the tremendous technological problems associated with these new developments that we have not had the time to dig into the intangible causes of the fearful increases in cost. But the situation is becoming so serious that we must now take the time to study this problem carefully and objectively.

A major portion of the cost of research, development and engineering is reflected in technical effort. So when we talk of skyrocketing research and development costs, we really are speaking about vastly increased numbers of engineering man years. Because our supply of scientists and engineers is limited, the availability of technical people to do the work may represent an even greater problem than the actual dollar cost in carrying out our future development programs. It is even doubtful that the availability of substantially more dollars for electronic research and development would significantly increase our developmental capabilities, because it would only tend to super-saturate our already saturated technical resources. This constitutes a further incentive and justification for a careful analysis, by both the military departments and industry, of the management of military research and development to determine what steps can be taken toward better economy and more effective utilization of technical manpower.

### *Problem Studies*

Many people in the military departments and in the Office of the Secretary of Defense are extremely concerned about these interrelated problems of cost and technical manpower utilization. On March 16, 1957, the Secretary of Defense, recognizing the seriousness of the problem, established a committee to study the extent to which current policies and procedures concerned with the design and development of military materiel impair the efficiency of technical manpower utilization in the industries serving the Department of Defense. The responsibility for forming this committee and directing its activities has been assigned to the Assistant Secretary of Defense for Research and Engineering.

The objectives of this newly formed committee were stated by Secretary Wilson in a recent memorandum to the secretaries of the three military departments and the interested Assistant Secretaries of Defense as follows: "The study should encompass those problem areas in which corrective action can be expected to promote the most efficient use of technical manpower in the execution of design and development projects and programs. Among the items which the committee should consider are: *Engineering Records,* particularly requirements imposed on industry for drawings and specifications which lead to ineffective utilization


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f technical manpower in design and evelopment. *Contractual Practices* volved in the selection of design d development contractors by bid-ing and other methods which tend to ssipate technical manpower re-urces in industry. *Technical Ad-inistration of Design and Develop-ent Contracts* to include the wide riances that exist in industry in the e of engineers and other technical ople on similar projects or con-acts and the extent to which tech-ical manpower is wasted by un-alistic classification and processing f engineering changes."

You can appreciate the magnitude s well as the intangible nature of the roblem areas involved in this study. /hile it is expected that some of the roblems can be solved by revising ertain policies and procedures with-1 the Department of Defense, the chievement of major economies in ne use of research and development esources will require an earnest and holehearted endeavor on the part of merican industry.

Although I have emphasized the eed for more economy in the use of ur research and development dol-ars and technical manpower, I don't vant to leave you with the impres-ion that this is our only research nd development problem in the area of military electronics. Having the money and engineers to do the job ahead of us is only the means to the end. Even then, we face a most difficult task in advancing electronic technology on many fronts to meet the new demands.

### Requirements

During the past decade, weapon developers have been withdrawing from our "bank account" of basic electronic technology much faster than we have been replenishing it. In fact, it has been necessary in recent years for those engaged in system developments to sponsor research and development on tubes, component parts and basic electronic techniques. This has resulted in lengthened time cycles for weapon development, compromises in desired weapon performance, duplication of research and development efforts and a serious departure from the principles of standardization.

It is essential that research and technical development effort in the area of electronics be substantially increased if the demands of new system developments are to be met on a timely and economical basis. For reasons of security, I cannot state specifically where this increased effort is most urgently needed, but I can say that significant advances are required in many areas of electronic components and technology, and we must have breakthroughs in some.

Considerable progress in fundamental electronic research is being made in Government, academic and industrial laboratories. Nevertheless, the fruits of these efforts must be more specifically directed toward military applications through a coordinated and intensified program of applied research and technical development.

As I have already pointed out, it is very costly—in many cases, wasteful—to perform this applied research and technical development in connection with system developments. To be effective, this work should be planned, funded and executed apart from specific weapons system programs, but it must fully consider the requirements of these system programs.

### Reliability

More money will be required to establish and maintain an adequate research and technical development program in the area of electronics, but these funds must be made available even if they must be obtained from the appropriations for weapons and weapons system development for production. Those people in the Government who are responsible and have the authority for appropriating defense funds should realize that in electronics we have the basic building blocks for all weapons and that, unless sufficient money is made available to improve this fundamental building material, advanced weapons developments may not be possible. We cannot build tomorrow's weapons with today's electronic components and technology.

Thus far, I have emphasized the need for more economy in the expenditure of funds and technical manpower in carrying out military research and development programs, and I have presented the requirements for more research and technical development effort in electronics to meet the demands of advanced new weapons and weapons systems.

To these are added further problems. On the less glamorous side, we must find the answers to some mighty tough engineering questions too. You know that we have been working very hard, both in the military services and in industry, to build enough reliability into our military equipments and systems to make them effective in service. In this we have been making excellent progress, but the job is going to get much tougher as our systems become more complex and as we press farther into areas of new technology. So, in the future, we will have to place even greater emphasis upon reliability engineering.

Still on the engineering side, we urgently need much more effort in the areas of standardized design methods, designing for automatic manufacturing processes, obtaining better and more reliable tubes and components parts and improving our general engineering specifications and practices.

### Seeking Solutions

I shall now summarize the major problems confronting industrial organizations and the Department of Defense in the area of military electronics. First, with respect to the skyrocketing costs of electronic development and engineering, we must determine the causes for this serious situation and immediately take corrective action.

Next is the question of successfully carrying out essential research and development work in the face of a technical manpower shortage. We must make sure that the services of every scientist and every engineer working on military programs are being utilized for maximum effectiveness.

The third item to be considered is the real, fundamental problem of advancing our basic electronic technology fast enough to meet the requirements of new weapons and weapon systems. To do this, we must put more emphasis and more dollars on applied research and technical development.

Certainly not the least of our problems is that of achieving the excellence and maturity of engineering that is needed to make our new weapons and systems acceptably reliable for service use and ready for production in the quantities required for mobilization.

The solution to these problems can be accomplished only through the combined and cooperative efforts of industry and the military services and by the most effective teamwork between our scientists and engineers. It is our challenge that we must resolve these questions in time and successfully to reinforce and strengthen the future security of this country.

I feel sure that, in seeking solutions to these critical problems, the Armed Forces Communications and Electronics Association can and should play a vital and inspiring part.

# "HOT STUFF" coming through...

A vital product need just ahead on the horizon, lies in the field of INFRARED*. For detection of any potential aggressor, Hot stuff* comes through! IR* has numerous significant advantages: target size is not critical...a passive seeker, it never divulges its source or location...will outperform radar of comparable dimensions. IR can't be jammed . . . when detecting, it can't be detected. LMEE...pioneering these advantages...has the research and production facilities to make all this a protective reality today. Its Advanced Electronics Center at Ithaca, New York, has an INFRARED Projects Group staffed by recognized authorities on IR development. INFRARED by LMEE...with its broad applications to Airborne Weapons Control Systems...is another LMEE contribution to new uses of Defense Electronics. For information on IR ...write Section D.

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**GENERAL ELECTRIC**

LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
FRENCH ROAD, UTICA, NEW YORK

# SIGNAL·GRAM

## — GOVERNMENT —

V PROGRAMS TRANSMITTED TO CUBA The FCC has given the go-ahead for inauguration f overseas telecasting by authorizing the first use of "over-the-horizon" program roadcasting. AT&T and Florida Micro Communications, Inc., Miami, both received ermission to transmit ultra-high frequency television programs between Florida and uba, a distance of 180 miles, via the tropospheric scatter technique.

ARACHUTES UTILIZED FOR TALKING TO THE ENEMY Air Research and Development Command ARDC) has announced a new parachuting public address system as an aid to talking he enemy into surrendering. The development, nicknamed "Talk Down," is for the se of psychological warfare units trying to get enemy troops to give up. This omb-shaped device goes "on the air" at 4,000 feet with a tape recorded message bout 250 times louder than that of an average TV set. Instead of hovering over the area with a loud speaker which is risky under ground fire or bad weather conditions, hey can now drop their peace appeals from high altitudes. The system was developed on an inter-service and industry project monitored by ARDC's Wright Air Development Center. Cook Research Laboratories, Skukie, Illinois, has the development contract.

BALLOON RECORD SET IN MINNESOTA In June, Capt. J. W. Kittinger, Jr., a jet pilot, rode a huge plastic balloon to a record 18 miles high, beating the old manned-balloon mark by four miles. Kittinger landed safely in the helium-filled bag, suspended in a 3 by 7-foot gondola, after soaring to 96,000 feet for one hour and 50 minutes. Total flying time was six hours and 34 minutes. The test was cut short when the voice transmitter failed on the way up due to antenna trouble. This ascension, one of a series, may prove valuable in future rocket and manned-satellite flights. Later this summer the Air Force will attempt a manned-balloon flight to 100,000 feet to remain for twenty-four hours.

"ROBOT" TRACTOR AT FORT BELVOIR A tractor that can be operated anywhere within range of the radio by which it is controlled is undergoing tests at the Army Research and Development Laboratories, Fort Belvoir, Va. The tractor, believed to represent the first application of the remote control principle to construction equipment, may prove invaluable in construction work in radio-activated and combat zones and in fighting large fuel storage fires. From a jeep or helicopter equipped with a standard military radio transmitter and a special control box, normal operations can be performed from distances up to 15 miles, simply by manipulating the buttons on the control box. By mounting small television cameras on the tractor, it is believed that the remote operator could manipulate without any information from a visual observer.

CONTRACT AWARDS: The ARMY has announced the following contracts: Servo Corp., development of a high accuracy direction finding set (AN/TRD-15), $143,563; Chrysler Corp., guided missile components, $3,782,738; Chrysler Corp., 900 M48-A2 Tanks, $119,000,000; Collins Radio Co., 12 radio transmitting sets (AN/FRT-22) and 4(AN/FRT-26), $1,137,225. NAVY grants include: Sperry Rand Corp., super-radar used to guide anti-aircraft TERRIER missiles toward targets (SPQ-5), $51,550,398; General Electric Co., development of T64 gas-turbine engine, $58,500,000; Eastman Kodak Co., production of VT fuses, $3,000,000; Northern Ordnance, Inc., TERRIER launching equipment, $20,000,000; Hercules Powder Co., testing of experimental missile propulsion systems, $3,500,000; Aerojet General Corp., JATO units and spare igniters, $3,500,000; Elgin National Watch Co., guided missile SIDEWINDER fuzes, $700,000. The AIR FORCE awarded contracts to: Page Communications Engineers, Inc., design, procurement, installation and test-operation of scatter communications systems for SHAPE, $3,500,000; Lockheed Aircraft Corp., continuation of ramjet engine flight test program, $14,500,000; Hughes Aircraft Co., modification of airborne electronic control systems used in all-weather jet interceptors, $1,071,239; Boeing Airplane Co., Bomarc missile, $7,109,195.

## — INDUSTRY —

SENSITIVE CAMERA OPERATES UNDER WATER Admiral Corporation has developed a new military television camera for the U. S. Navy's Bureau of Aeronautics with such extreme sensitivity that it can be operated under water. It was announced that special circuitry in the new image orthicon TV camera permits it to be used for reconnaissance even under the most adverse conditions. The camera is used in conjunction with a television monitor on which the phase of the signal can be reversed and the picture size can be controlled.

NATO TO BE LINKED BY FORWARD SCATTER COMMUNICATIONS SHAPE has issued a letter of intent for the engineering and installation of one of the most modern and extensive military communications systems in the world. This new network will combine over-the-horizon tropospheric forward scatter and line-of-sight radio relay links extending from Eastern Turkey around the broad crescent throughout NATO Europe to Norther Norway, with its main center in Paris, France. This estimated $9,000,000 contract was signed by International Standard Electric Corp., the overseas management subsidiary of IT&T and Hycon Eastern, Inc.

RADAR AIDS IN THE KITCHEN Scientists at Raytheon Manufacturing Company's Food Laboratory are using radar's electronic energy to preserve fresh and cooked foods so they can be stored on a kitchen or grocer's shelf at room temperature indefinitely without refrigeration, and without loss of flavor, texture, or nutrient value. The preserved food weighs only a fraction of the fresh product. From 70 to 95% of the fresh foods' weight is water, which is removed by applying microwave energy while the food is held under vacuum at below freezing temperatures. The food can be restored to its original fresh condition in minutes simply by immersing in hot water. Still in the laboratory stage, this "freeze-drying" process has tremendous potentialities for the military in their supply problem—on the sea, in the air, and on the ground.

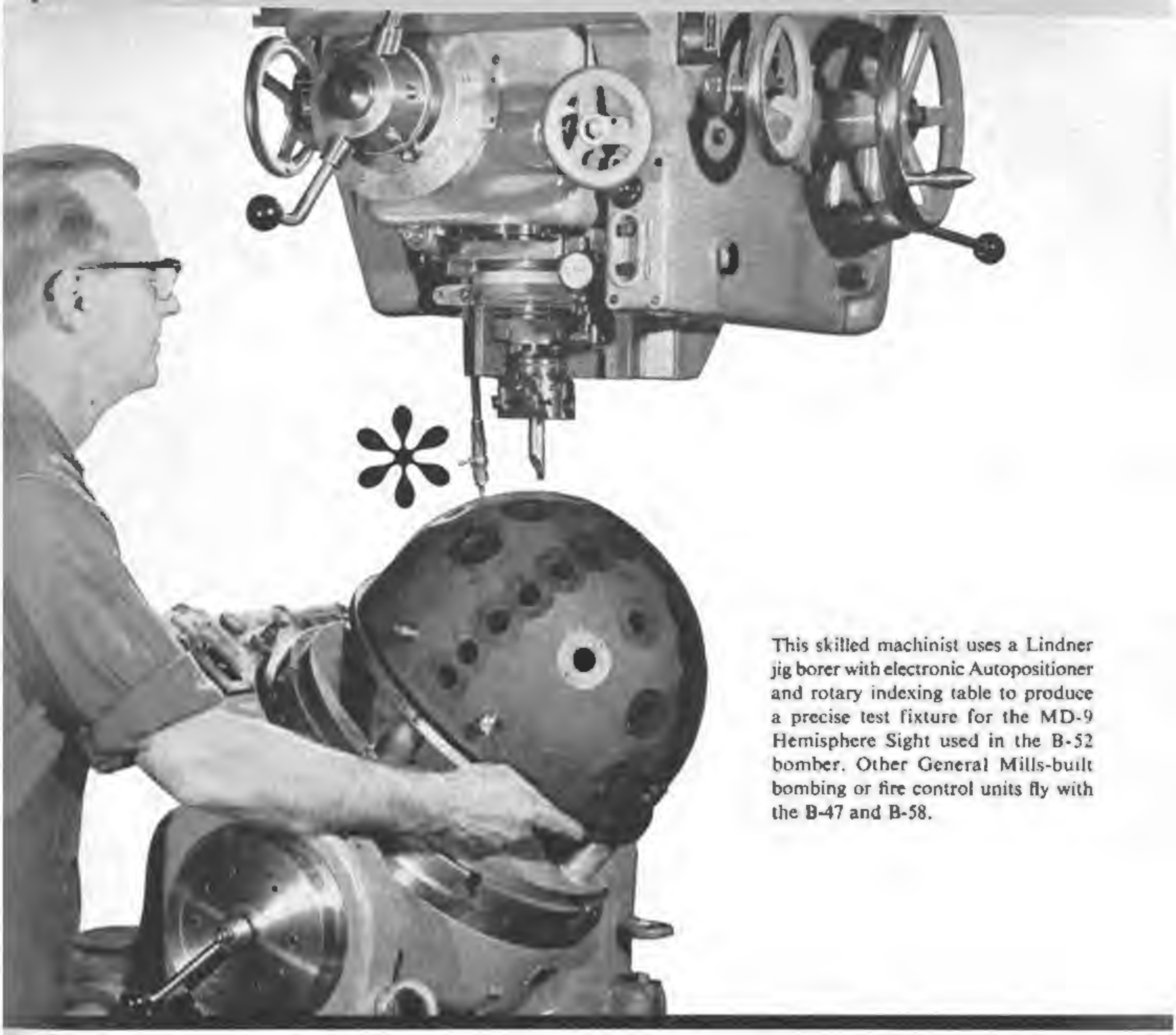
THE TOUGHEST METALS KNOWN TO MAN A new furnace, pioneered in titanium melting and described as "a major metallurgical breakthrough," is being made available in the metals industry. This announcement came from Titanium Metals Corp. of America, Allegheny Ludlum Steel Corp., and the Lectromelt Furnace Division of McGraw-Edison. The furnace, called a consumable electrode vacuum remelting furnace, melts titaniu zirconium, high alloy steels, or other ferrous or non-ferrous alloys which are remarkably free of impurities. Such high-performance metals are used in building jet aircraft and engines, missiles, and atomic reactors. One official said the precision low-cost melting technique was in great part responsible for advancing titanium to a tonnage metal at constantly lower price levels.

## — GENERAL —

RADIO AMATEURS TRANSMIT A "FIRST" The first successful transmission of sports pictures and Sunday comics to the Antarctic was made on Sunday, May 5, via radio facsimile. The transmission was accomplished by radio amateurs in the U. S., more than 8,000 miles from the point of reception. The pictures were transmitted to the Antarctic by W2KCR at North Syracuse, N. Y., and the Operation Deep Freeze Committee of the Radio Amateurs of Greater Syracuse as a function of the American Red Cross Amateur Radio Morale Message Service. The new radio picture transmissions are a forecast of similar and more personal transmissions in the future.

U.S. AND PORTUGAL LINKED BY DIRECT TEX CIRCUIT RCA Communications, Inc. has announced the opening of a direct radio-teletypewriter exchange service (TEX) between the U. S. and Portugal. The new point-to-point circuit provides increased capacity for handling the two-way TEX calls made by business-men. Now, circuits to Holland and France, over which Portuguese TEX traffic was routed previously, are able to carry heavier volumes of calls, and calls between Portugal and Japan, Hawaii, or the Philippines will all be processed more rapidly. Rates for TEX service between the U. S. and Portugal will remain at $3.00 a minute for a three-minute minimum call.

"ELECTRONIC EQUIPMENT" RECEIVES RECOGNITION The International Telephone Directory, a worldwide classified business phone directory, will have a special section under the general classification of "Electronic Equipment" in its third edition which is slated to be published January 1958. Sub-classifications bearing the prefix "electronic" are as follows: "Engineers," "equipment designers," "industry," "measuring and testing devices," "research," "tubes and equipment," and "tube-machinery manufacturers."

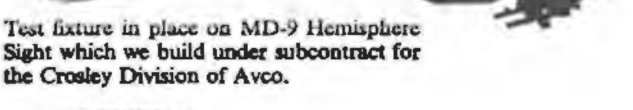


This skilled machinist uses a Lindner jig borer with electronic Autopositioner and rotary indexing table to produce a precise test fixture for the MD-9 Hemisphere Sight used in the B-52 bomber. Other General Mills-built bombing or fire control units fly with the B-47 and B-58.

# *B-52 gunners are better marksmen because of this General Mills craftsman

Maintaining accuracy of the MD-9 Hemisphere Sight for the tail defense system in B-52 bombers calls for unusually close tolerances. Holding these tolerances requires exacting test fixtures. We designed, engineered and built many of them.

The optical device in the picture has flat, microfinished surfaces with angular accuracy within two minutes of arc surrounding lens openings. The critical flat areas and openings are located from bearing holes that are held within +.0002″, −.0000″.



Test fixture in place on MD-9 Hemisphere Sight which we build under subcontract for the Crosley Division of Avco.

*We'd like to tell you more about how we combine creative engineering and fine precision production to serve industry and military. Our unified team can handle research, development or manufacturing—or the whole package. Send for facts, Dept. SG7*

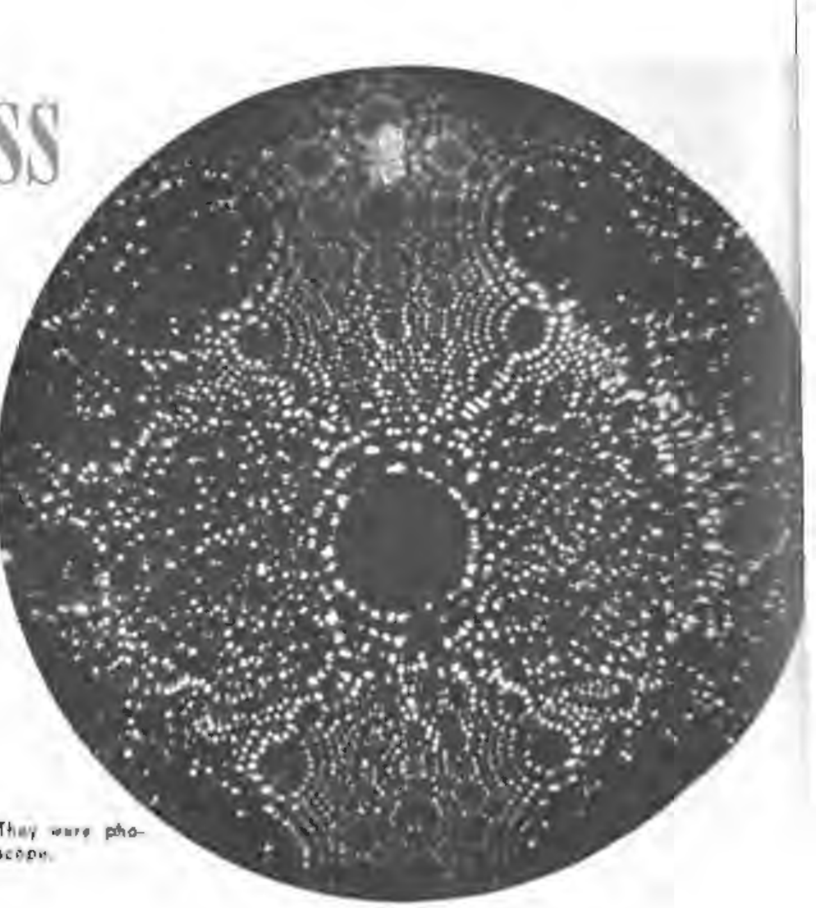
**MECHANICAL DIVISION** General Mills

*Minneapolis 13, Minnesota*

CREATIVE RESEARCH AND DEVELOPMENT • PRECISION ENGINEERING AND PRODUCTION

# photoprogress

by FRANK SMITH
**PHOTO EDITOR**
**SIGNAL**



The white dots pictured here are tungsten atoms. They were photographed by means of the field ion microscope.

### Photography Of Atoms

Photographers interested in the photography of particles too small to be seen by the most powerful microscope will doubtless be interested to know that photographs of individual atoms of tungsten, rhenium and some other metals, have been made by means of the field ion microscope developed by Dr. Erwin Müller of Pennsylvania State University, University Park, Pa.

The field ion microscope is an improved version of the field emission microscope which was invented by Dr. Müller some years ago.

Briefly, the field emission microscope consists essentially of an evacuated glass envelope which is shaped somewhat like a small TV tube. Leading into the glass envelope are two current carrying wires which terminate in a very fine point and form the emitter (cathode). The inner surface of the tube is coated with a conducting film which forms the anode.

The viewing screen is formed by coating the inside convex face of the tube with a phosphor powder which produces visible light when electrons or ionized atoms impinge on it.

In operation a negative potential of several thousand volts is applied between the cathode and anode. A visual image of the lattice structure of the cathode tip then appears on the phosphor viewing screen.

In the field emission microscope, the emitter tip is charged negatively, whereas in the field ion microscope, the emitter tip is charged positively. The positive ions which form the image are made from a thin gas of helium atoms introduced into the microscope.

In contrast with the electron microscope which gives a resolution of about 10-20 angstrom units, the field ion microscope gives a resolution of the order of three angstrom units and since atomic dimensions are of this order, they can be resolved. Magnification is of the order of two million and the images produced are bright enoug to be recorded by sensitive film with an exposure tim of one minute.

Professor Müller has worked out a color print technique by means of which changes in the atomic structur between pictures taken at different times may be shown For instance, a copy of the first picture is illuminate by green light and a copy of a second almost identica picture is illuminated by red light. The two pictures ar brought to coincidence by optical means and the resulting picture is then photographed on color film. In the resultant picture, all atoms that occupy identical positions on both photographs appear bright yellow, the ones that are only on the first picture appear green and the ones that are only on the second picture, red. The color pictures are quite striking and allow one to view the distribution of the loosely bound atoms over the crystal hemisphere.

The field emission microscope is expected to play an important part in studies of certain properties of metals such as fatigue, creep, evaporation, etc.

### New Air Force "Cat Eye" Light Amplifier

According to the Office of Information Services, Air Research and Development Command, Baltimore, Md., a new light amplifier called the "Cat Eye" may provide the means for answering the questions about the "canals" on the planet Mars.

The "Cat Eye," which grew out of a research program of the Air Research and Development Command under the sponsorship of ARDC's Aeronautical Research Laboratory at Wright Air Development Center (WADC), Dayton, Ohio, can see a scene at night and reproduce it with daylight brightness, even when the human eye can see nothing. Research work on "Cat Eye" light amplifiers was conducted for ARDC by Westinghouse Corp.

nd the Radio Corp. of America.

Conventional photographs of planets and other heavnly bodies taken even with the best telescopes suffer from ne "jitters." The "jitter" is caused by tremors of air nasses in the earth's atmosphere which affect the resoluion of distant objects such as planets and galaxies, beause the light is deflected first in one direction and then n another. An example is the shimmering of starlight een on a clear night. This shimmer causes the photoraphs to blur, since conventional photographic techiques require exposures of several seconds for Mars, and ven longer periods for more distant planets or the stars.

In operation, the "Cat Eye" light amplifier senses and mplifies the always present light unseen by the human ye. Photons, the electro-magnetic waves which appear s light over certain frequencies, are sensed and imaged n a photosensitive surface. There they are transformed rom photons to electrons, accelerated, and produce lectro-static images. These are further amplified and are ensed by an electron beam. The resultant signal again is mplified into the cathode ray tube.

Photographic exposure times can be reduced 16,000 times with the light amplifier, according to Mr. Radames K. H. Gebel, of WADC's Aeronautical Research Laboratory. This will permit photographs that might reveal the nature of the "canals" and other features of Mars, and also make it possible to see perhaps 100 times farther into space than with the finest telescopes using conventional photography.

The WADC's Aerial Reconnaissance Laboratory is planning integration of the "Cat Eye" into reconnaissance systems which can take aerial pictures at night.

## Electron-Image Recording by Xerography

An interesting method of using Xerography for the purpose of recording of electron images of the type produced in electron microscopes and electron diffraction cameras is described by P. B. Sewell in the April 13, 1957 issue of *Nature* (London).

Sewell states that by using an accelerating voltage of 50 kv., electron diffraction patterns have been recorded on vitreous selenium films about 60 microns thick, developed for use with X-radiation.

A limited number of experiments has shown that, using 50 kv. electrons, the particular selenium plates employed require an exposure similar to that used with Ilford N. 50 photographic emulsions.

A diffraction pattern just visible on the fluorescent screen requires an exposure time of about five seconds.

The author states that the following points are of particular interest with regard to the possibility of using the technique to record electron images:

(1) The vitreous selenium plates are free from outgassing effects at room temperature,

(2) Xerographic plates of the type developed for radiography can be used for recording electron images produced in electron optical instruments using beam accelerating voltages between 45 and 55 kv.,

(3) Such plates require an exposure similar to that used with the high-contrast photographic emulsions commonly employed in electron microscopy and electron diffraction,

(4) The use of suitable liquid developing techniques makes possible image resolution beyond the limits attainable with conventional photographic materials, without sacrificing the plate sensitivity,

(5) The high image-contrast and wide latitude of exposure that have been demonstrated with Xeroradiography could be advantageous in the recording of electron microscope images, which frequently exhibit low relative contrast.

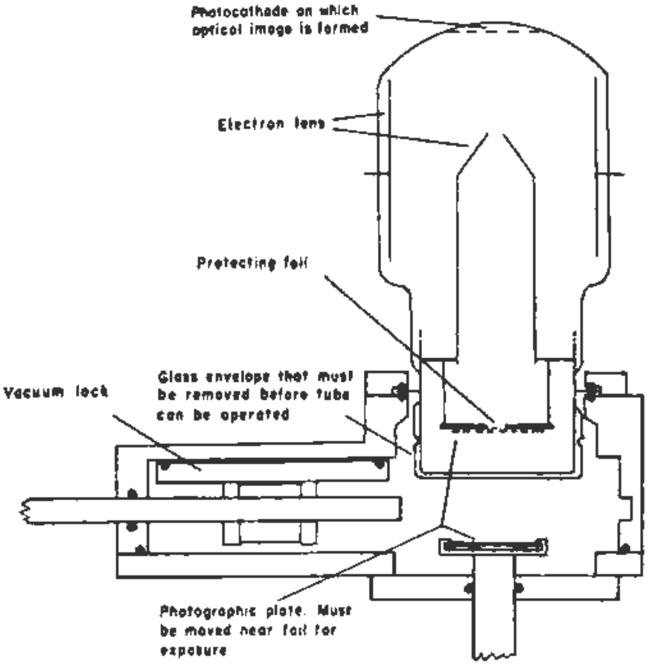
Your author has long thought of the idea of a truly electronic camera for ordinary use wherein the light or optical image of a scene is picked up by an image tube and converted into an electron image which is instantly and directly recorded by electronic means as a dry photograph, thereby doing away with the conventional silver halide film with its attendant chemicals. darkroom and processing.

Sewell's experiments seem to indicate that such a camera may not be beyond the realm of possibility.

## Image Converters in Photography

One of the interesting developments in recent years is the increasing use of image converter tubes in the field of photography and particularly in high speed photography. However, it is not alone in the field of high speed photography that these tubes are useful, but also in astronomy for direct photographs of star fields and stellar spectra.

Although it may not be so well known, it has been amply demonstrated that the information recorded per unit time by a photographic film can be greatly enhanced by exposing the emulsion to accelerated photoelectrons instead of photons. In order to do this, an image converter must be used and the film must be placed inside the converter. Since the film contaminates or poisons the photocathode and shortens its life—perhaps to the order of one hour—a method had to be found to overcome this. W. A. Hiltner of Yerkes Observatory, Williams Bay, Wisc., under a contract sponsored by the Office of Ordnance Research, U. S. Army, has experimented and demonstrated an ingenious method of doing this by inserting a thin metal foil between the photocathode and film. The foil has the property of transmit-



The above is a schematic diagram of the Hiltner image converter tube with protecting foil and plate changer. In recent years, use of the image converter tube in high speed photography has increased. These tubes prove valuable not only in the field of high speed photography but also in astronomy for direct photographs of star field and stellar spectra.

ting the electrons but holds back the contaminates (water vapor) of the film. Thus, an effective barrier is set up.

The image converter was made by the Farnsworth Electronics Corp. and is a modification of a standard image converter with the phosphor replaced by a thin aluminum foil.

Other workers, notably Professor André Lallemand of the Paris, France, Observatory, use converter tubes constructed along somewhat different lines but also with good results. Image converters which are said to be 100 times more efficient than a photographic emulsion for reacting to photons have been reported and the use of this tube for astronomical photography seems to be assured.

Quite a different use for image converter tubes is reported in a paper entitled "Millimicrosecond Photography With an Image Converter Tube" by R. Carroll Maninger and R. W. Buntenbach of Precision Technology, Inc., Livermore, California, presented at the 1957 IRE Convention in New York City.

The authors describe a camera that uses a new type image converter tube which is designed for image control, focussing and deflection by pure electrostatic means as opposed to electrostatic-magnetic means in previous type cameras.

Some applications of high speed cameras such as photography of the growth and decay of electrical discharges, detonation propagation, shock wave formation, etc., require cameras of ultra high speed.

The apparatus described in the paper consists of a specially designed image converter tube, associated pulse circuitry, and oscilloscope recording camera. The use of the image converter tube and its associated circuitry in this camera is unique in that it acts both as a shutter and as a means for moving images across the face of the stationary recording film. The camera can take a multiple framed sequence with controlled time spacing between frames and with exposure times during each frame as short as ten millimicroseconds.

The image converter camera is easily synchronized with the events being photographed and under certain conditions, the camera requires less light from the event than other types of cameras. This results from the ability to obtain light amplification within the image converter tube itself. The image tube used is an RCA Type C73435A with nominal characteristics.

The resolution capability of image converter tubes is customarily referred to the cathode. The authors state that the first six C73435A tubes had a resolution capability of 14 to 28 line pairs per millimeter. This corresponds to some 20 to 40 line pairs/mm on the screen.

The authors further state that considerable success has been achieved with Type 44 Polaroid film, and the convenience and ease of developing this film makes its use highly desirable.

## Exicon—Expanded Image Contrastor

The development of a new color X-ray viewer with the exotic name of "Exicon"—Expanded Image Contrastor—that increases the readability of X-ray pictures through the use of contrast enhancement and color TV techniques has been announced by the Philco Corp., G&I Division, 4700 Wissahickson Ave., Philadelphia 44, Pa.

The "Exicon" X-ray viewer performs three essentially different, but equally important, functions to extract quickly and accurately a maximum amount of information from an X-ray transparency, according to Dr. J. Gershon-Cohen, Chief of Radiology of the Einstein Medical Center. Northern Division, Philadelphia, Pa. Dr. Gershon-Cohen, who has been in close contact with Philco, Government and Industrial Division, research engineers during the development of the "Exicon" X-ray viewer, said that the viewer "enhances X-ray contrast in 'gray scale' variations, increases readability by utilizing full color and magnifies an area being viewed."

The viewer consists essentially of monochrome and color monitors, an operator's console and a flying spot scanner. An X-ray negative placed before the flying spot scanner will be magnified and separately reproduced in enhanced monochrome and color. Negatives may be quickly shifted about to obtain magnified images of any portion. The system may be used in conjunction with closed circuit color TV installations.

Before processing the information contained on an X-ray negative through a contrast, enhancing device and a color converter, the information must be transformed into an electric signal. This is accomplished through the use of a flying spot scanner. The heart of this device is a cathode ray tube. By means of a sharply focused, internally generated electron beam, a very small spot of high luminous intensity may be produced on the tube's phosphor screen. This bright spot is then focused by a lens system upon the X-ray transparency under examination.

An amount of light, proportional to the transparency of each small area of the negative, passes through the negative and is picked up by a photo tube. There the light is transformed into a video signal which is then amplified. This signal is then fed to a constant enhancing device in which adjacent areas having a difference in brightness that is hardly discernible, may have their relative contrast enhanced well above the threshold of visibility. This TV signal is now fed to a black-and-white monitor and through a color monitor where the X-ray picture is reproduced in color.

On the color monitor, the strongest signal obtained from particularly transparent sections of the X-ray negative will be portrayed as the color red; the weakest signal will show up as blue. Between the extremes, colors range through orange, yellow, chartreuse, green and cyan. The system has been made sufficiently flexible so that different color sequences may be realized. It is also possible to electronically convert the image from a negative to a positive in an instant.

Other uses for the new system now under study are: aerial reconnaissance, air traffic control and various industrial techniques such as those employed in the fields of metallurgy, chemistry and pharmacology.

## New Photographic Science and Engineering Society

One of the signs of the times—particularly as it relates to photography and its advancing use in science and technology—is the recent formation of a new technical group, the Society of Photographic Scientists and Engineers, Washington, D. C.

The new society which has been formed is the result of the merger of the Technical Division of the Photographic Society of America (PSA) and the former Society of Photographic Engineers.

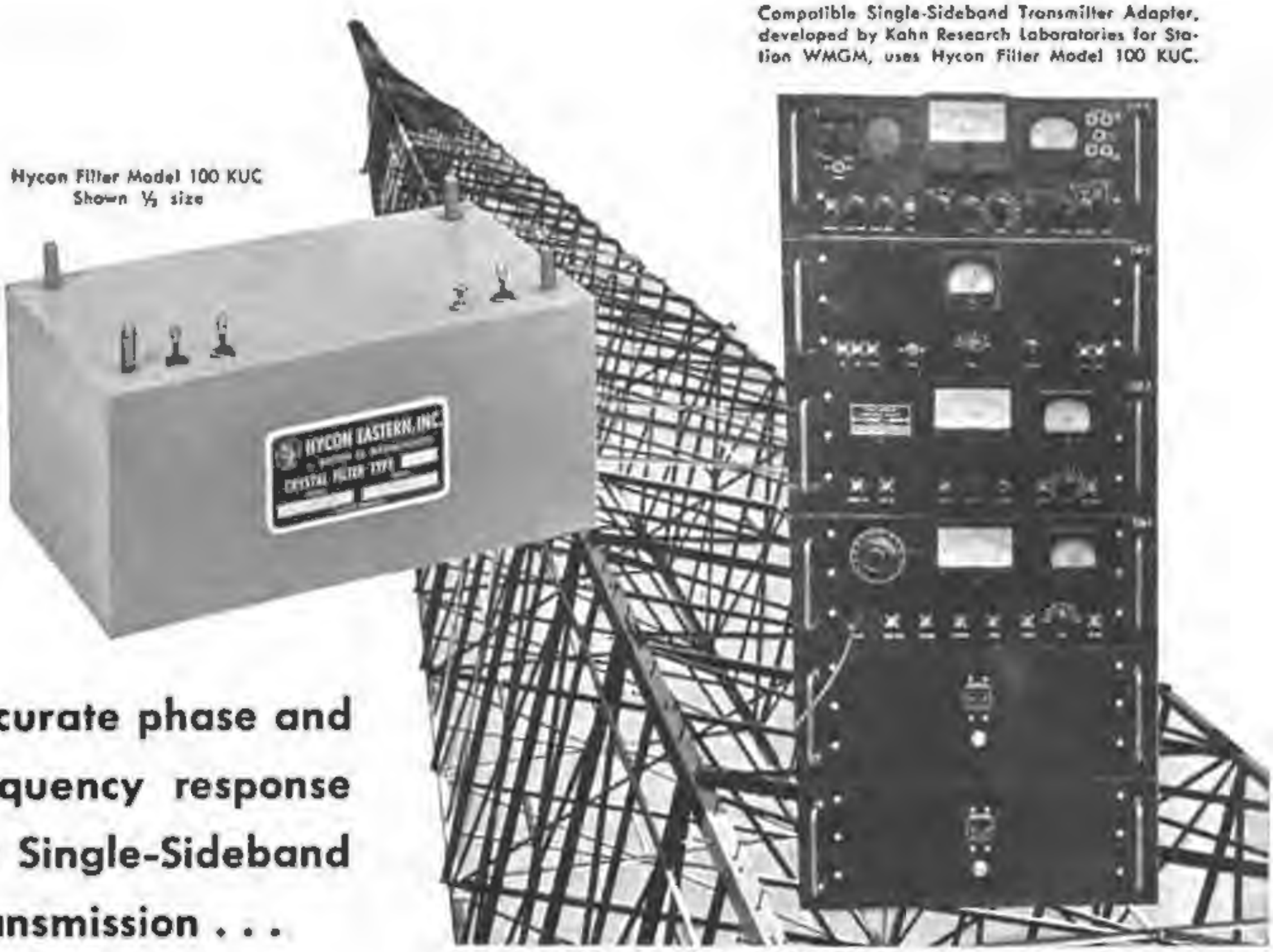
The new society which will consist of some 1,200 scientific and engineering members scattered throughout the world is dedicated to the "application of photography to science and science to photography."

A new official journal of the society to be called *Photographic Science and Engineering* made its debut in June, 1957. The new journal featured papers and articles of scientific and engineering interest to the profession.

*(Continued on page 40)*

Compatible Single-Sideband Transmitter Adapter, developed by Kahn Research Laboratories for Station WMGM, uses Hycon Filter Model 100 KUC.

Hycon Filter Model 100 KUC
Shown ½ size



**Accurate phase and frequency response for Single-Sideband Transmission . . .**

Radio Tower of Broadcast Station WMGM (50,000 watts)

# another problem solved by HYCON FILTERS

The first domestic broadcast installation of the Compatible Single-Sideband Modulation Method has recently been completed by Broadcast Station WMGM of New York City on an experimental basis. Advantages of this system are improved fidelity, improved range in the presence of co-channel interference, resistance to fading and reduction in spectrum space. Because of their ability to meet the stringent requirements for the SSB frequency selective networks, Hycon Filters were chosen for this installation by Kahn Research Laboratories, designers of the CSSB Transmitter Adapter.

**ELECTRICAL SPECIFICATIONS (Model 100 KUC)**

Carrier Frequency: 100 KC
Attenuation at carrier +300 cps: 2 db maximum
Attenuation at carrier +6000 cps: 2 db maximum
Attenuation at carrier −300 cps: 60 db minimum
Insertion Loss: 10 db maximum
Passband Response Variation: ± ½ db
Impedance: 8200 ohms
Dimensions: 5 ⅛" x 3" x 2 ⅝"

ALSO AVAILABLE: Model 100 KLC—Lower Sideband
Model 100 KPA—Carrier Selection

Whether your selectivity problems are in transmission or reception, AM or FM, mobile or fixed equipment, Hycon quartz crystal Filters offer you these advantages: LOW COST — standard models; LOW DISTORTION—passband uniformity within ±½ db; HIGH STABILITY — inherent in crystal resonators, also freedom from microphonic behavior; ZERO MAINTENANCE — hermetically sealed, requiring no realignment or readjustment. Hycon Eastern, Inc. can assist you in the selection of filter characteristics best suited to your needs. *Write for Crystal Filter Bulletin.*

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Work of the new society will be carried on principally through local chapters located in many principal cities of the United States such as Washington, D. C., New York City, Rochester, N. Y., Chicago, Ill., Los Angeles, Calif., Dayton, Ohio and others.

Monthly technical meetings are held in the various chapters and an annual technical conference, the first of which will be held Sept. 9 to 13, 1957 at the Berkeley-Carteret Hotel, Asbury Park, N. J.

Address of the Society of Photographic Scientists and Engineers is Box 1609, Main P. O., Washington, D. C.

This new Nikon "Fisheye" camera has 180-degree vertical and horizontal coverage. It uses standard 120 roll film and produces 12 circular pictures on a 2¼" x 2¼" square. The camera, representing an important stride in the field of ultra-wide-angle optics, is designed to view objects as a fisheye sees and is available only on special order.

## New "Fisheye" Camera Takes 180-Degree Picture

A new camera that has 180-degree vertical and horizontal coverage has been developed by Nikon, Inc., 251 Fourth Ave., New York 10, N. Y.

Called the "Fisheye," the camera uses standard 120 roll film and produces 12 circular pictures on a 2¼" x 2¼" square. The camera is equipped with a Nikkor lens which represents an important optical advance in ultra-wide-angle optics. The lens has a focal length of 16.3mm and is designed to "see" as a fisheye sees.

Because of the wide coverage a viewfinder is not absolutely required since the photographer can see the approximate coverage from the reflection in the lens. The camera is provided with three aperture settings, f/8, f/11 and f/16 and shutter speeds ranging from ½ second to 1/200 second.

The camera can be handheld and is equipped with an automatic film counter and a single-stroke wind-back film advance crank.

Although the camera is designed primarily for scientific work, and particularly for sky and cloud conditions, it may be used for any purpose for which extreme wide angle coverage is desirable.

The price of the camera is $3,000 and it is available only on special order.

## Viewing Negatives as Positives

Professional photographers, who are plagued with the time-consuming process of working proof prints in order to determine the best negative for printing, need worry no longer, for a unique European development which makes possible the viewing of negatives as positives, has been announced by the C. P. Goerz American Optical Co., Inwood, N. Y., the American distributor.

The instrument, which is called the Vertoscope makes it possible to view any film negative instantly as a positive, enlarged 2½ times.

The principle of operation of the Vertoscope is as follows: A fluorescent screen is excited by ultra-violet light radiations, causing it to glow. The glow effect is cancelled out by the exposure of the fluorescent screen to infra-red radiations.

As the image of the negative is projected onto the fluorescent screen, using the infra-red light source, the dark areas of the negative do not permit the transmission of the infra-red radiation. The clear areas of the negative readily pass the infra-red. Therefore, the fluorescence is cancelled in the regions that are of light density and the fluorescence of the screen is not cancelled in the areas corresponding to the dense areas of the film. These areas continue to glow and appear bright to the viewer. Thus the values of the negatives are reversed. The image viewed is the equivalent of a positive print with corresponding intermediate tones faithfully reversed.

The process is continuous as long as the fluorescent screen is excited by the ultra-violet radiation. Variations in contrast are easily produced by varying the intensity of the light source by means of a single knob control. This permits the reversal of thin or dense negatives.

All negatives up to 2¼" x 3¼" or 70mm format, in any length, may be viewed. A rotating negative carrier swings 180 degrees for vertical or horizontal subjects. A larger negative carrier up to 105mm is available. Two viewing parts permit simultaneous viewing by two observers.

The Vertoscope is equipped with a 1,000 watt lamp contained in a housing which is blower cooled. The instrument is designed for 110 volt A.C. operation and consumes 1250 watts. Overall dimensions of the Vertoscope are 13½" x 25" x 16½".

## A New 360-Degree Azimuth Camera

A new 360-degree azimuth camera for recording horizon profiles, plane table work and similar uses has been developed by the Aero Service Corp., 210 East Courtland Street, Philadelphia 20, Pa.

The horizon camera uses 35mm motion picture film and its precision design assures very accurate measurement of azimuth angles despite differential shrinkage of the recording film or photo prints.

First used to record vertical and horizontal images for the radar station sites of the Distant Early Warning Line in Northern Canada, the camera weighs approximately 20 pounds and mounts on a surveyor's standard tripod.

The horizon camera is available with a choice of lens and choice of scales for the azimuth angle. Current models use a 12- or 20-inch lens and have horizon scales of approximately 5 degrees and 10 degrees per inch. A flare-reducing mask permits photographing almost directly into the sun with good results.

Set up and leveling for the horizon camera follows the same routines as setting up a surveyor's level. The camera turns through its 360 degree arc in approximately one minute, the speed of turning being pre-set to control the exposure time. The constant speed drive motor is operated by a 24-volt battery.

Film capacity is approximately 400 feet, sufficient to survey about 60 sites. The film chambers are darkroom loaded but may be installed or changed in daylight, so different films may be used as required to penetrate ground haze. Infrared and panchromatic film are the principal types used.

* * *

# FILLING THE GAPS IN FREEDOM'S FENCE

The possibility of low-level bombers, slipping through the continental radar fence, has been the cause of much concern in our Air Defense Command. But a new "gap filler" radar eliminates the shadow areas caused by the earth's curvature and irregularities of terrain . . . helps give instant warning of the approach of intruding aircraft.

Vital in the chain of "gap filler" radar sites is a Varian Type VA-87 klystron amplifier, sending out a million-watt pulse of power a thousand times a second on a 24-hour-a-day basis. It provides the absolute dependability necessary to our national security. Result—a radar that will operate fully automatically, for prolonged periods of time, with neither operating nor maintenance personnel at the radar site.

Complete dependability is a characteristic of *all* Varian klystrons, along with extreme ruggedness, frequency stability, and outstandingly long life in service. Write the Varian application engineering department for complete specifications on the Type VA-87, or ask your Varian representative for a copy of the Varian Catalog.

*Varian is now building more than 1,000 VA-87 klystron amplifiers for the United States Air Force, for use in the AN/FPS-18 gap filler radar systems being manufactured by Bendix Aviation Corp.*

**VA-87C**

Frequency range: 2800-2900 Mc
Peak power output: One megawatt
Duty cycle: .003
Power gain: 60db

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# The Trend of Facsimile in Military Communications

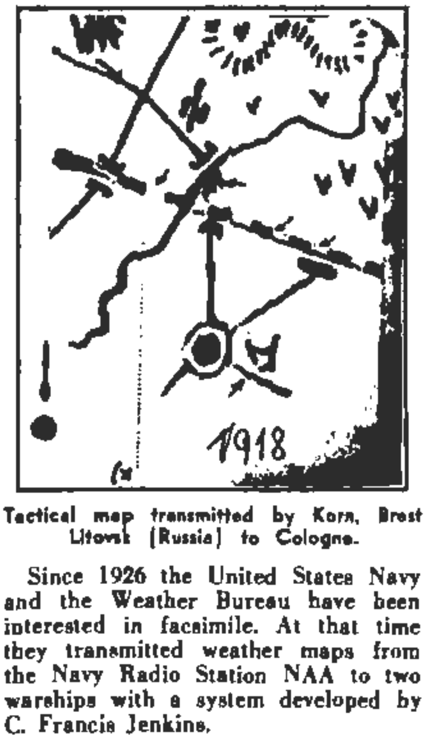
### by A. G. Cooley, Executive Vice President, Times Facsimile Corp.

Editors Note: The following three articles are the first in a series of technical papers presented at the Eleventh AFCEA National Convention. Additional articles will be published in subsequent issues of SIGNAL.

SAMUEL MORSE HAD HARDLY finished learning the Morse Code before the inventors of his day were trying to find a graphic means of communication. Their goal was a system that would deliver a message as a facsimile of the original.

The first facsimile equipment was built and tested in 1848.

As other methods of communications improved through the years up to 1930, the apparent advantages of facsimile for message communications became less obvious, and the facsimile pioneers directed their attention more and more toward picture transmission. One exception was Dr. Arthur Korn's work in transmitting tactical maps for the Wermacht in 1918 and weather maps for Dr. Bjerknes of Norway around 1923.



Tactical map transmitted by Korn, Brest Litovsk (Russia) to Cologne.

Since 1926 the United States Navy and the Weather Bureau have been interested in facsimile. At that time they transmitted weather maps from the Navy Radio Station NAA to two warships with a system developed by C. Francis Jenkins.

General George Gibbs described in a 1930 edition of *Electronics* the transmission of facsimile messages from a Signal Corps plane flying over San Francisco.

Commercial photofacsimile, developed and operated by the Bell System, got under way in 1925. Message facsimile has been a regular part of Western Union's telegraph system since 1939. Now they have approximately thirty thousand installations.

Facsimile was ready for service during the tune-up for World War II. It was used in Spain during the revolution. Its next service was in Poland. Successful military tests were made by the United States Signal Corps at the Plattsburg, Ogdensburg and the Louisiana maneuvers prior to World War II. These tests led to the adoption of facsimile for military uses by the Allies.

One very important service performed during the Normandy invasion was the transmission of reconnaissance photographs. The photographs were taken by observation planes flying over Normandy. They returned to England where the pictures were developed, analyzed, and then transmitted by facsimile to the front line troops, all within an hour from the time when the pictures were taken.

From a central weather plotting station in England, weather maps were transmitted to many of the airfields so that all missions would be using the same weather interpretations, thus coordinating their navigation calculations. This aided in bringing the planes together at their scheduled rendezvous. The weather map transmission system proved extremely serviceable during tactical operations.

After V-E day the traffic load fell off and the operators entertained themselves with the transmission of interesting French photographs. It was decided that better use could be made of the equipment, so it was returned to the States where the Air Weather Service set up a national wireline facsimile weather network.

Around the clock, seven days a week over 600 military, Weather Bureau and commercial meteorological offices now receive facsimile charts from Suitland, Maryland, where they are prepared by Weather Bureau meteorologists.

Radio transmissions supply weather information to ship and shore stations for the entire North Pacific and North Atlantic areas. Navy ships receive special bulletins by facsimile and transmit various types of material including drawings required in making emergency ship repairs.

The Air Force is using facsimile over land lines for administrative communications and is setting up a second weather network to cover additional requirements.

The Signal Corps operates a radio facsimile service with headquarters in the Pentagon. There are circuits to Japan, Honolulu, Europe and Africa. Of special value is the circuit to Eritrea on the Red Sea where the mail service is particularly poor. The traffic consists of engineering drawings, photographs, bills of lading, etc.

The Weather Bureau uses facsimile equipment of the newsphoto type to transmit photographs of radarscope presentations showing hurricane cloud formations. An improved type of equipment of the flat bed scanner type has recently been delivered to the Air Force for use in a similar service.

### *Fax Systems In Pioneering Phase*

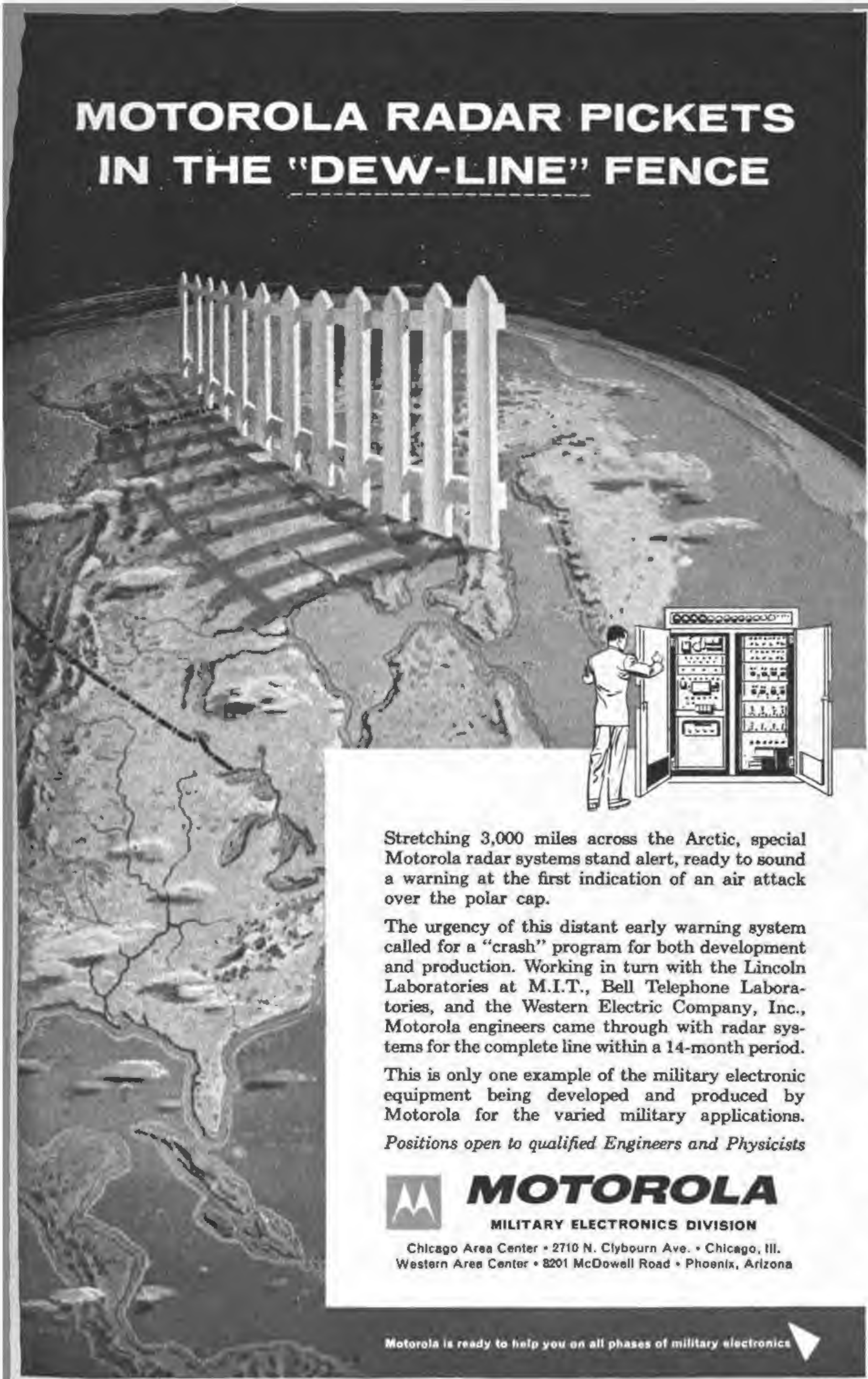
The need for a facsimile field unit equivalent to the walkie-talkie has long been recognized. Two or three attempts have been made to develop suitable equipment but military requirements have not as yet been met. A new project of development will soon be underway for the Marine Corps.

The transmission of reconnaissance photographs from plane to ground is a project that has received off and on attention since the Signal Corps' transmissions in 1930. Reconnaissance photographs contain small detail which require very fine scanning, approximately 500 lines per inch definition. Transmission over a voice frequency channel of a 7 by 9 inch aerial photograph would require more than an hour and a half. To make the transmission in five minutes a band width of 30,000 cycles is needed. The problem of providing such radio channels from plane to ground base station and channels for repeating from the base station to headquarters limits the scope of this application of facsimile.

Hospital services will soon benefit by facsimile. A system has been developed at the suggestion and under the guidance of Commander J. Gershon-Cohen, Medical Corps, U. S. Naval Reserve, as a result of his military experience during World War II.

(*Continued on page 44*)

# MOTOROLA RADAR PICKETS IN THE "DEW-LINE" FENCE



Stretching 3,000 miles across the Arctic, special Motorola radar systems stand alert, ready to sound a warning at the first indication of an air attack over the polar cap.

The urgency of this distant early warning system called for a "crash" program for both development and production. Working in turn with the Lincoln Laboratories at M.I.T., Bell Telephone Laboratories, and the Western Electric Company, Inc., Motorola engineers came through with radar systems for the complete line within a 14-month period.

This is only one example of the military electronic equipment being developed and produced by Motorola for the varied military applications.

*Positions open to qualified Engineers and Physicists*

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**Motorola is ready to help you on all phases of military electronics**

Many test transmissions have been made to Bethesda Naval Hospital, Wright-Patterson Air Force Base and Rome Air Force Base from several field stations at distances of 60 to 600 miles. The results show that by means of facsimile the small dispensary unit can enjoy the same expert interpretation of the X-ray films as the largest and best staffed hospitals. Plans are now underway for operational tests on a more extensive scale.

The Strategic Air Command is experimenting with a communications system using various commercial types of equipment so as to become acquainted with facsimile operations with a minimum of delay.

When new and improved equipment designed especially for message communications becomes generally available to the military, the facsimile traffic load will unquestionably increase, partly because facsimile is considered to be error-free in operation. While there may be some exceptions under certain conditions, facsimile does have a very substantial advantage over other methods in this respect.

Facsimile is also desirable in military work because only a few minutes are required for operator training. Some of the recently designed equipment requires only the dropping of a message in a slot and pushing a button.

Communicators do not even want to be bothered with pushbutton warfare, nor do they want to be handicapped with the element of time in transmitting their communications. The need for operating manpower and maintenance is looked upon with fear and disdain.

To meet this challenge of the communicators, the facsimile manufacturers and the operators of the communication channels are working overtime. Today's equipment is good. We want you to make the maximum use of it so we will learn the needs of tomorrow's machines.

## *Speed Of Transmission*

Let us now consider the problem of speed. We all think of television as an instantaneous operation—so why can't we have a facsimile system which is also instantaneous. One such system was developed at considerable expense to a commercial company. Its capacity was demonstrated by transmitting the one thousand page novel, "Gone with the Wind" in the amazing time of two minutes and twenty-one seconds. The equipment could transmit a half million words per minute over a standard video circuit.

Last year *The New York Times* wanted to deliver to the delegates of the Republican Convention in San Francisco, papers containing the news in the final edition which is closed in the composing room at 2:45 am, Eastern Standard Time. Without the use of jet planes, deliveries of papers printed in New York could not be made to the hotels in San Francisco by 7 am Pacific Time. So, a special set of facsimile equipment was built to transmit at the rate of one newspaper page in two minutes.

Received copy was on film from which engravings, matrices and stereotype plates were made for printing on a rotary press. The success of this operation has encouraged many military communicators to look toward high speed facsimile for future requirements.

The facsimile equipment can be designed to operate at most any speed but each type of communications channel has definite limitations. Over a good voice frequency channel normally used in telephone conversations, one can transmit 2500 pulses or elemental areas per second. This corresponds to 15 square inches per minute when scanning at the rate of 100 lines per inch. Such a rate is fine enough for average copy. In transmitting *The Times* to San Francisco, a scanning rate of 200 per inch was used in order to reproduce the small print in the financial columns.

This is an important point to remember in facsimile. A system designed to transmit small type will be spinning its wheels when scanning large type. And, it will draw a blank when scanning blank areas.

The first approach toward the transmission of the maximum amount of information in a given time is, therefore, optimum use of the message blank. The next is the transmission of more elemental areas per second. The fastest circuits commercially available are television channels. They are capable of transmitting nearly eight million elemental areas per second as against 2500 over a voice frequency channel. In other words, the TV channel can transmit approximately 3000 times the information of a voice channel. The channel cost is approximately twenty-five times as great. If we are permitted to dream, we might say that in speeding up by a factor of 3000 there is a cost savings of over 100 to 1.

This is blue sky thinking of course, but there are a lot of blue sky planners around Washington and they might as well have this idea to work on.

At the present time no one is known to have enough traffic to load up a TV circuit and there are relatively few points where TV terminals are available. There is, however, encouragement for the communications planner who wants a serviceable high speed facsimile system in the reasonably near future.

In many carrier telephone systems a 48kc band is divided up to provide twelve telephone channels. The 48kc circuit is referred to as a group circuit. Facsimile tests have been made within the past few weeks over these circuits and they were found to have a capacity of 200 square inches per minute with 100 line scanning definition. This is equivalent to 2500 words per minute of elite typewriter type.

Group circuit connections can be provided to most any point requiring service. If the group circuits are used to any great extent for facsimile, one of the distortion factors can be eliminated with additional equipment and the capacity increased approximately 100 per cent.

As facsimile develops in importance, more and more attention will be paid to the design of wireline communications facilities for the proper transmission of facsimile signals. Fortunately, the special considerations that facsimile requires are also needed for the transmission of data processing signals [illegible] there is good justification for the [illegible] of improving the circuits.

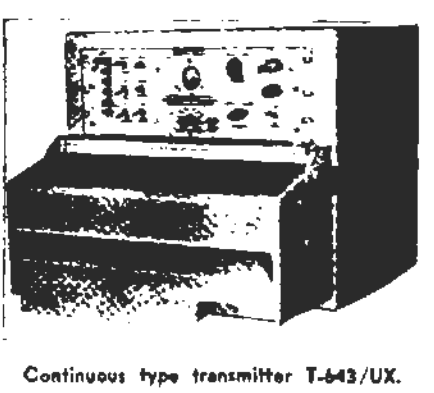
## *Equipment*

Facsimile equipment designed and built during World War II requires a certain amount of manual operation. In the interests of operating convenience a continuous type of recorder has been developed for meteorological services. First deliveries of this recorder in its military form, AN/UXH [illegible] will be made within the next year. The commercial version is now [illegible] production after nearly fifteen years of engineering and development [illegible]

Continuous type weather map recorder AN/UXH-2.

The UXH recorder feeds out a continuous web or strip eighteen inches wide and at the rate of twelve, eighteen or twenty-four square inches per minute. It is designed to operate over voice frequency circuits. At the lower speed the circuit requirements are lenient; at the higher speed the circuits must meet the highest standards in the 600 to 2600 cycle range.

A continuous type of transmitter to cooperate with this recorder has just been delivered to the Bureau of Ships. It is designated as the T-643/UX.



Continuous type transmitter T-643/UX.

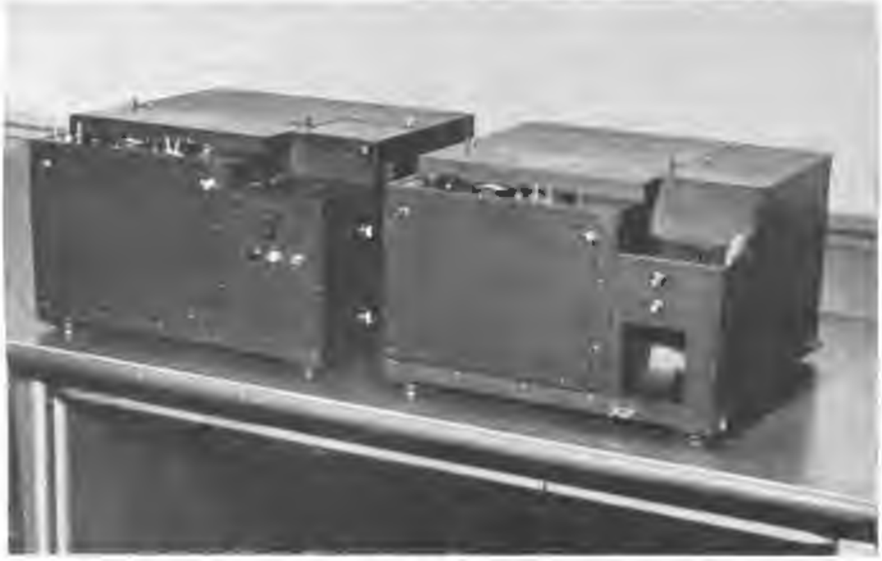
# THE FLIGHT HEARD 'ROUND THE WORLD

Recently three B-52 bombers flew around the world in 45 hours and 19 minutes. They were only specks in the vastness of the sky, yet they were in voice-contact every mile of the way—with SAC headquarters in Omaha, with each other, with bases along the route and with the KC-97 tankers that refueled them in the air.

Their speed-of-light contact was the AN/ARC-21 liaison communications set in each of the ships. This is a long-range, pressurized, high-altitude airborne system, capable of world-wide communications. It may be operated by the pilot, so no radio operator is needed. It is characterized by minimum training requirements, simplified maintenance, high reliability, positive channel selection—with a choice of any 20 of 44,000 frequencies.

In this as in other ways, RCA serves our Nation's armed forces. RCA scientists and engineers are constantly creating, designing and producing new and better electronic systems and equipment.

**RADIO CORPORATION of AMERICA**
*DEFENSE ELECTRONIC PRODUCTS* — *CAMDEN, N. J.*
Tmk(s) ®



Flat bed type set AN/GXC-4 for operation with polaroid film.

New equipment, AN/GXC-4, built for the Air Force to transmit radarscope pictures in the flat scanner type, will transmit from a polaroid picture and record on a polaroid film with a scanning definition of 200 lines per inch. Although the basic design is very old, the U. S. Army Signal Engineering Laboratories built the first experimental machine that worked successfully in scanning wide copy.

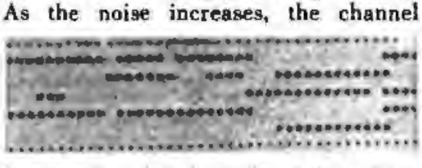
### *Computer Techniques*

Computer techniques were used in the transmission of radio photos by one of Korn's systems across the Atlantic in 1922, and cable photos by the Bartlane system in the period around 1925. The 5 pulse digital code was employed. Before abandoning the cable photo system, plans were developed to speed it up by making fast jumps along scanning lines of uniform density.

Considerable excitement has again been aroused over the possibilities of computer techniques. The leaders in information theory are confident that a method can be devised to reduce the channel band width by a factor of 100.

It is believed that plans for doing this are close to completion. But, there are certain drawbacks to this approach. Any savings in wireline costs may be offset by equipment complexity.

One of the basic information theories is that error-free transmission is possible up to the channel capacity, provided that the proper coding is used. As the noise increases, the channel capacity decreases. By varying the size of the transmitted characters, facsimile can adjust itself to the channel capacity as noise changes.



Portion of coded facsimile picture, Korn, 1920.

The facsimile system is in itself a simple analog computer. The read-out delivered when transmission is made under bad conditions may look like pretty sorry copy, but at this point it is passed on to a second computer which for this type of work is far superior to the IBM 706, Univac, Bizmac and the Maniac combined. This superior computer, which is so effective when interpreting communications presented in the form of facsimile recordings, is the human eye and brain.

I am going to illustrate to you a picture of a facsimile recording made under simulated noisy radio receiving conditions. Noise full of spikes was superimposed upon the facsimile signal. From the loudspeakers you will hear the signal as it appeared at the input terminals of the facsimile recorder. No filtering was involved. See photos at lower left corner.

### *Questions And Answers*

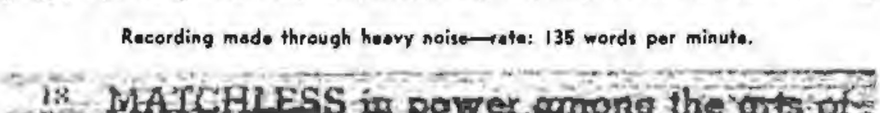
I know that many of you have questions outside the limited scope of this paper.

We often hear the question: Why is it that facsimile has progressed so slowly while other arts such as television have moved so rapidly?

The development of facsimile has moved cautiously, partly because of the fear that an improvement in recording papers will require entirely new mechanisms. Another problem is that of the "chicken and egg" type. Before a low cost mass production design can be developed, many years of operating experience are required. Few are willing to invest in facsimile until such designs are ready.

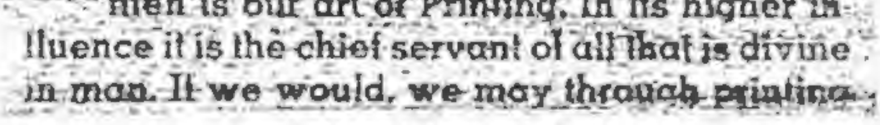
What is the military doing to support the development of facsimile?

Probably five million dollars has been spent by the military in the development of facsimile since 1945. However, progress has been slow because of the time required in preparing specifications, procurement of funds and the letting of contracts. In line with the statements made by Admiral Bennett yesterday, I would like to say that fast progress can be made when military funds are available for the procurement and development of equipment based on best commercial practices. An example of how such a system did operate is found in a Bureau of Ships contract where the contractor was required to furnish equipment built in accordance with good commercial design and performance equal to or better than certain JAN approved equipment. In a very short time the equipment was developed at no expense to the Bureau of Ships except for a nominal rental cost. The contractor maintained the equipment and was therefore, cognizant of design deficiencies even before the customer knew it and was able to make corrections on a day to day basis without going through the long harangue of obtaining approval for changes through channels.



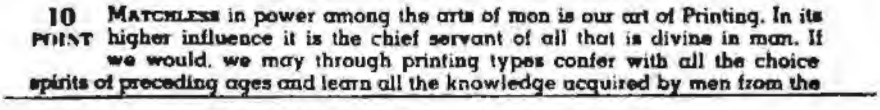
12 MATCHLESS in power among the [illegible] art of
POINT Printing. In its higher influence it is the chief servant of
all that is divine in man. If we would, we may through printing
types confer with all the choice spirits of preceding ages and

Recording made through heavy noise—rate: 135 words per minute.



18 POINT MATCHLESS in power among the arts of
men is our art of Printing. In its higher in-
fluence it is the chief servant of all that is divine
in man. If we would, we may through printing

Same conditions as above, but at 75 w.p.m.



10 POINT MATCHLESS in power among the arts of man is our art of Printing. In its
higher influence it is the chief servant of all that is divine in man. If
we would, we may through printing types confer with all the choice
spirits of preceding ages and learn all the knowledge acquired by men from the

Recording at 135 w.p.m. with no noise present.

# Single Sideband Receivers

**by H. F. Comfort, Radio Corporation of America**

THE GROWTH OF RADIO COMMUNICATION by use of single-sideband techniques may be said to have been "slow but sure" over the past twenty-five years. As early as 1922, R. V. L. Hartley discussed the "Relations of Carrier and Sidebands in Radio Transmission." But the separation of the sidebands from the carrier wave and from each other and their separate use for radio communication seems not to have been seriously undertaken until a decade or so later. In 1933, A. H. Reaves reported on "The Single-Sideband System applied to Short Wave Telephone Links." Two years later in the Proceedings of the Institute of Radio Engineers, Polkinghorn and Schlaack described "A Single-Sideband Short Wave System for Transatlantic Telephony." The study of single-sideband techniques became quite widespread in the ensuing years.

Widespread adoption of single-sideband communication systems was retarded for some years by the size and complexity of the equipment and the requirement of extreme frequency stability. However, at present, techniques are available for securing adequate frequency stability. At the same time electromechanical filters, new phasing systems, transistors, and modular assemblies are reducing the size and complexity of the circuits and equipment. Currently, then, the retarding factors have been largely removed.

Single-sideband communication systems began to be adopted first because of the need for radio spectrum conservation resulting from the rapid growth of radio communications for both commercial, military, and amateur use. It was recognized that the bandwidth of radio frequencies required for communication by a single-sideband system was only half as great as for the conventional double sideband transmissions. In the second place, studies of the fading of amplitude modulated radio signals over long distances were beginning to reveal that the fading was frequency selective. The carrier was found to fade intermittently with respect to one or the other of the sidebands and the sidebands to fade with respect to each other. On radiated radio waves modulated to 100% by audio frequency signals, the selective fading of the carrier with respect to the sidebands produced over-modulation. The result—which was perhaps noted before the cause was fully understood—was that large distortion was noted in the audio signals recovered from the transmitted wave by demodulation at the receiver.

Distortion of the phase relationships of carrier and sidebands due to multipath transmission is fully as serious and perhaps more so than the direct relative amplitude changes above mentioned. Both of these troubles are avoided by use of single-sideband communication except for a possible slight amount of selective fading within the one sideband itself.

The advantages of single-sideband communication in narrower bandwidth and relative freedom from selective fading still exist today, of course. Others are now also recognized. A third advantage is that an interfering signal near the desired frequency is less troublesome than with conventional AM transmission since, with a suppressed carrier SSB transmission, no carrier is present at the receiver to heterodyne with the interfering signal. A fourth advantage is the decrease in power needed from primary sources at the transmitter for a given radiated power, as compared with a conventional AM transmitter. This power gain has been indicated by various writers to be in the order of 12 to 15 db, depending upon the transmission conditions.

The purpose of this paper is to describe a high frequency communications receiver which has been designed primarily for single-sideband reception. In order to make the receiver compatible with current communication systems, the necessary circuitry has been included to permit the detection of DSB amplitude modulated signals.

Such a receiver must have a system of frequency generation, stabilization, and control, of such accuracy that it is unnecessary to transmit any carrier at all for demodulation or synchronization purposes.

### *Frequency Standard*

The concept involved is to use separate master frequency standards at both transmitting and receiving stations of such accuracy that frequencies equal to those at the transmitter, within the required tolerance for distortionless demodulation, can be generated locally at the receiver without the necessity of synchronizing signals from the transmitter. The frequency standard at each of the transmitting and receiving stations is a 1 megacycle highly stabilized crystal oscillator kept in an oven of accurately controlled temperature. Each is accompanied by the necessary number of frequency dividers, multipliers, and pulse shapers to produce both the required standard r.f. and pulsed output signals. The latter are the precisely spaced pulses of 100 kc and 0.5 kc repetition rates used to control or "lock" the frequencies of the oscillators of the Pulse Locked Generator. The former are the 3 mc and 350 kc standard injection frequencies for the second and third receiver mixers, respectively, and the 250 kc local carrier which is fed to the single-sideband demodulators.

A block diagram of the Frequency Standard developed by RCA is shown in Figure 1.

The basic unit of this frequency standard is the one megacycle crystal controlled oscillator which uses a Colpitts type circuit. Its quartz crystal is supported on a shock and vibration-free mounting within an evacuated glass envelope equipped with standard octal base connecting pins. Firmly clamped in its socket and mounted in an oven of accurately controlled temperature, this crystal controls the frequency of the oscillating circuit, the pulse locked generator, and the whole receiving system to well within one part in ten million under all conditions of shock and vibration.

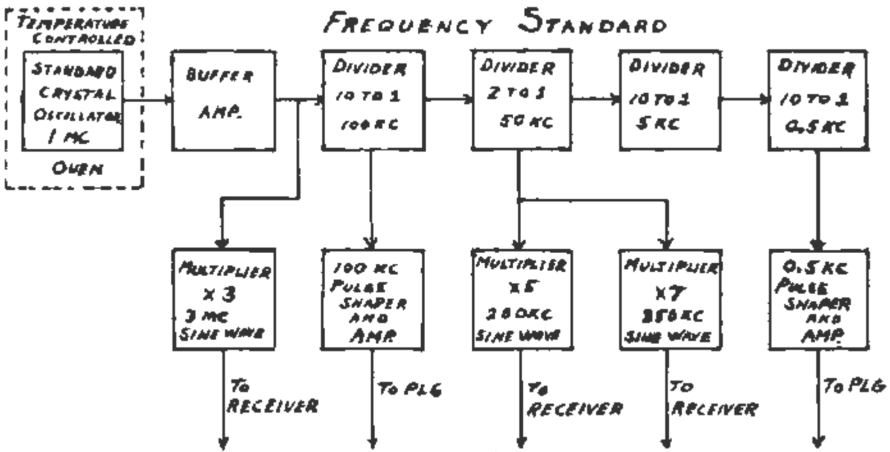


FIG. 1

The one megacycle output voltage of the temperature controlled, crystal oscillator type frequency standard is passed through a buffer amplifier to both a multiplying circuit and a dividing circuit. In the former, multiplication by 3 gives a standard referenced 3 megacycle voltage which is fed to one of the mixers in the receiver to be described herein. In the latter the standard frequency is accurately divided by 10, resulting in a 100 kc standard referenced frequency. This, in turn, is fed to a 100 kc pulse shaper and amplifier. Sharp pulses from the latter are fed to a pulse locked generator used with the receiver.

The output of the first 10 to 1 divider circuit is also fed to a 2 to 1 divider circuit and thence both to a 7 to 1 multiplier circuit and a 5 to 1 multiplier which, respectively, yield sinusoidal voltages of 350 kc and 250 kc. These are fed to the receiver for conversion and demodulation purposes respectively. In a separate circuit the 2 to 1 divider output experiences a further division by 100 in two divider circuits of 10 to 1 ratio each. The resulting 500 cycle signal, still accurately referenced to the 1 mc frequency standard is passed through a pulse shaping circuit and thence to the previously mentioned pulse locked frequency generator. It is now a train of pulses with a repetition rate of exactly 500 pulses per second.

### *Pulse Locked Generator*

A pulse locked generator, as the name implies, is a generator of frequencies which are phase locked, or held accurately to their required values by comparison with the time spacing of pulses derived from and controlled by a frequency standard.

The pulses with 100 kc and 500 cycle repetition rates mentioned earlier are those used for phase and frequency locking of the pulse locked generator now to be described.

Figure 2 illustrates the pulse locked generator or PLG by means of a block diagram.

The RCA pulse locked generator contains three oscillators. Two of these are locked, or phase and frequency stabilized, by phase comparison of their output signals respectively with the 100 kc and 500 cycle pulses obtain[illegible] rectly from the Frequency S[illegible] already described. Each of th[illegible] conventional L-C oscillator. Th[illegible] quency of the former varies from [illegible] 27.8 megacycles whereas the [illegible] the latter is only from 300 to 2[illegible] cycles.

The output of each oscillator [illegible] to a phase detector. The 100 kc [illegible] and the 500 cycle pulses from [illegible] quency standard also are fed [illegible] respective phase detectors. Now, [illegible] phase of either oscillator out[illegible] different at the time of arrival of [illegible] pulse than it was when an earli[illegible] arrived, the associated phase [illegible] develops an output error voltage [illegible] is of such polarity that, when [illegible] to a reactance tube or voltage-[illegible] capacitive diode attached to the [illegible] latory circuit, transient changes [illegible] quency and phase of the oscil[illegible] voltage are initiated which restore [illegible] to their proper values.

The function of the third or [illegible] oscillator of the pulse-locked [illegible] is to produce a voltage of [illegible] quency that, when mixed with the [illegible] sired incoming signal in the [illegible] three frequency bands of the receiver. a 2400 kilocycle intermediate frequency mixer output signal results. For the 2 lower bands an intermediate frequency of 600 kc is to be produced.

For the reception of radio signals anywhere within the high frequency communication band of from 2 to 30 megacycles, the master oscillator is to be frequency controlled by the pulse locked oscillators over a range different from the above by the appropriate intermediate frequencies. The controlled range in the pertinent equipment is from 2.6 to 27.6 mc in 500 cycle steps. The master oscillator output is fed to a mixer for mixing with that of the 2.9 to 27.8 mc oscillator locked exactly to the multiple of 100 kc nearest that of the chosen frequency by the 100 kc pulses. The mixer output is compared in a phase detector with the outnut of the 300 to 200 kc pulse locked oscillator. Should the output of the master oscillator be not exactly on the required frequency to correctly receive the desired signal, an error outout voltage will be developed in the pertinent phase detector. This voltage applied to a reactance tube or voltage sensitive capacitive diode causes the frequency error of the master oscillator to be eliminated. In each of the three frequency control loops of the pulse locked generator, the dc error voltage is passed through a low pass filter to eliminate any spurious signal or hum voltages from modulating it and possibly causing hunting, etc., of the controlled oscillator frequency.

This frequency control system has been tested under all standard prescribed conditions of shock and vibration. In no case have the frequency deviations of the system exceeded the prescribed goal of one part in ten million, or 3 cycles at 30 megacycles.

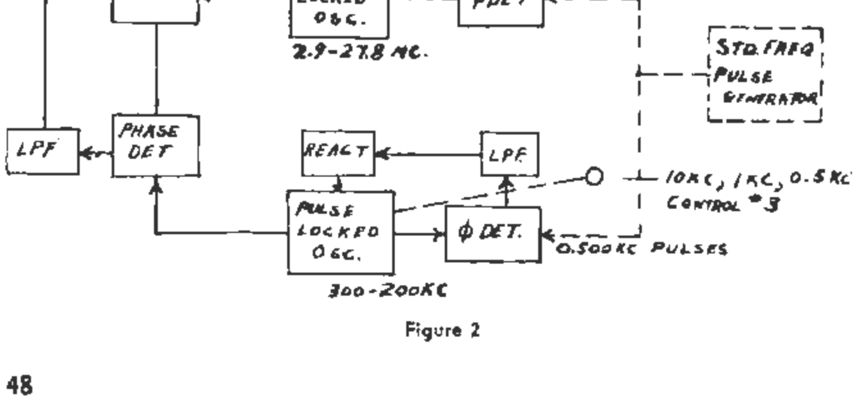


Figure 2

Here, in Admiral's Nucleonics Laboratory, radiation tests are conducted with a cobalt 60 source rated at 20,000 curies. The observer is shielded by 41 inch walls of magnetite ore within steel shells, and a 42 inch lead glass window.

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Figure 3

Figure No. 3 is a photograph of the Pulse Locked Generator.

The set-up procedure is very simple. The desired frequency is set up on the dials, and this gives us the selected frequency. But, in order to obtain the maximum assurance that the frequency will remain correct under the various environmental conditions, a tuning meter is provided to permit setting of the oscillators to the center of their pull-in range.

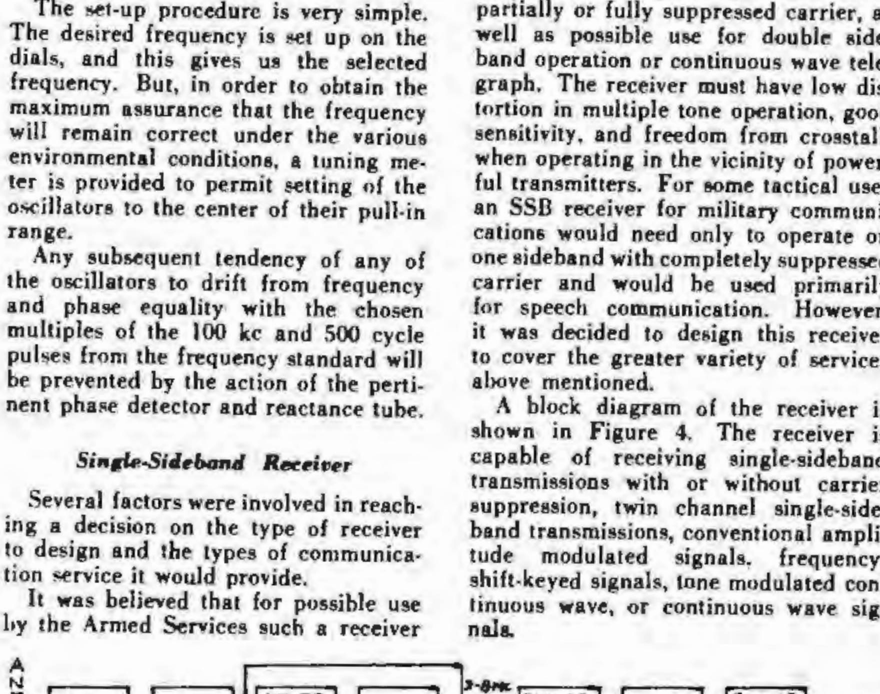
Any subsequent tendency of any of the oscillators to drift from frequency and phase equality with the chosen multiples of the 100 kc and 500 cycle pulses from the frequency standard will be prevented by the action of the pertinent phase detector and reactance tube.

### *Single-Sideband Receiver*

Several factors were involved in reaching a decision on the type of receiver to design and the types of communication service it would provide.

It was believed that for possible use by the Armed Services such a receiver should be capable of single-sideband or twin-sideband operation with either partially or fully suppressed carrier, as well as possible use for double sideband operation or continuous wave telegraph. The receiver must have low distortion in multiple tone operation, good sensitivity, and freedom from crosstalk when operating in the vicinity of powerful transmitters. For some tactical uses an SSB receiver for military communications would need only to operate on one sideband with completely suppressed carrier and would be used primarily for speech communication. However, it was decided to design this receiver to cover the greater variety of services above mentioned.

A block diagram of the receiver is shown in Figure 4. The receiver is capable of receiving single-sideband transmissions with or without carrier suppression, twin channel single-sideband transmissions, conventional amplitude modulated signals, frequency-shift-keyed signals, tone modulated continuous wave, or continuous wave signals.



The radio frequency amplifier has two tuned circuits ahead of the first tube followed by two tuned stages using pentode tubes. As is shown in the upper left corner of the block diagram the amplified r-f signal proceeds from the r-f amplifier to the first mixer stage. Here the correct frequency is injected from the pulse locked generator. The dials of the pulse locked generator are so calibrated, however, that they read the exact value of the frequency of the desired incoming signal instead of the difference between it and the intermediate frequency to be produced in the mixer. In the r-f section of the receiver, any one of five sets of r-f coils may be chosen by the bandswitch on the panel thus dividing into five bands the h.f. range of 2 to 30 megacycles.

An incoming signal in the range of the first and second bands has its frequency changed in the first mixer to a 600 kc intermediate frequency and passes directly to the 600 kc or 2nd IF amplifier. Signals in the range of the remaining three bands emerge from the first mixer at 2400 kc, pass through the 2400 kc or 1st IF amplifier and thence to a second mixer into which an exact 3 megacycle signal from the frequency standard is also injected. The result of mixing these 2 signals is a 600 kc intermediate frequency. After amplification in the 2nd IF amplifier, the signal proceeds to the 3rd mixer in which both the signal and an exact 350 kc voltage from the standard frequency generator are mixed. In case of receiving an incoming r-f signal whose frequency is not an exact multiple of 500 cycles, the VFO switch is thrown to ON. This allows injection of an oscillatory voltage centered at 350 kc at slightly reduced accuracy, but adjustable to any frequency within about 250 cycles of 350 kc, and on either side of it.

The 250 kc output of the 3rd mixer is amplified in an amplifier whose bandwidth is 6 kc. A 70 ohm output from this amplifier is available at the rear of the receiver for special uses in which a 6 kc bandwidth is required. The signal at 250 kc is also fed to four circuit branches. The first of these is an ordinary diode circuit which accomplishes detection in case the received signal is one using double sideband amplitude modulation. The other three branches are, respectively, amplifiers and following equipment for lower sideband, upper sideband, and carrier signals. The upper and lower sideband branches each consist of their respective sideband amplifiers and filters, demodulators, and audio amplifiers. Both of these branches terminate at their respective phone jacks, both on the front panel for headphone connection and at the rear of the receiver for connection to the proper terminal equipment.

Single or double sideband reception may be selected by the front panel function switch. With the function switch in the SSB position, either sideband can be used for voice; or voice can be used, for example, in the upper sideband channel while multiple tone operation with as many as sixteen frequency-shift-keyed (FSK) channels is occurring in the lower sideband channel. Continuous wave signals can also be processed in the lower sideband branch. When the latter type of operation *is chosen* by the CW switch on the panel, a narrow band-pass filter centered at 1000 cycles is automatically switched into the lower sideband audio amplifier in place of the low pass filter normally in use there for the recovery of speech signals.

The carrier amplifier is used primarily to supply a carrier source of voltage for automatic gain control when a partially suppressed carrier is transmitted. Various degrees of carrier suppression can be compensated for by use of the front panel carrier control which is used to adjust the gain of the carrier amplifier. A very sharp filter of about 200 cycle bandwidth contained in the latter amplifier removes all sidebands from the carrier as well as practically all noise components. The amplifier output is thus a noise and modulation free carrier for use as a source of AGC voltage when needed.

The completed radio communications receiver, for the control of which the frequency standard and pulse-locked generator were designed, is illustrated in the photograph of Figure 5. The front panel layout is as follows: The two function switches are shown in upper central part of the panel allowing reception of either single-sideband, double-sideband or continuons wave signals. The bandswitch is to be seen at the center left and the r.f. tuning control and frequency dial on the upper left portion of the panel. At the lower left is the r.f. gain or volume control. Next toward the center, near the bottom of the panel, is the adjustment for the automatic gain control threshold. The toggle switch below the latter selects a fast or slow AGC time constant as desired. The carrier level control is at a lower central position. This is used, only when carrier operated AGC is desired, to raise the level of carrier until it is the strongest of several input voltages to the master AGC control and therefore governs the operation of the latter.

Two headphone jacks for the reception either of upper sideband transmissions or for either lower sideband or conventional AM are at the bottom of the panel to the right of center. Above them are access holes for screw-driver adjustment of gain of either of the two audio amplifiers of the receiver. At the extreme right of the panel are the VFO On-Off switch, tuning control, and frequency dial, mounted in that order from bottom to top of the panel. The tuning meter to the left of the VFO tuning knob indicates when a given radio transmission is correctly tuned by the VFO.

### *Receiver Characteristics*

Measurements made on the receiver have indicated its characteristics as follows:

1. *Sensitivity:* The conventional AM sensitivity with 70 ohm antenna input and a 1000 cycle tone for modulating a 2 megacycle transmitted carrier was 1.5 microvolts input for a 10 db signal to noise output. Over the 2 to 30 mc frequency range the SSB sensitivity was from 0.3 to 1.0 microvolts for a 10 db signal-to-noise ratio using a 1000 cycle tone for modulation but with no carrier transmitted.

2. *Selectivity:* The upper sideband selectivity is due to the upper sideband filter, whose pass band extends roughly from 247 to 249.6 kc.

The lower sideband filter, likewise, extends roughly from 250.4 to 253 kc. Both filters are of the electromechanical type.

Measured between frequencies where the signal response is down 6 db from the maximum of the pass band, the bandwidth of these sideband filters is 3.2 kc.

Figure 5

The adjacent channel selectivity of the sideband filters is such that tones between 400 cycles and 3000 cycles are attenuated at least 55 db in the other channel.

3. *Distortion:* Requirements for distortion limits in the receiver are approximately 1% for teletype and 5% for voice. Two tone intermodulation distortion measurements were made using tone inputs of 1000 and 1400 cycles to the sideband amplifiers. All distortion products were found to be less than 1%, indicating greater than 40 db attenuation below signal level.

4. *Variable Frequency Oscillator (VFO) Stability:* Measurement made on VFO frequency stability indicates that about 40 minutes is required to reach a stabilized condition after the power source is connected. After this period the frequency is constant within ± 5 cycles.

A few general observations concerning the receiver may be in order:

1. The mechanical design of the equipment uses the subassembly type of construction with modular construction for the tubes and associated components. The layout can very easily be adapted to printed wiring which would appear to be desirable in the future model design.

2. In this version of the receiver miniature tubes were used in nearly all stages of the receiver. In other versions it would be possible and desirable to use transistors in much of the circuitry. Germanium diodes are used in the present model in the ring demodulators in order to obtain low distortion output in multiple tone operation.

3. Distortion in the audio amplifiers is minimized by the use of negative feedback obtained by omitting bypass condensers for the cathode resistors.

4. Temperature control and voltage regulation of the plate and screen supply voltages are both used to obtain the desired stability in the operation of the variable frequency oscillator (VFO) when used.

The Frequency Standard and the Pulse Locked Generator may be supplied as an integral part of the receiver, or as separate units that may be used for purposes other than operating the receiver. For example, they may be used to control the frequency of a single-sideband transmitter, as a highly accurate signal generator, or for any other application where a highly accurate source of frequencies is required.

The design of this receiver is the result of the joint efforts of the Surface Communications Department of the Defense Manufacturing Division of the Company and the communication scientists of the David Sarnoff Research Center.

* * *

*Acknowledgement is made by the author to Mr. I. I. Grasheim and Mr. P. K. Taylor, both of RCA, for their assistance.*

# A Fully Automatic Teletypewriter Distribution System

### *by Richard C. Stiles and Leith Johnston, Automatic Electric Co.*

THIS PAPER DESCRIBES AN AUTOMATIC teletypewriter distribution system designed and built to meet the requirements of an agency of the government. The system receives teletypewriter messages from many geographically remote points and distributes each message to a number of local and remote stations in the offices of the agency.

Before proceeding with a description of the system, it seems advisable to reflect for a few minutes on the type of communications involved. This system is basically a military teletypewriter system, and as such it operates in a communications network which is subject to many rigorous specifications from both technical and operational standpoints. Automatic Electric Company has previously produced fully automatic teletypewriter switching systems which are at the present time operating in the Signal Corps Army Command and Administrative Network. The first of these was an experimental system installed at Headquarters, Fifth Army in Chicago in 1952, and the next installed in 1956,- was a full scale switching center of a production type now in operation at Headquarters, Sixth Army at Davis, California. These systems are successfully switching many thousands of messages daily. Since this system is similar in some respects to these earlier systems, and since it too must operate in military networks, it seems advisable to consider some of its characteristics.

In the military organizations a person who desires to originate a message assigns a definite degree of precedence to the message. This precedence indicator, one of six precedence classifications, remains with the message throughout its handling. Communication personnel attach address or routing indicators, a specified start of message indicator which consists of the character sequence ZCZC, and a specified end of message indicator, and then transmit the message over a teletypewriter channel to the nearest relay point. At the relay point the message is reproduced on paper tape and may or may not be held temporarily, depending upon the availability of circuits toward its destination and the relative degree of precedence of the message. In this way a message may proceed toward its destination through as many relay centers as are required and as transmission facilities are available. The handling of messages at some relay centers is manual, in that operators are required to read the address and precedence indicators and insert the message tape in a suitable transmitter at the proper time. The automatic switching centers, mentioned earlier, accomplish this temporary storage and routing automatically.

It is apparent, then, that in order to insure a high degree of reliability, automatic switching centers for use in military networks must be built to exact specifications. Some of the most important of these are:

(1) They must be capable of switching messages swiftly and accurately.

(2) They must be compatible with all existing networks to the extent that they can be located at any point in a network without the introduction of a similar or special equipment elsewhere in the network.

(3) They must possess a high degree of reliability, since the loss of even a single message in military networks cannot be tolerated. This, of course, is made possible only by an elaborate system of alarms.

(4) They must handle messages in accordance with all six degrees of military precedence, with the provision for interrupting messages of a low precedence for the transmission of one which is extremely urgent.

(5) They must be capable of automatic routing of multiple address messages.

In addition to all of these general features, they must be engineered for ease of operation and supervision by semi-skilled personnel located in various parts of the world.

The type of system discussed in this paper is similar to these military switching centers. It uses similar equipment, receives messages of the same general type, and receives many messages directly from the military networks mentioned earlier. Beyond these few basic similarities, however, there is a radically different concept of operation involved in this system. Here the concept is one of distribution to a number of receiving stations rather than of relaying messages by receiving and retransmitting.

The agency which will be using this system has a requirement for the collection and control of reports of data and statistical analysis. When received, these reports are normally routed to several different offices depending on the subject matter of the report. As an example we can consider the following situation. An office in Chicago may have several reports to transmit to the control agency. One may concern the total dollar volume of business handled the preceding day. We may say that a report of this kind must be routed to five different offices in the agency headquarters, although this fact may be unknown to the originator of the report in Chicago. Another report from this office might concern a breakdown of the day's business into dollar volume quantities of several individual products. A report of this nature might be routed to fourteen different offices, some of which may have been included in the distribution pattern for the report on the overall dollar volume. In all cases the originator of the report need not know the type of distribution involved. It is readily apparent that if such a system is used the patterns of distribution can be changed at will by the home office without informing the field.

In order to understand the operation of the system, we must consider the type of network and the general characteristics of the message to be handled. In the network under consideration, the control agency is at the hub of the network with all circuits leading in toward the agency. In those cases where relay centers are used they may be operated by one of the three military services and may contain automatic switching equipment of the type previously referred to.

In a typical message handled by this system, the address contains a two letter precedence indicator and a three letter group which identifies the subject matter of the message, as shown:

```
ZKZK RR ABC DE XYZ 005A
  051643Z            (2CR)(LF)
T E X T              (2CR)(8LF)
NNNN
```

Note also that there is a sequence of characters which identifies the end of the message. The three letter group which identifies the subject matter is called a Delivery Distribution Indicator, abbreviated DDI. The message originator knows only that the DDI consisting of the letters ABC, will identify a message concerning the day's total dollar volume.

This is the basic message format required for distribution of the reports. It is quite another matter to address the message so that it will arrive at the control agency for distribution.

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Below is shown the same message with a special prefix attached to the message which will permit this routing.

```
ZCZCAAA(FIGS)101
   (LTRS)CDE254    (2CR)(LF)
RR RUEPAB          (2CR)(LF)
DE RUWPAB          (2CR)(LF)
ZKZK RR ABC DE XYZ
   005A 051643Z    (2CR)(LF)
T E X T            (2CR)(8LF)
NNNN
```

In the above example, the ZCZC is the start of message indicator recognized in the service networks. The automatic equipment in use in the network requires this symbol for proper message handling. The next sequence of three letters and three numbers identifies the channel and serial number of transmission over which the message was transmitted as it arrived at the distribution center. Please note that there is more than one set of channel number designations depending upon the number of line transmissions which were involved in the message transmission from origin to destination. Since one of these sets of channel designation and number is added for each transmission, the first set appearing after the ZCZC is the only significant one. The serial number appearing in the significant set must be verified automatically to insure continuity of message traffic.

The next line of the message contains the precedence indicator and the routing indicator. The precedence indicator has been previously explained. The six letter routing indicator represents the address of our control agency within the military network. This indicator will cause the message to find its way through the service networks for delivery to the Teletypewriter Distribution System. The next line of the message identifies the routing indicator or address of the message originator. Thus it can be seen that the first two lines are required to cause the message to be delivered to the distribution system.

Nearly all messages handled by the system must be delivered to several distribution points or offices. It is apparent that some offices will receive a higher volume of traffic than others, and thus they will be equipped with a greater number of page printers or other receiving devices. Most of the stations are located in the same area, but a small number of offices are located at remote points and will require special treatment which will be described later.

We may proceed now to a description of the system operation.

As a message arrives at one of the incoming lines over a teletypewriter channel, it is reproduced by a typing reperforator in a paper tape. The message is typed on the tape for the convenience of operators and each character is perforated in the standard five unit "Baudot" code. As the message accumulates, the tape reader automatically starts to read the tape, hunting for the letter Z. When this letter has been detected, a sequence register is activated which acts to register the reading of the sequence ZCZC. If the sequence is not perfect a fault will be indicated. You will recall that the sequence ZCZC is the start of message indicator. The receipt of this sequence conditions a second register to receive a figure shift function, which must precede the first numerical digit. When the figures shift character is received it prepares a register circuit which records the three digits of the channel number. Each digit of the channel number must be verified against a corresponding digit in a rotary switch register. The rotary switch register keeps a record of all message numbers received and advances the register once for each message received. Each digit of the channel serial number of the message being received must be verified. Failure to verify any digit results in an immediate alarm and temporary stoppage of message processing. After personal attention by an operator the message may be permitted to proceed. This process constitutes a channel number check and need be accomplished for only the first set of channel numbers on the message.

You will recall that the first three lines of the incoming message contained information required to deliver the message to the distribution system and we have used at least a portion of the first line to identify the message and to check the channel number. After the number has been checked the tape reader again scans the message tape for information. Since the distribution system is not concerned with the origin of the message, the next significant characters are those in the sequence which appear in the fourth line. This sequence identifies the start of significant distribution information, so that the ZKZK is recorded in a register. At this point the incoming line circuit causes the tape reader to stop and also requests the services of a Director. In this system connections are established by use of a Director which receives routing information, determines proper connections and withdraws from an established connection during message transmission. The Directors of this system are pooled so that a set of two Directors are assigned to work with a group of 25 incoming lines. In response to the demand for service from an incoming line circuit, an idle Director finds the calling incoming line and takes over control of the tape reader in the line equipment. Under control of the Director the tape reader continues to scan the incoming tape and the characters read by the reader feed into the Director. You will recall that the first characters appearing after the ZKZK are those of the precedence indicator. These are stored on relays in the Director for future use. The tape reader continues and the three characters of the DDI are recorded in the Director. At this point the tape reader [illegible] stopped to permit the Director equipment to process the DDI.

Processing of this delivery indicator includes as a first step a translation process. For this purpose the Director calls for the translator unit which is available to all Directors in the system. When the translator has been assigned, the DDI is transferred from the Director into the translator. Within 50 milliseconds the translator returns an indication to the Director of one station involved in this delivery indication. The translator then releases from the Director. Having obtained this station indication, the Director must find an available printer at the designated station and prepare it for use. This is accomplished by a series of tests in which the Director makes use of the terminal finder unit. When a suitable page printer has been seized it is placed under control of the incoming line circuit by action of its associated incoming selector switch and held for future use. Following this, the Director again demands the services of the translator unit and again transfers the delivery indicator into the translator. The translator in this case returns to the Director an indication of the second station involved in this indicator. In response to this, a page printer associated with the second station is seized and held in the same manner as the first printer. Following this action the Director repeats this process until all stations of the delivery indicator have been selected. As the last station of the indicator is being indicated to the Director the translator informs the Director that no further translations are required for this delivery indicator.

When the Director has selected a printer associated with the last station, the tape reader again is permitted to read the tape. A delivery indicator may contain a maximum of 10 stations. Therefore, if more than 10 are desired the message must include two or more delivery indicators similar to the first. After finishing processing of the first indicator a second may be read by the tape reader. If so, it is processed similarly to the first and additional page printers are selected and held for further use.

After completion of processing of the last delivery indicator the tape reader again continues to read the tape. The next significant characters are those of the sequence DE, which indicates to the switching equipment that no further processing is required. When this sequence has been recorded in the register of the Director, a signal is sent from the Director to the incoming line control relay circuit which then takes over control of all associated page printers. At this point the Director releases from the connection and is immediately available for service to another line. The line circuit then remains associated with the selected page printers and transmission of the mes-

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sage begins from the transmitter at the incoming line position directly to the several associated page printers. The entire message is transmitted to all stations.

Although the process just described is the basic plan of the system, there are many interesting sidelights, some of which are worthy of note here. You will recall that the page printers of this system are all located at a control agency headquarters. There are actually over 400 of these page printers and all are located within the confines of one building. As was mentioned earlier, since some of the stations require a heavy traffic volume they must be equipped with several printers. It is the job of the switching equipment to select an idle printer from the group at any one station. This is accomplished by 50 point selector switches in the terminal finder unit and by a distribution terminal control relay group in the distribution terminal unit. There is one control relay group associated with each page printer.

One might ask, "What will happen if all printers at one station are busy when a new message arrives?" The traffic of the system has been estimated accurately and sufficient printers have been planned for each station to insure that such an occurrence will be very unlikely. However, it must be realized that it could happen. Since an incoming line circuit must hold all selected printers until all required printers are available, it was deemed inadvisable to plan on holding them for any great length of time. Accordingly a feature has been added to the system which will cause such an overflow condition to result in the selection of a message storage unit into which a message for any station may be placed temporarily awaiting an available page printer at the busy station. In this way unnecessary holding of printers at other stations is eliminated. These temporary storage units are called cross office units and they are pooled together such that any one of them may be temporarily associated with any incoming line and with any station. A message which is directed into one of these cross office units will wait until a line to the desired destination is available and then will be transmitted to the station by way of the distribution terminal unit. Selection of an incoming line and a station is accomplished for the cross office units by the action of the Director in the initial action on the message. Actual control of transmission from the cross office unit, however, is by way of control circuits within the cross office control relay assembly.

The cross office pool has other uses, which we would like to elaborate on. Because the printers are located within the same building with the distribution system equipment, the transmission facilities to these points can be rigidly controlled and will be very reliable. For this reason it is deemed unnecessary to report to numbering messages from the distribution equipment to the local station. However, there are a few stations which are not located in the same building, and thus transmission to these stations must be handled by either commercial or military land line or radio circuits. Since these transmission facilities cannot be controlled by the agency it was considered necessary to number messages to these points. A message to one of these points will be directed to temporary storage in a cross office unit. The unit will have its outgoing selector switch positioned to the desired line by the Director. Those terminals on the banks of the outgoing selector switches which are assigned tn those remote points will be connected to line monitor equipment. This equipment consists of a monitor reperforator, a transmitter, automatic numbering equipment, and the necessary relay control circuits. The monitor records on perforated tape all transmissions to the particular line, and this record can be used to re-run specified messages. The numbering equipment automatically supplies a serial number to each outgoing message. These numbers can be manually verified at the remote point to insure sequential continuity. The numbers, channel designation, and other pertinent information are transmitted to the line by the transmitter which can be controlled by the number registers and the associated circuitry. In operation, when a cross office unit has a message ready for transmission to a remote point it demands control of the outgoing line. If the line is idle it may be assigned to the particular cross office unit for control. After seizure the transmitter in the line circuit sends out the channel designation and serial number. Following this the body of the message is transmitted to the line directly from the transmitter in the cross office unit. While a message is being transmitted to this line, other messages may accumulate for this line in various cross office units. When the line becomes idle all waiting cross office units demand the line and only the one carrying the highest degree of precedence will gain control of the line.

Another very important use for the cross office pool is its facility for handling high precedence messages in an overflow condition. As was mentioned earlier, if a message requires a printer at a station which has all of its printers busy, a cross office unit may be seized to store the copy of the message which is destined for the busy station. The military concept of precedence requires that messages of the two highest degrees of precedence must cause interruption of a message of lower precedence, if necessary. Obviously unless there is an overflow condition this automatic interruption would not be required. If, however, a high precedence message is directed to a cross office unit due to an overflow condition, an interruption may be required.

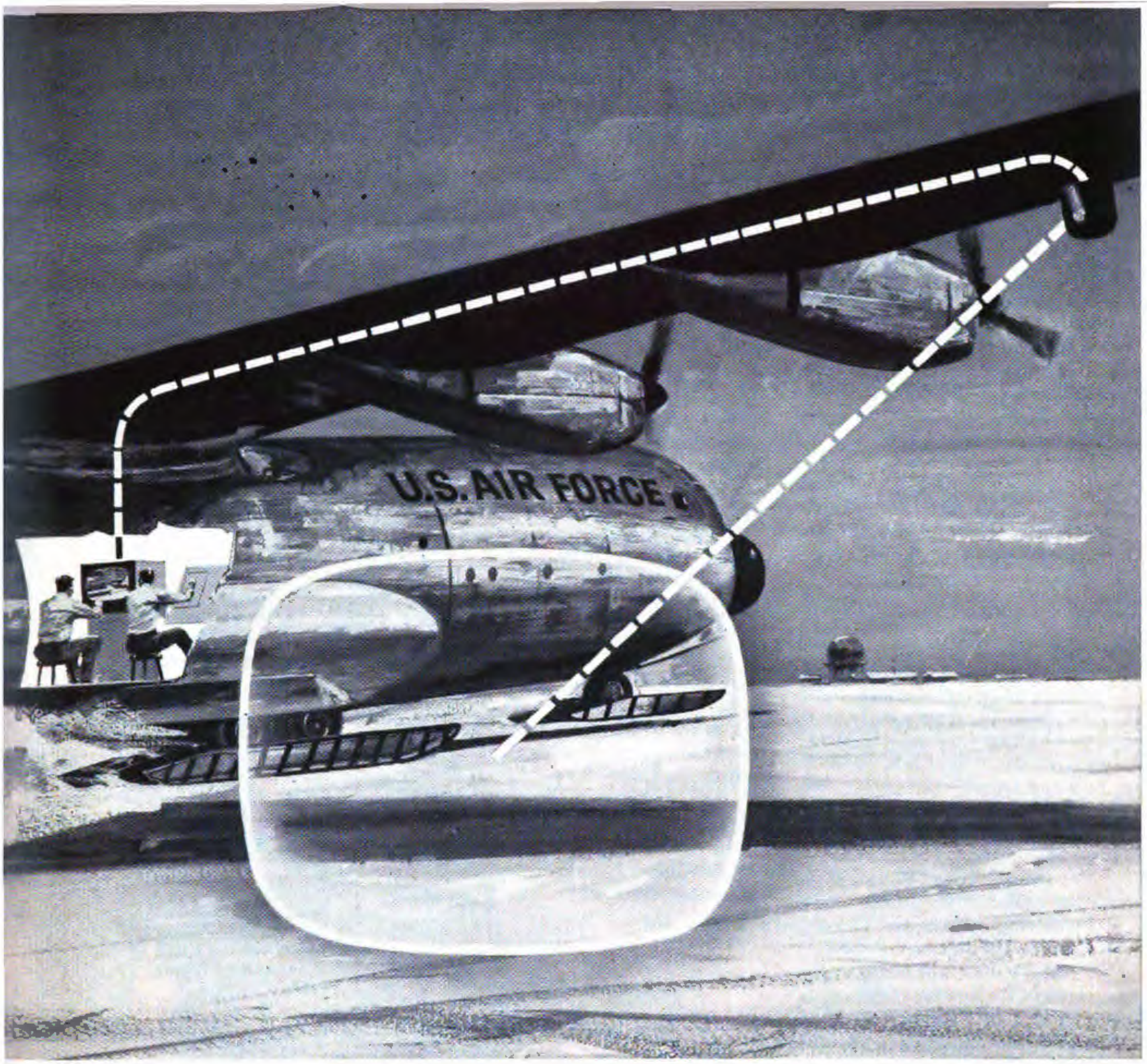
When a high precedence message arrives at a cross office unit and is ready for transmission to a local station, the control circuits of the cross office unit examine the degree of precedence of one of the lines to a given station. Should it be lower than that of the message in storage, a decision to interrupt is made and a signal is sent from the cross office unit by way of the distribution terminal convertor unit, the distribution terminal unit, and the incoming selector switch unit back into the incoming line unit which is transmitting the low precedence message. This signal causes transmission to cease immediately to all connected stations and then causes a special cancellation sequence to be sent to all stations. This sequence advises operating personnel that the message is incomplete and that the complete message will follow later. After this is accomplished the original connection is released and the cross office unit is permitted to send its high precedence message. An operator is summoned by alarm lamps to the incoming line transmitter to pull tape back and re-start the interrupted message. It should be apparent that this feature is extremely important.

The system is very thoroughly interlaced with alarms and other safeguards to prevent loss of a message. Messages which arrive at the distribution system without sufficient distribution information are routed to special intercept positions so that an operator can repair the message tapes or take other corrective action.

One example of the thoroughness of the alarm system is the provision for immediately stopping transmission to a station if a printer at that station is not feeding paper properly.

As we have pointed out, the distribution plan can be controlled by the control agency without informing the field. As an example, consider the possible change of plans which might occur each day at 5 o'clock when office personnel are leaving for the day. Under these conditions an entirely different type of distribution plan might be used after 5 o'clock. This is accomplished in the equipment in a few seconds by removing one strapping plug board from the translator unit and replacing it with one which carries an entirely different type of distribution plan.

This system is undergoing installation testing at the present time and will be put into service later this year. Although it is being installed for a specialized application, it must be realized that other uses for a system of this type can be found in business and industry. It would seem that wherever a large volume of reports or other written communications are to be funneled down to a centralized agency for local distribution or where such information must be channeled to automatic business machines, a system of this type could be used.



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# Association affairs

## NEW AFCEA OFFICERS AND DIRECTORS

The following Officers were elected at the annual Council and Board of Directors meetings during the National Convention. President—Frederick R. Furth, Rear Adm., USN (Ret.), Director of Research and Development, International Telephone and Telegraph Corp. 1st VP—Maj. Gen. Alvin L. Pachynski, USAF, Director of Communications-Electronics, USAF. 2nd VP—Maj. Gen. James D. O'Connell, USA, Chief Signal Officer of the Army. 3rd VP—Rear Adm. Henry C. Bruton, USN, Director of Naval Communications. 4th VP—Joseph E. Heinrich, staff supervisor, American Telephone and Telegraph Co., Long Lines Dept. 5th VP—John R. Howland, General Sales Manager, Dage TV Division, Thompson Products, Inc. Counsel—Ralph L. Walker, partner in law firm of Pierson, Ball and Dowd.

The following Directors were elected to serve until 1961: Raymond C. Maude, Maj. Gen., USAF (Ret.), Vice President, Allen B. DuMont Labs., Inc.; Percy G. Black, Asst. Vice President, Automatic Electric Co.; Roland C. Davies, Publisher and Editor, *Telecommunications Reports;* Harry E. Austin, Vice President in charge of Pacific Coast District, RCA Communications; Edward K. Foster, Vice President and General Manager, Bendix Radio Div., Bendix Aviation Corp.; Francis H. Lanahan, Maj. Gen., USA (Ret.), President, Federal Electric Corp.; Joseph R. Redman, Rear Adm., USN (Ret.), Vice President, Western Union Telegraph Co.; Robert C. Sprague, Chairman of the Board, Sprague Electric Co.; W. Walter Watts, Executive Vice President, Defense Electronic Products, Radio Corp. of America; Frank W. Wozencraft, Washington attorney.

## AFCEA Honor Awards

Ten officers graduating with top honors from courses at the U.S. Army Signal School were recently presented the AFCEA award for outstanding scholastic achievement.

The five men who were in the Signal Officers Basic Course were: 2nd Lt. E. W. Summerford, Hartselle, Ala. and 2nd Lt. P. A. Watts, Birmingham, Ala.; both studied at Alabama Polytechnic Institute; 2nd Lt. V. L. Anderson, Mabton, Wash., an agricultural engineering student at State College of Washington; 1st Lt. R. M. Johnson, Brooklyn, N. Y. and 2nd Lt. W. F. Colescott, Monterey, Calif., a graduate of the University of California.

2nd Lt. D. M. Keith, Chicago, Ill., a graduate of the University of Wisconsin, scored highest in the Communication Center Operation Officer Course.

In the Signal Supply Officer Advanced Course, Capt. R. F. Prael, New York City, took the number one spot.

Honor man in the Signal Material Maintenance Officer Course was Chief Warrant Officer Ely Kastenbaum, Far Rockaway, N. Y.; 2nd Lt. J. A. Weatherman, Charlotte, No. Carolina, a graduate of Georgia Institute of Technology, scored highest in the Electronic Warfare Officer Course.

In the Field and Fixed Station Radio Officers' Course, 2nd Lt. J. M. Robbins, Malvern, Ark., took top honors. He is a graduate of Henderson State Teachers College.

## Introducing AFCEA's New Group Member

The AFCEA greeted the Ramo-Wooldridge Corp. of Los Angeles, California, as a new group member in June. Ramo-Wooldridge is one of the large and important electronic firms in the Los Angeles area, concerned with the research and development of advanced electronic systems.

The members of the firm who will be company representatives in AFCEA are: Wiley V. Conover, Washington Representative; G. W. Fenimore, Director, Electronic Instrumentation Division; W. B. Hebenstreit, Director, Computer Systems Division; A. B. Hunter, Dayton Representative; George E. James, Director, Boston Division; M. H. Jennings, Boston Representative; J. F. Manildi, Director, Market Research; Burton F. Miller, Director, Communications Division; Milton E. Mohr, Director, Control Systems Division; William M. Richardson, Washington Representative.

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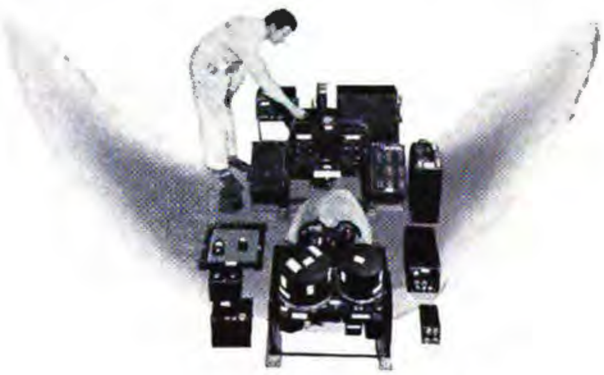

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*Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By thei membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.*

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***SAN JUAN:*** Pres.—Wyman S. Borden, P. R. Tel. Co., Box 4275, San Juan, P. R. Sec.—Albert Crumley, Radio Corp. of P. R., P. O. Box 10073, Caparra Heights, P. R.

***SCOTT-ST. LOUIS:*** Pres.—Col. Charles W. Gordon, 3310 TTGrp Cmdr., Scott AFB, Ill. Sec.—Allan L. Eisenmayer, P.O. Box 456, Trenton, Ill.

***SEATTLE:*** Pres.—Raymond J. Laine, 521 E. 123rd Sec.—Merrill R. Stiles, 916 W 122nd.

***SOUTH CAROLINA:*** Pres.—Cmdr. H. C. Rodin, Bldg. 10, Charleston Naval Shipyard, Charleston. Sec.—F. L. Davis, Southern Bell T&T Co., Owen Bldg., Columbia.

***SOUTH TEXAS:*** Pres.—Col. Albert H. Snider, 1822 AACS Group, Randolph AFB, Tex. Sec.—S. J. Keane, Southwest Research Institute, Box 2296, San Antonio.

***SOUTHERN CALIFORNIA:*** Pres.—Charles A. LeHar, RCA Victor Div., 1560 N. Vine St., Hollywood. Sec.—Jack Warner, Jr., 4000 Warner Blvd., Burbank.

***SOUTHERN CONNECTICUT:*** Pres.—Edwin B. Hurley, So. New England Tel. Co., Box 1562, New Haven. Sec.—J. A. Leopold, Dictaphone Corp., 375 Howard Ave., Bridgeport.

***SWITZERLAND:*** Pres.—William P. Lear, Lear Radio, Geneva; Sec.—Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

***TINKER-OKLAHOMA CITY:*** Pres.—Loyd G. Dorsett, Dorsett Labs., Inc., Norman. Sec—Col. William L. Gregory, 1800 AACS Wing, Tinker AFB.

***TOKYO:*** Pres.—James T. Ramsey, Hq. FEAF ,Box 228, APO 925, S. F. Sec—Paul W Becker, SigO, AFFE-8A Rear, APO 343, S.F.

***WASHINGTON:*** Pres.—L. Harriss Robinson, Motorola, Inc., 1145 19th St., N.W. Sec.—Ralph Irwin, Westinghouse Electric Co., 1625 K St., N.W.

U. S. Air Force Photo

Designed basically for night photographic work, the Martin RB-57 is employed by USAF TAC, powered by two Wright J-65 jet engines.

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This is one of a series of ads on the technical activities of the Department of Defense.

105

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# Chapter News

***Augusta-Fort Gordon***—Shown during the May meeting are, left to right: Joe S. Stone, Vice Pres., Southern Bell T&T Co.; Col. Clarence R. Dunlap, Chief of Personnel and Admin. Div., USASTC, Fort Gordon; Col. Thomas A. Pitcher, Chief of Staff, USASTC; guest speaker George M. Dean, Asst. Vice Pres., AT&T Co., and Col. Braxton E. Small, chapter president.

### Augusta-Fort Gordon

George M. Dean, Assistant Vice President of the American Telephone and Telegraph Company, New York, was guest speaker at the chapter's May 16th meeting and described some of the measures being taken by AT&T to strengthen this Nation's "military posture."

After a brief explanation of the AT&T system, Mr. Dean told the members of the defense role that could be played by "by-pass routes" now being installed around populous cities. The system will enable telephone calls to pass around, instead of having to go through, congested areas.

"We are ringing the biggest cities," he said, "at a cost to our investors of some $100,000,000. While this arrangement will have some beneficial effect on normal peace-time telephone use, it is primarily a defense measure to insure continued service, if this country is ever attacked by enemy bombers."

The AT&T executive estimated that if the Nation were to "become a battle ground" only about 20 per cent of normal civilian telephone traffic could be maintained. The emphasis, he said, would be only on military and emergency service calls.

Mr. Dean also discussed the installation of the "advance warning" radar network being strung across the top of the North American continent by Western Electric Company, an AT&T subsidiary. He described it as a "terribly difficult job."

Among the visiting guests were Charles M. Eberhart, president of AFCEA's Atlanta Chapter, and Joe S. Stone, Vice President, Southern Bell Telephone & Telegraph Company. Col. Braxton E. Small, chapter president, served as host.

### Chicago

The Navy Electronics Supply Office, Great Lakes, was the scene of the May 27th chapter meeting.

Principal speaker was Capt. Richard S. Mandelkorn, Commanding Officer and Director of the U. S. Naval Radiological Defense Laboratory, San Francisco, whose subject was "The Problem of Living with the Atom."

Host for the occasion was Capt. H. J. Goldberg, Supply Corps, U. S. Navy, Commanding Officer of the Electronics Supply Office and a Director of the Chicago Chapter.

The chapter's April 25th meeting was addressed by Hardy G. Ross, Project Manager of DEW Line for Western Electric Company. He supplemented his talk with a color sound film and slides which gave the audience a vivid picture of the construction and installation problems encountered in establishing the radar chain in the wilderness of the Arctic Circle.

### Detroit

The Burroughs Corporation, group member of the AFCEA, hosted the chapter at its Tireman Plant in Detroit on May 10th.

Following luncheon in the plant dining room, Harry B. Rottiers, Director of Defense Contracts for Burroughs and host for the meeting, group to order and introduc Plant Manager Ed W. Sch briefly explained the electr of the factory.

The audience then was di small groups and given an guided tour of the plant whi cently doubled in capacity new precision production re for a new classified Ballist contract. The tour covered v duction stages of the AN/ ordinate Data Transmittin Burroughs' contribution to SAGE continental air defen Included was a close inspect automatic printed circuit essential to the production of in cards for the T-2 data p system.

The chapter reports the little doubt as to the signific electronic data processing a puter equipment to modern def the important position Burroug in the field.

During the business session, chapter's annual elections were held and the following officers were chosen for 1957-58: president—Col. James J. Vanderhoof, Commander, 30th Air Division; vice presidents—Harry B. Rottiers, Burroughs Corporation; R. A. Berkfield, Michigan Bell Telephone Co.; A. A. Minowitz, Rett Products Co.; treasurer—J. H. White, Michigan Bell; assistant treasurer—K. C. Crumb, Michigan Bell; secretary—J. R. Saxton, Michigan Bell; assistant secretary—H. A. Dawson, Michigan Bell.

### Fort Monmouth

Col. Robert B. Tomlinson, director of the Signal Equipment Support Agency, was elected president of the chapter during the annual elections on May 17th.

Other officers named were: vice

***Chicago***—Chapter officers are pictured with their hosts at the Navy Electronics Supply Office on May 27th. Left to right: front row—James F. Weldon, secretary; G. R. Haase, director; Henry J. McDonald, president; Col. A. N. Niemi, director; second row—Col. Melvin Kemkamp, director; Captains H. F. Kuehl, H. J. Goldberg, Richard S. Mandelkorn and M. H. Glunts of the Electronics Supply Office, and Carrington H. Stone, vice president.

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S-C

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**Detroit**—Annual elections were held on May 10th. Shown above are the new president, Col. James I. Vanderhoof, USAF, and the new first vice president, Harry B. Rottiers of the Burroughs Corporation which was host to the chapter for this meeting.

presidents—Halsey F. Hubbard, Equipment Support Agency; Norman Freeman, Stromberg-Carlson Company; secretary—Harry C. Ross, Equipment Support Agency; treasurer—Esther M. Ipri, The Signal School.

Directors selected were: Arthur L. Adamson, Col. Olin L. Bell (retiring president), Brig. Gen. Earle F. Cook, Col. Fred J. Elser, Raymond L. Gilbarte, Col. Joseph E. Heinrich, Brig. Gen. Stuart S. Hoff, J. Peter Hoffman, Edward F. Kolar, Col. Paul O. Langguth, Lt. Col. J. P. McGovern and Harry Sundermeyer.

A dinner-dance at Gibbs Hall Officers' Club followed the business session.

### Gulf Coast

Election of officers was the main item of business at the May 6th dinner meeting. Ancil Z. Arseneau, Keesler Air Force Base, was chosen to head the chapter during 1957-58.

The other new officers are: vice president—George D. Sheffield, Southern Bell Telephone and Telegraph Co.; secretary — Joseph A. O'Connell, Southern Bell Telephone and Telegraph Co.; treasurer — Donald E. Payne, Keesler Air Force Base.

**Fort Monmouth**—Col. Olin L. Bell, retiring chapter president (left center), congratulates his successor, Col. Robert B. Tomlinson, following the May 17th elections. At extreme left is Norman Freeman, new second vice-president, and at right, Harry C. Ross, new secretary.

The chapter extended a vote of thanks to Maj. Don L. Poling, outgoing president, for his leadership during the past year.

Program feature of the meeting was the Bell System film. "Voices Beneath the Sea," which describes the laying of the Trans-Atlantic telephone cable.

### Korean

Chapter members and guests met at the Chosen Hotel in Seoul on April 26th. Among the sixty-five present were Korean Minister of Communications E. J. Lee and the newly appointed Vice Minister of Communications, Maj. Gen. E. T. Cho (Ret.).

Following dinner, the group was taken on a conducted tour of the Seoul Central Telephone Exchange by Korean Ministry of Communications personnel.

**Korean**—The Korean Ministry of Communications conducted the program for the April 26th meeting in Seoul. Left to right are: Mr. E. J. Lee, Minister of Communications; Col. Walter E. Letz, Jr., chapter president; and Maj. Gen. (Ret.) E. T. Cho, Vice Minister of Communications.

### San Francisco

The regular bi-monthly meeting was held at the Algiers Restaurant in Redwood City on May 16th.

Following dinner, the seventy-five members and guests visited the trans-Pacific radio transmitting station of Mackay Radio and Telegraph Company at Palo Alto for a conducted tour of the facilities. The station handles the overseas and ship-to-shore radio services to points in and beyond the Pacific Area, using over twenty radio transmitters which are arranged for twinplex and poliplex operation.

The late departure of the visitors, many of whom had never seen a major trans-oceanic radio-telegraph station before, attested to the program interest.

### San Juan

Each of the last two meetings were in honor of a charter chapter member who was being transferred. The dinner-meetings took place at the Officers' Club, Fort Brooke.

Tribute was paid on April 25th to Arthur T. Cline, Engineer-in-Charge of the FCC Office in San Juan, who was being transferred to Atlanta as head of the FCC Regional Office in that area; and on May 23rd to Paul A. Girard, President of the Radio Corporation of Puerto Rico and a former president of the chapter, who was leaving for Rio de Janeiro to be Manager of RADIONAL, the Brazilian affiliate of IT&T.

The annual elections brought the following into office for 1957-58: president—Wyman S. Borden, Puerto Rico Telephone Company; vice-president—Capt. Gifford Grange, USN, commanding officer, Naval Communications Station; secretary—Albert R. Crumley, Jr., Radio Corporation of Puerto Rico;

treasurer—Jose A. Pabon, Insular Police Communications Department.

Directors: Felix Gros, Civil Aeronautics Administration; Kinne Prachel, Prachel's Radio & TV Service; Marcel Roth, Puerto Rico Telephone Company; Homero Cordero, Radio Corporation of Puerto Rico; and Maurice Doran, 10th Naval District Headquarters.

The retiring president, James P. Fitzwilliam, was given a vote of thanks and appreciation for his leadership during the past year.

### Scott-St. Louis

"Earth Satellite for Geophysical Studies" was the program feature of the May 3rd meeting. Presented by the Bendix Radio Division, Bendix Aviation Corporation, Baltimore, the program consisted of a lecture by Ernest A. Duquet of Bendix which was supplemented by slides and was followed by a question and answer period. The program was introduced by Joseph Moncrief, Public Relations, Bendix.

Special guests of the chapter were: Brig. Gen. Bert E. Johnson, Staff Judge Advocate, Headquarters Air Training Command, and Col. William D. Cairnes, Deputy Base Commander, Scott Air Force Base.

The new officers and directors elected at the April meeting were introduced, with Col. Charles W. Gordon, the new president, presiding.

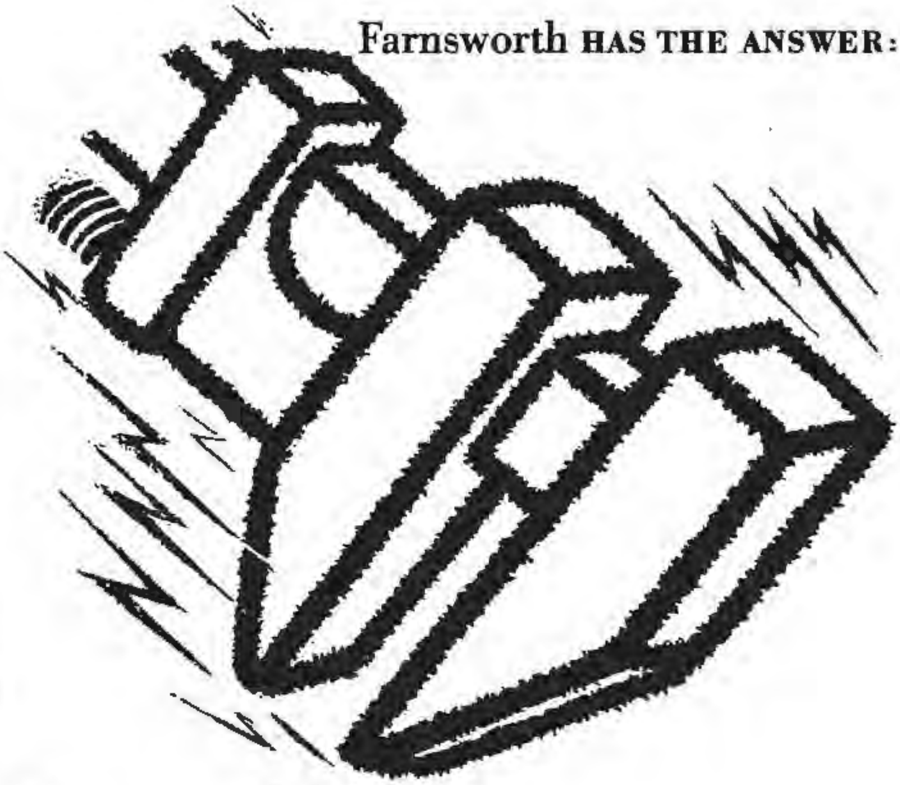
Committee chairmen recently appointed were introduced as follows: membership—Lt. Col. Arvid E. Dahlberg and Edward H. Gray; meetings and programs—Allan L. Eisenmayer; publicity—Howard D. Yund; industrial relations—Clifford G. Wassall; financial—Earl F. Hagen; hospitality—Walter W. VanSkiver.

### South Carolina

Mr. J. S. Bonner, General Coordinator of Civil Defense Services of the Southern Bell Telephone and Telegraph Company in Atlanta, was guest speaker at the May 3rd dinner-meeting held at the Columbia Hotel in Columbia. In an illustrated lecture on latest developments in Civil Defense, Mr. Bonner described the new alerting setup of the Air Force and the Civil Defense System which was placed in effect throughout the United States on May 1, 1957.

New chapter officers were elected during the business meeting as follows:

President — Cdr. Harry C. Rodin, Electronics Superintendent, Charleston Naval Shipyard, and Electronics Assistant to Industrial Manager, Sixth Naval District; vice presidents — W. Thomas Edwards, South Carolina Chief Engineer, Southern Bell Telephone and Telegraph Co.; Col. Hubert N. Sturdivant, Commanding Officer, 8th Communications Group, Shaw Air Force Base; secretary-treasurer—F. Lawrence



*San Francisco*—A tour of the trans-Pacific radio transmitting station of Mackay Radio and Telegraph Company at Palo Alto featured the May 16th meeting. Above, Sidney N. Barton, (second from right) chapter president and manager of the Mackay Radio station, explains oscilloscope pattern to a group of members.

Davis, South Carolina Inventory & Costs Engineer, Southern Bell Telephone and Telegraph Co.

Board of Directors: Hugh C. Pulliam, Vice President, South Carolina Continental Telephone Co.; Capt. Arlington C. Krajnik, 727th AC&W Squadron, Myrtle Beach Air Force Base; Cdr. Albert B. Kunz, Reserve Electronics Officer, Sixth Naval District.

### South Texas

For the June meeting, Eberle Park, the picnic area for Randolph Air Force Base was the scene of a special get-together and a barbecued chicken dinner.

During the social hour preceding dinner, the young people of the Randolph Riding Club put on a jumping exhibition in the riding ring adjacent to the picnic area. Following dinner, the catering for which was done by the chapter treasurer and his wife, Capt. and Mrs. Blaine Shockey, two color sound movies were shown depicting the VOLSCAN semi-automatic and the ILS fully automatic instrument landing systems.

This experimental picnic meeting was such a decided success that the chapter plans to feature a similar gathering annually.

### Southern Connecticut

The program of the May 16th dinner-meeting consisted of two films furnished by the Southern New England Telephone Company. One, entitled "Voices Beneath the Sea," told the story of the laying of the Trans-Atlantic telephone cable, and the other depicted the establishment of stations in the DEW Line.

Special guest of the chapter was Henry R. Bang, AFCEA Regional Vice President, who addressed the group on regional and national affairs of the Association.

### Tinker-Oklahoma City

"NAVAIDS for the Jet Age" was the subject of the April 26th dinner meeting. The program was presented by John C. Mercer, Technical Assistant to

*Scott-St. Louis*—Seated, left to right: Ernest A. Duquet of Bendix Radio, principal speaker at the May 3rd meeting; Col. Charles W. Gordon, chapter president; Joseph Moncrief of Bendix Radio; and Brig. Gen. Bert E. Johnson, ATC, Scott AFB. Standing, left to right: Col. William D. Cairnes, Deputy Base Cmdr., Scott AFB; Robert E. Melling, chapter director; B. Roger Robards, vice-president; Allen L. Eisenmayer, secretary, and Prosper L. Kinsella, treasurer.

# CHAPTER NEWS

Director of Materiel, 1800th AACS Wing, Tinker Air Force Base, who reviewed the problems of high speed aircraft and navigation in face of increased air traffic. He supplemented his remarks with color slides and a film on TACAN.

At the May 31st meeting, Delbert F. Cravens of Southwestern Bell Telephone Company was elected chapter president. Other new officers were chosen as follows: vice presidents — Robert E. Davis, 1881st AACS I&M Sqdn.; John C. Mercer; Col. William L. Gregory, 1800 AACS Wing; Jack W. Grewell, CAA; secretary—Lt. Col. Albert A. Rudd, 1800 AACS Wing; treasurer — Maurice Williams, Southwestern Bell Telephone Co.

Board of Directors: Lt. Col. Richard Amann, 1881st AACS I&M Wing; Orin Cline, Gilfillan Bros.; Fred W. Coble, RCA Service Co., Inc.; Loyd G. Dorsett, Dorsett Laboratories, Inc., retiring chapter president; Hal Doolittle, Southwestern Bell Telephone Co.; W. A. Kitchen, Oklahoma Gas & Electric Co.; Grant Landon, Oklahoma City Fire Department; M/Sgt. B. F. Niederkorn, 1800 AACS Wing; Frank Rohrer, Western Union.

The program for this meeting was arranged and conducted by Lt. Col. Richard Amann, Deputy Commander of the 1881st AACS Engineering and Installation Group. He gave a stereophonic sound demonstration which included audio, high fidelity, and tape recording and reproducing.

### *Washington*

The 97th anniversary of the founding of the Army Signal Corps was commemorated at the chapter's June 11th luncheon-meeting at the Willard Hotel. Among the 410 members and guests in attendance were General of the Army Omar N. Bradley, former Chairman of the Joint Chiefs of Staff; a number of former Chief Signal Officers of the Army; and AFCEA's new National President, Rear Adm. Frederick R. Furth, USN (Ret.).

Highlight of the program staged by the Signal Corps and introduced by Maj. Gen. James D. O'Connell, Chief Signal Officer, was the "appearance" of Brig. Gen. Albert J. Myer, who organized the Signal Corps and served as the first Chief Signal Officer from 1860-1863 and from 1866-1880. General Myer, most ably impersonated by Col. Leon J. Fishkin, Office of Technical Liaison, OCSigO, congratulated his Corps on its accomplishments but also cautioned it against complacency and over-confidence. "After all", he said to General O'Connell, "you have just gotten around to getting rid of your pigeons!"

***Washington***—**The Present meets the Past. Maj. Gen. James D. O'Connell, Chief Signal Officer, greets Brig. Gen. Albert J. Myer, the first Chief Signal Officer of the Army (impersonated by Col. Leon J. Fishkin), who appeared at the chapter's June 11th celebration of the 97th anniversary of the founding of the Signal Corps.**

As was to be expected, General Myer reminisced on some of his experiences in organizing the Signal Corps during the Civil War but he went on to show a surprising knowledge of modern technology, thus proving that the Signal Corps gets the message through not only in this world but in the next.

General Myer paid tribute to several former Chief Signal Officers present. He presented a "one-time Albert J. Myer Award" to Maj. Gen. George I. Back, for "having done more than any other Chief Signal Officer in history to accumulate statistical information on the value of the ACAN system". He also paid tribute to Maj. Gen. Harry C. Ingles for having done the spade work in organizing the AFCEA, commenting "I wish I had had such an association as this to back me up in 1860". He cited Maj. Gen. Spencer B. Akin's service as General MacArthur's Signal Officer in the Pacific as "a wonderful example of the type of cooperation which should exist between a Commander and his Chief Signal Officer". He also said, "the closest the Signal Corps had ever come to being a joint command was when Akin had his own Navy and Air Force while he was MacArthur's Signal Officer".

Also featured in the entertainment was the Second U. S. Army Chorus from Fort George G. Meade.

During the business session, Chapter President M. C. Richmond formally presented the new officers and directors of the chapter for 1957-58 as follows: president - L. Harriss Robinson; vice-presidents - Maj. Gen. W. P. Corderman, USA; Col. B. M. Wootton, USAF; Capt. J. S. Dorsey, USN; and Harry M. Stephey; secretary - Ralph A. Irwin; treasurer - John R. O'Brien; general counsel - F. O. Willenbucher; board of directors - Percy G. Black; Claude B. Blair; John N. Boland; Capt. Will I. Bull, USN; Brig. Gen. A. F. Cassevant, USA; Ralph I. Cole; Francis Colt deWolf; Francis H. Engel; Paul Goldsborough; Maj. Gen. D. D. Hale, USAF; Thomas B. Jacocks; Keith B. Lewis; Col. I. F. Stinson, USAF; Capt. W. E. Sweeney, USN; and Rear Adm. J. N. Wenger, USN.

Following the installation, the chapter gave an enthusiastic vote of appreciation to President Richmond and George Sheets, out-going secretary, for outstanding direction and execution of Washington Chapter affairs during the past year.

Admiral Furth gave a short greeting to the chapter and congratulated it on its record of activities.

Seated at the head table were: General of the Army Bradley; General O'Connell; Admiral Furth; Maj. Gen. H. C. Ingles, former CSO 1943-47; Maj. Gen. S. B. Akin, former CSO 1947-51; Maj. Gen. G. I. Back, former CSO, 1951-55; Brig. Gen. J. H. LaBrum, USA (Ret.); Rear Adm. H. C. Bruton, Director of Naval Communications; Maj. Gen. A. L. Pachynski, Director of Communications - Electronics, USAF; Rear Adm. J. N. Wenger, Director of Communications-Electronics, JCS; Brig. Gen. A. F. Cassevant, Chief, Procurement Div., Dep-Log; Maj. Gen. W. P. Corderman, Deputy Chief Signal Officer; Maj. Gen. V. A. Conrad, Commanding General, Fort Monmouth; Brig. Gen. J. Dreyfus, Chief, Procurement & Distribution Div., OCSigO; Brig. Gen. W. P. Pence, retiring Chief, Combat Development & Operations Div., OCSigO; Brig. Gen. K. F. Zitzman, Chief, Combat Development and Operations Div., OCSigO; Capt. G. L. Caswell, retiring Asst. Director of Naval Communications; Capt. J. S. Dorsey, new Asst. Director of Naval Communications; outgoing President Richmond, Secretary George Sheets; L. Harriss Robinson, new president; Ralph Irwin, new secretary; and John O'Brien, new treasurer.

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A new 200,000 square foot "controlled conditions" plant, in Pickens, South Carolina is geared for full capacity production of Dynamotors, Rotary Converters, Generators, Special DC Motors—all built to meet your most exacting specifications for quality and performance.

### ENGINEERING HELP AVAILABLE

Sangamo maintains a complete engineering and technical staff to assist any organization with its power supply planning. Ask for an engineering analysis and recommendations for power supply units to meet your special application problems.

# ITEMS OF INTEREST

## From Government, Industry and the Services

### New Defense Weapon

The Department of the Army has revealed the successful development of a versatile air missile system designed to reinforce the low-altitude capability of U. S. defenses.

Able to destroy the lowest flying aircraft, this new defense weapon, known as the HAWK, will carry a lethal, modern war-head. The missile can detect, track and attack craft in the blind zone of conventional radars and at ranges insuring effective protection of defended areas. It will complement the defense against high-altitude air attack provided by the Army's NIKE.

Flexible and mobile, the HAWK can operate in the continental United States air defense complex at fixed installations or with fast moving combat troops of the field Army. In its mobile role the HAWK also will be adopted by the U. S. Marine Corps.

Site selections for the new weapons already have been initiated in the New York City and Washington-Baltimore areas.

The HAWK, which uses a solid-fuel propellant, is about 16 feet long, 14 inches in diameter and utilizes radars of unique and highly effective design.

It was developed and will be produced by Raytheon Manufacturing Company, prime contractor for the entire system. (See Cover)

### "Gapless" Coverage For MATS

A new air-to-ground communications system has been designed to provide "gapless" coverage for Military Air Transport Service planes approaching and leaving East coast air fields. A combination of telephone land lines and UHF radio, the development was announced by MATS and the Long Lines Department of American Telephone and Telegraph Company.

The system permits contact with aircraft about 400 miles from control centers at McGuire, N. J., and Dover, Del., Air Force Bases. As a plane flying the North Atlantic route approaches the East coast, its radio signals are automatically picked up by the nearest receiver and relayed by wire to McGuire and Dover.

With previously used systems the approaching plane had to be within range of the base to communicate directly.

Automatic speech level regulation and improved tonal quality are characteristics of the system.

Effective range of the radio equipment will be increased 20 per cent by use of high-gain antennas.

The Air Force's Ryan X-13 Vertijet, pictured here, is capable of taking off in a vertical attitude and quickly switching to high speed horizontal flight.

### The Ryan X-13 Vertijet

The U. S. Air Force Ryan X-13, world's first Vertijet (vertical take-off and landing jet airplane, VTOL) has demonstrated successfully its ability to take off straight up, make the transition to high speed horizontal flight, then back to vertical hovering for a zero speed landing, it has been officially disclosed.

Under the hush of military security, the VTOL research craft, first of an entirely new class of high-performance jets, has been flying for more than a year at the Air Force Flight Test Center. First flight was December 10, 1955, piloted by Peter F. Girard, chief engineering test pilot for Ryan Aeronautical Company, San Diego, designers and builders of the X-13. First complete VTOL flight in full operational sequence was made by Girard on April 11, 1957.

Rising and descending on a column of seething exhaust gases, the Vertijet depends solely upon thrust from its jet engine for both direct lift and high speed conventional flight.

### A Computer Composer

Mathematicians Dr. Martin Klien and Dr. Douglas Bolitho have proven to their satisfaction that an electronic digital computer is capable of writing popular music.

Reasoning that if humans could write poor quality popular music at the rate of a song an hour, they could compose music of an equal caliber faster with a machine.

In less than a month they educated the Datatron Digital Computer to write songs at the rate of more than 4,000 an hour. Composer and ASCAP member, Jack Owens, set lyrics to one of the melodies, five recordings were made and the tune, "Push Button Bertha," was introduced on the ABC network.

However, the Library of Congress refuses to issue a copyright since they have never been confronted with a machine written piece of music.

### New Insurance Plan For Servicemen

A $10,000 group life insurance program, designed to provide service men and women with the maximum amount of family protection at low cost, is being offered to members of the Armed Forces Enlisted Personnel Benefit Association, it was announced recently by the Board of Directors, representing all of the Services.

Available to all grades of "regular" enlisted personnel of all Services, the group life insurance plan is designed solely to assist the serviceman on active duty. No medical examinations will be required.

Supplementing the benefits offered by the Survivors Benefit Act where necessary, the plan formerly was available only to commissioned and warrant officers.

Regardless of age or travel requirements, the monthly contribution will be $9.00 for all members, except those performing hazardous duties. Such members will contribute $12.50.

Master Sergeant John J. Klasinski, Army representative on the Board of Directors, said it is anticipated that annual refunds will be made to reduce the cost of the plan to members.

The program will be underwritten by Mutual of New York and upon

Association membership termination, the insured can convert the life insurance, without medical examination (within a specified period of time) to any permanent form of insurance customarily issued by this company.

## Facsimile Set Speeds Battle Pictures

The Army has produced a new, portable, high-speed radio facsimile system capable, in five minutes, of rushing a high quality photo to a destination miles away. This is said to be the fastest way to convey a photo from one spot to another.

Developed by the U. S. Army Signal Engineering Laboratories, Fort Monmonth, N. J., the device can flash vital military reconnaissance pictures by radio to command headquarters in time to affect critical decisions.

The new system fits easily into the back of a radio-equipped jeep or car and can send a picture to its companion receiver 40 miles away. A photo can also be dispatched thousands of miles over standard telephone lines as well as aroud the world by long range circuits.

Mounted on a light reconnaissance plane or helicopter, the set is able to speed aerial surveillance pictures directly to battle headquarters from the aircraft.

In addition to combat application, the facsimile can speed military weather predictions and prove valuable to newspaper photo reporting.

Combining high-speed Army techniques with Polaroid film, the system, the fastest of its kind in the world, produces a finished print in one minute without use of a darkroom.

## Denison Research Foundation Organized

In view of today's more or less universal interest in the subject of research and development, coupled with the shortage of available engineers, William C. Denison announces the organization of the Denison Research Foundation, a non-profit corporation.

Denison Research, located in Columbus, Ohio, will serve industry and the U. S. Government by providing talent and facilities for conducting a wide variety of research. Initial emphasis will be on projects in the electronic, mechanical, metallurgical, ceramic and management fields.

Tiny silicon wafers, or solar batteries, grouped in long narrow clusters on the crown o Army's new helmet radio, can provide all the electrical power needed to operate the t mitter-receiver. Like the original helmet radio, the sun-powered version is a developmen the U. S. Army Signal Engineering Laboratories, Fort Monmouth, New Jersey. Teamed small nickel-cadmium storage batteries for peak power and nightime operation, the solar can provide current for as much as a year, as compared with dry cell life measured in h

## Army Helmet Radio

According to the Department of the Army, exposure to sunlight may soon be all that's needed to obtain electrical power for year long operation of both transmitter and receiver of a helmet radio now under development.

The helmet-housed radio experiments proved so promising that similar power is now under consideration for the walkie-talkie and other light field radios.

These experiments, conducted at the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., have shown that solar batteries, which convert light to electricity, can power the world's smallest transmitter-receiver.

Long, narrow clusters of tiny solar cells are placed on either side of the crown of the helmet. Powering the radio for normal daylight operation, these silicon wafers also charge four small nickel-cadmium storage batteries to operate the set at night as well as supply peak current in daytime.

Use of the solar cells in combination with rechargeable nickel-cadmium batteries would provide power for many months, possibly a year or more. With dry cells now used in the helmet radio, battery life is less than a day if used continuously.

## Radar-Equipped Blimp

Blimps, with a radar antenna rotating inside the airship's skin, will be the newest addition to the Nation's defense arm, the Continental Defense Command revealed recently. The radar-equipped blimps join the continuing ocean patrols.

Test flights of the blimps have b conducted since January, accordi to General Earl E. Partridge, co mander in chief of the Air Defe Command. Beginning January four of the "ZPG" blimps, buil Goodyear Aircraft Corporation, ma a 10-day continuous sentry flight ov the Atlantic. Weathering a 37-ho blizzard and long periods of "zer zero" visibility, they set records f endurance.

"The airship," said General Pa tridge, "has established its positi as the ideal electronics carrier sui able for operation and antisubmarin warfare as well as radar early warn ing."

## New Guided Missile Developed by British

The British Navy has developed a ship-to-air guided missile, known as the "Seaslug," which is capable of engaging enemy bombers at any height where modern aircraft can operate.

Propelled by a motor and four rockets, the "Seaslug" will attack bombers which evade fighter defenses of the Fleet. Targets are detected by long range radar and subsequently plotted for range, height and bearing.

The missile is operated and fired from positions within the ship that do not necessitate crew exposure. Firing of the missiles requires a smaller crew than the conventional gun in a major warship. However, a large number of officers and men are engaged in maintenance and preparation for launching. The "Seaslug" is projected from a triple-ramp launcher automatically fed from a magazine below decks.

## Dynamics Corporations Acquire REL Stock

It has been announced recently that namics Corporation of America ; acquired all the outstanding stock Radio Engineering Laboratories, :.

The company's growing commu- ations operations, including Radio gineering Laboratories, will be solidated in a new 170,000 square t building. This step will combine one building the manufacturing of ir ship-to-shore marine radio- phones, television broadcasting, gle side band communications and pospheric scatter telephone equip- nt.

## Fire Truck Combats Large Scale Fires

\ highly mobile aluminum fire ck, designed for effective employ- nt in combating large scale fires, l those involving non-conventional ls, has been developed by the U. S. my's Engineer Research and De- opment Laboratories, Fort Belvoir, .

Manufactured by the Walter Motor . of Long Island City, N. Y., the ck is equipped with a turret to nbat large fires inaccessible by hose. It carries a 1,000-gallon water tank and 150 gallons of concentrated foam. A pump driven by the main engine provides for discharges of fire extinguishing foam at rates up to 6,000 gallons a minute.

All equipment is enclosed in insulated compartments heated by an automatic gasoline-fired electrically controlled coolant heater. The entire unit, built to operate in temperatures as low as 65 degrees below zero and as high as 125 degrees, is also capable of withstanding the harmful effects of salt water, high humidity, fungi, molds and tropical insects.

## Army to Sponsor Symposium

The United States Army, in cooperation with all military services, Department of Commerce, and the National Security Industrial Association, will sponsor the Third Joint Military-Industry Packaging and Materials Handling Symposium on October 1, 2, and 3 at Fort Lee, Virginia, home of the U. S. Army Quartermaster Corps.

Top level defense and industrial leaders will address the symposium entitled, "Packaging and Materials Handling in Action." The symposium will relate packaging and materials handling to conditions in the field and will familiarize defense and industrial personnel with new developments in critical areas of mutual interest. Exhibits and field demonstrations will be featured.

Further information is obtained at the Procurement division, Deputy Chief of Staff for Logistics, Dept. of the Army, Washington 25, D. C.

## Remote Vehicle Control

Lear, Inc., of Grand Rapids, Michigan, has introduced a unique system for remote control of vehicles. Equipped with the Lear system, a vehicle may be used for obtaining data or information from remote, hazardous, or otherwise inaccessible areas via a television transmitter. Easily installed in any tracked or wheeled vehicle, the system uses electromechanical actuators to control the functions usually performed by the driver. The vehicle may be controlled by radio or through an electrical cable which permits a variety of driver locations. Ordinary manual operation of the vehicle is not hampered, and quick switch-over from manual to remote control is easily accomplished.

The system was designed to operate under the most extreme environmental conditions and has been used in actual testing of U. S. Marine Corps land vehicles under dangerous surf conditions. In this application, the LVT was controlled by radio from a hovering helicopter or from an observation post on the beach.

(Continued on page 76)

# PERSONNEL CLEARING HOUSE

## *AFCEA Members Available to Industry*

**The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronic and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ——, SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.**

FIELD ENGINEER: ELECTRONIC, COMMUNICATION, MARINE EQUIPT. Data processing and automation. DOD project coordination. Branch Management, sales promotion, customer relations. Surveys and reports, subcontract and material expediting, program planning, production control, priorities. Box 123.

REPRESENTATIVE, with all clients performing R & D or supply work for Wright Field and other agencies, needs more lines to develop with both military and commercial potential. Preferred are electronics or photographic equipments and ANP (have AEC Access) or packaging material. Box 124.

MANUFACTURERS REPRESENTATIVE, WASHINGTON, D. C. Long established and contacting all government procurement points in Washington, D. C., has opening for an additional account. Prefer a company manufacturing an end-use item and which is already doing some business with the military. Can also cover Philadelphia and Fort Monmouth. Replies confidential. Box 125.

MANUFACTURERS LIAISON REPRESENTATIVE. Retired Lt. Colonel Communications-Electronics Officer with twenty-one years experience. Education: Electrical Engineering and Business Administration. Familiar with Operational Suitability Testing and R & D. Desires to represent manufacturers or act as liaison for companies conducting business with Eglin Air Force Base, Florida. Box 126.

MANUFACTURERS REPRESENTATIVE with over sixteen years experience, partly as a USAF employee, in negotiating and liaison engineering of contracts with the USAF at Wright Field and Gentile AF Depot has time available for additional companies desiring or doing Air Force business. Box 127.

## *Government and Military Positions Available*

**Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.**

ELECTRONIC TECHNICIAN ($7,570-$8,645 plus 25% (non-taxable cost of living allowance). Major duties are to plan, direct and supervise the operation and maintenance of carrier, repeater, terminals, telegraph and associated equipment installed in the toll test rooms. Includes inspections of facilities to determine required training, the organizing of the training and when necessary the actual conducting of the training. Three years general experience required and three years specialized experience. Inquiries should be directed to Civilian Personnel Officer, Alaska Communication System, 550 Federal Office Binlding, Seattle 4, Wash.

ELECTRONIC ENGINEERS GS-5 through GS-12. These positions have a salary range of $4,480 through $8,645 per annum. Employees in these positions serve as advisors and consultants to Signal Corps Contracting Officers on technical phases of procurement of Signal Corps equipment during the period of solicitation and during the life of the contract. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

SUPERVISORY GENERAL ENGINEER ($6,950 a year). To serve as an assistant to the military post engineer. Function of the Depot Facilities Division is related to maintenance, care and preservation of all buildings, structures, and rights-of-way and other real estate of the depot; responsible for fire protection and prevention for the depot, and management of depot facilities. Inquiries may be directed to the Civilian Personnel Office, Decatur Signal Depot, Decatur, Illinois.

EAST COAST PICTORIAL CENTER has an opening for a studio electrician at $2.51 an hour. Duties include operating most elec-

(*Continued on page 76*)

# The Microwave Radio System that Grows... as you Grow!

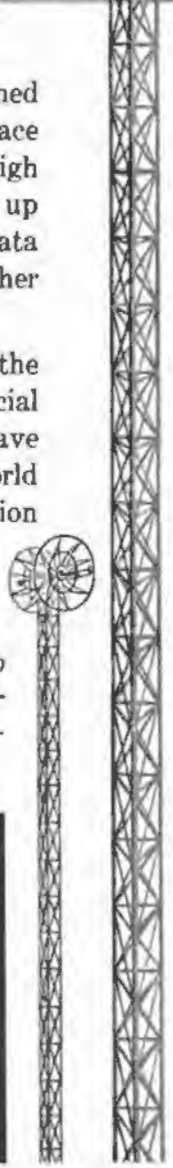
RCA Microwave Radio Systems are designed with future needs in mind. They do not face obsolescence because of users' growth. High channel capacity permits orderly growth up to a total of 120 channels for voice, data transmission, supervisory control and other purposes.

RCA was one of the earliest pioneers in the development of microwave for commercial communications. Today, RCA Microwave Systems provide users throughout the world with many important features . . . operation in the most advantageous frequency bands, simplified installation and minimum maintenance cost.

Serving their users with dependability and precision, RCA Microwave Systems are now operated by utilities, gas and petroleum pipelines, cross country turnpikes, and government agencies.

More than a million channel miles of RCA Microwave Systems in service . . . performance proved throughout the world.

*RCA Microwave specialists will be glad to answer any questions and help plan your installation. Mail coupon for further particulars.*



RCA
Tmk(s) ®

**RADIO CORPORATION of AMERICA**
**COMMUNICATIONS PRODUCTS**
**Camden, N.J.**

**SPECIAL NOTE TO RCA CUSTOMERS:**

Ask about the RCA "Package Expansion Plan" which confirms your wise choice of RCA CW-20 or MM-26 Microwave for your communications system. A minor field modification will bring your system up to 48, 72 or even 96 channel capacity, depending on your revised requirements.

**Radio Corporation of America**
**Communications Products**
**Dept. U-291, Building 15-1, Camden, N. J.**

☐ Tell me more about RCA "Package Expansion Plan." We have RCA________Microwave.

☐ Send latest literature on RCA Microwave Radio for use in________________

NAME________________ (PLEASE PRINT) TITLE________

COMPANY________________

ADDRESS________________

CITY________ ZONE____ COUNTY______ STATE______

☐ Have representative contact me.

trical equipment, required for motion picture production. Knowledge of lighting effects and switchboard wiring required. A position is also available for an architectural draftsman at $4,525 a year. Situation requires ability to execute designs and plans for motion picture settings, and to paint and dress sets, dioramas and other pictorial representations. Clerical duties include filing, developing and printing of blue prints, and a minimum amount of typing. For further information, write to Civilian Personnel Office, Army Pictorial Center, Long Island City, 1, N. Y.

PHYSICIST—GS-9. Qualified expert on radiology responsible for the operation of the film badge service unit and for the monitoring of personnel, material, equipment and radioactive sources. Accountant—GS-9. Responsible for receiving and analyzing all reports generated by the Finance and Accounting Branch; practical application of accounting theories. Cost Accountant—GS-9. Serves as Staff Accountant for the Maintenance Division responsible for performing professional accounting work in connection with cost accounting and Army Industrial Fund activities. Electronic Engineer—GS-7. Responsible for independent accomplishment of professional engineering work as related to research, development, design, evaluation, standardization, modification, etc., of prototype production and fabrication models of electronic equipment. Inquiries should be directed to the Civilian Personnel Director, Lexington Signal Depot, Lexington, Kentucky.

MEDICAL OFFICER GS-12. This position pays $8,645 per annum. The employee will be responsible for the operation of a Federal Civilian Health Service type of dispensary containing examination and treatment rooms and equipment. Examines military personnel having initial responsibility for diagnosis and disposition of cases for treatment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

### FORT MONMOUTH VACANCIES

Supv. Physicist (General), GS-14; Electronic Engineer (General), GS-14.
*Duty Station:* Pasadena, California.
Electronic Engineer (Radio), GS-13.
*Duty Station:* Christ Church, Hampshire, England.
Electronic Engineer (General), GS-13; *Duty Station:* Fort Monroe, Va., Fort Knox, Ky., Fort Bliss, Texas, and Fort Rucker, Ala. Electronic Engineer (Radio, Instrumentation), GS-12; Chemical Engineer, GS-11; Electronic Engineer (Radio, General & Wire Communications), GS-11; Mechanical Engineer (S&S, Signal Equipment), GS-11; Training Officer (General Fields), GS-11; Mechanical Engineer and Mechanical Engineer (Signal Equipment), GS-9; Employee Utilization Representative, GS-9; Instructor (Radar, Radio-Microwave, Wire Sound Recording), GS-9; Radio & Electronic Equipment Installer and Repairer, WB-15.

U.S. CIVIL SERVICE COMMISSION. Vacancies now exist for Electronic Technician positions in the Civil Aeronautics Administration in Alaska. Starting salaries are $4,080 and $4,525. No written test required. Full information on how to apply may be obtained at many post offices throughout the country or from th U.S. Civil Service Commission, Washington 25, D. C.

U.S. CIVIL SERVICE COMMISSION has announced vacancies fo communications cryptographic coding clerks at $3,415 a year Applicants must have general experience as a clerk, typist, teletypist or telegrapher, plus 6 months of specialized experience i enciphering and deciphering messages, involving the use of variety of current cryptographic systems and devices. Radi broadcast technician positions are also available in the International Broadcasting Service at $5,915 a year. No written test required. Further information and application forms from th U.S. Civil Service Commission, Washington 25, D. C.

ELECTRONIC ENGINEERS. Starting salaries $5,335 and $6,115 Electronic Technicians, salaries from $3,670 to $5,440. Vacancie now exist at the Electronics Division of the New York Nav Shipyard, located at Navy and Sands Streets, Brooklyn 1, N. Y. The shipyard is engaged in activities ashore and afloat, including construction of new super-carriers. Direct inquiries to the Industrial Relations Officer, Telephone Main 5-4500, Extensi 2877, 2379 or 2593.

### FORT HUACHUCA VACANCIES

Supervisory Electronic Engineers (2) GS-855-14, General
Electronic Engineers (2) GS-855-13, General
Electronic Engineer GS-855-13, Instrumentation
Electronic Engineer GS-855-13, Radio
Electronic Engineer GS-855-12, General
Electronic Engineers (2) GS-855-11, General and Radio
Electronic Specialist GS-855-9
Electronic Engineer GS-855-9
Physicist GS-855-9
Supervisory Analytical Statistician GS-1530-12
Mathematician GS-1520-12

SCENARIO WRITER ($7570 per year). Six years of progressively responsible and successful experience in writing scenarios, script, dialogue for motion pictures or related fields. Experience must include three years in field of motion pictures. Substitution of education for experience: successful completion of study in college or university may be substituted for not more than 3 years of the required experience on the basis of one year of education for each 9 months of experience. No educational substitution will be allowed for experience in the field of motion pictures. Grade GS-1071-12. Army Pictorial Center. Long Island City 1, N. Y.

TELETYPE OPERATORS, COASTAL STATION RADIO OPERATORS. International communications company. Liberal company benefits. Submit resume with name, address, age, past experience—if any, military experience—if any, FCC Second Class Radiotelegraph license required for Coastal Station Radio Operator. Write to Asst. Director of Personnel, RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

# ITEMS OF INTEREST

## New RCA Appointments

The Radio Corporation of America recently announced two executive changes. Theodore A. Smith was appointed executive vice president, Industrial Electronic Products, and Orrin E. Dunlap, Jr., vice president, Institutional Advertising and Publications.

In his new capacity, Mr. Smith will be responsible for RCA's computer, telecommunications, industrial control systems and other commercial products.

Mr. Dunlap will be in charge of the institutional advertising program and all publications of an institutional nature.

## Texas Instruments Appoints New Engineer

Louis G. Karagianis has been named Military Relations Engineer for the Semiconductor-Components division of Texas Instruments Incorporated. His appointment, along with his assignment to a new office opened at Dayton, Ohio, was announced by Earl Trantham, S-C division Military Relations Manager.

## In Memoriam

The founder of the International Telephone & Telegraph Corporation, Sosthenes Behn, died of a heart attack in New York on June 6. He was 75.

Mr. Behn, who, with his brother, organized the world-wide communications corporation in 1920, held the position of president until 1929 and retired as chairman last year.

Born in St. Thomas, V. I., he moved to Puerto Rico in 1906 where he later attained control of the telephone system. This became the basis of I. T. & T. which was operating in 42 countries by 1933. After connecting Puerto Rico with the United States by a series of land and submarine cables, he expanded his enterprises to Europe in 1924.

To carry out the proposed rehabilitation of the Spanish national telephone network, Mr. Behn raised $30 million from J. P. Morgan & Co. to buy the International Western Electric Co. This addition to I. T. & T. provided manufacturing subsidiaries and associates in Europe, Asia, and South America.

# *A major change in educational policy*

# CREI announces direct personal supervision for home-study final exams

Occasionally you will find skeptics who question the authorship of answers given in home study examinations. Possibly you have questioned this yourself. Did the student receive help? How can you be sure the home study course graduate actually knows what his diploma indicates he *should* know?

Our experience over the years indicates improperly-aided examinations to be an unlikely occurrence. CREI examination procedure has always been rigorous. However, to protect *all* our graduates from the effects of the above-mentioned skepticism . . .

***CREI has instituted a new testing procedure which will add even more meaning to the CREI Diploma . . . in the eyes of both industry and education.***

Effective immediately, all CREI final examinations will be given under personal and authoritative supervision. Here is how the new plan works:

**1** CREI sends final examination papers in 4 sealed envelopes to a designated supervisor in the student's own city. The supervisor will be a university or college department head . . . a high school principal . . . or (in the military services) he will be a commissioned officer attached to the student's ship or station (preferably the educational officer). In industry, the supervisor may be a responsible engineer who is superior in rank to the student.

**2** At the time the examination papers are sent, the student is notified where the examination may be taken. He then contacts his selected supervisor and arranges a mutually agreeable time for the 4-section examination, which requires full mornings and afternoons of two days.

**3** The student is given one section at a time, which he completes under the supervisor's administration. (The exams are primarily mathematical, and consist mainly of practical problems designed to test the student's knowledge of various sections of the course.)

**4** The supervisor returns the examination and the answers to CREI for grading, with a certification that the test was taken in privacy, and that there was no help received from anyone.

This forward step in educational technique is typical of CREI leadership through the years. For detailed information about any phase of CREI's Home Study or Residence Program, and how it can help with your technical manpower or training program, please write directly to E. H. Rietzke, President.

**CAPITOL RADIO ENGINEERING INSTITUTE**

*ECPD Accredited Technical Institute Curricula • Founded in 1927*
Dept. 217-D, 3224 Sixteenth Street, N.W. - Washington 10, D.C.

# NEW PRODUCTS FROM INDUSTRY

## *Smallest Teleprinter In History*

Called the "Mite," a miniaturized, 12-pound page teleprinter has been developed by the Western Union Telegraph Co., 60 Hudson St., New York 13, N. Y.

Smaller than a portable typewriter, the unique teleprinter measures only 5 x 11 x 11 inches. It will operate at any standard speed up to 100 words a minute, and in any position—horizontal, vertical, or otherwise.

Designed on a compact, building-block basis, the miniaturized unit is expected to be far less costly to manufacture than standard machines.

## *Liquid-To-Air Cooling Units*

For airborne, shipboard, or ground support electronic equipment, The Hallicrafters Co., 4401 W. Fifth Ave., Chicago 24, Ill., is now producing 3 newly-perfected cooling units claimed to be the first liquid-to-air cooling units offered to the electronic industry in ratings over 2,000 watts.

Revolutionary in design and capable of dissipating up to 7,000 watts, these units are 20% less costly and 30% lighter and more compact than comparable units now in use. In addition, they meet environmental conditions of MIL-E-5272 and MIL-E-5400 specifications, permit use of standard racks, and accommodate whatever auxiliary gear is desired.

All 3 stock units now available will dissipate 2,000-5,000 or 7,000 watts and can be adapted to any intermediate rating required.

## *First All-Transistorized Miniaturized Telephone Carrier System*

Now available for military use is the new completely transistorized, miniaturized "tactical telephone terminal" recently developed by Lenkurt Electric Co. of San Carlos, Calif.

The new multiple-channel telephone carrier system provides 4 voice channels and an order wire for either radio or cable transmission. Four terminals can be stacked together to provide a 16-channel system. The first all-transistor system of its kind to use the frequency-division method in providing extra voice channels, it requires less than half the power needed by the AN/TCC-3 terminal used by Signal Corps since 1952.

Designed for mounting in military vehicles, this new compact terminal takes only 3½" of vertical space in a standard 19" telephone rack, and is about 1/7 the size of equipment now in use. Weighing only ⅓ of the 170-pound AN/TCC-3 system, it is easily handled by one man.

Constructed to meet military environmental and strength requirements, a unique "egg-crate" type of chassis construction is used, and unitized plug-in subassemblies are hermetically sealed.

Built-in facilities for 3750-cps out-of-band AM signaling permit E and M signaling. A separate signal option unit provides 4 more types of signaling.

## *Telemation*

TelePrompTer Corp. of 311 W. 43rd St., New York, N. Y., now offers a series of new devices which may be operated in conjunction with their new process called "telemation," said to provide high efficiency both in TV and at meetings of any size or description.

Telemation copes electronically with the problems of synchronizing a speaker's words with off-stage effects by effectively providing fluff-proof insurance. Wiring of the teleprompter allows telemation to function similarly to an alarm clock which turns on a radio or furnace. As a cue word is spoken, an aluminum strip reaches a contact and an electronic circuit to the telemation unit is triggered. Whatever it may be—operation of a movie projector, slide projector, spot light or recorded music—the desired effect is activated instantly with no possibility for error or mistiming.

Among the 18 new accessory devices is the "magic hand." This wireless control, which starts and stops the 'prompter and governs the speed of the 'prompter script, enables the controlling operator to work from any location in the studio without cable encumbrance.

Another is the new automatic projector equipped with a slide-changer that will feed 60 slides in 60 seconds. Capable of producing 6,000 lumens of light, it is said the projector offers excellent definition and light value in addition to its portability (955 lbs.), high efficiency, remote-control and automatic slide-changing features.

## *Radar System Employs Unique Indicator*

Sperry Gyroscope Co. of Great Neck, N. Y., now features in its APN-59 radar system a pilot's auxiliary indicator, unique in its field, which uses a 5-inch cathode ray tube with excellent definition for viewing of targets located at distances up to 240 miles.

Mounted in the cockpit of an AF C-97, the pilot's auxiliary indicator can be held on a relative bearing type of presentation while the navigator's indicator is oriented to magnetic North or any other preselected compass setting.

Said to provide greater versatility, reliability, compact packaging and very high resolution in range and bearing, the APN-59 is the smallest and lightest radar for its power and range and is used in troop-carrying and cargo aircraft for search, surveillance, storm detection and other all-weather navigational purposes.

## *New Bell Radio Relay System*

A new microwave radio relay system, capable of carrying 3 times as many telephone calls, radio programs and TV shows as the most advanced network currently operating in the U. S., has been developed by Bell Telephone Labs., 463 West St., New York 14, N. Y.

Capable of carrying more than 10,000 telephone conversations, or a combination of 12 TV programs together with more than 2,500 phone calls, the new system also provides increased capacity for transmitting the "digital" information used in teletypewriter and data transmission. Featuring extremely fast switching equipment, the system is capable of bringing in alternate equipment or channels in case of component failures or atmospheric disturbances.

## *5-Watt, 10-Megacycle Transistor*

An experimental silicon power transistor, capable of providing an output of 5 watts at 10 megacycles either as an oscillator or an amplifier, has been developed at Bell Telephone Labs., 463 West St., New York 14, N. Y.

Unilateral gain is in excess of 20

(*Continued on page 80*)

# 15 g's
# 15 g's
# 15 g's
# 15 g's VIBRATION

## . . . no problem in Bell Aircraft's NEW 400 mc Receiver

**M**odular packaging techniques enable Bell Aircraft Corporation's new 400 megacycle receiver to meet the exacting requirement of 15 g's vibration from 5 to 2000 cycles, solid mounting.

Now thoroughly proven and in production, this receiver is available immediately for any application where demodulated control signals are needed for the activation of command systems requiring a high signal-to-noise ratio, high sensitivity and stability, and a wide audio bandwidth with low harmonic and phase distortion. It is equally at home in guided missiles — as a range safety instrument — or as a ground monitor receiver.

The new 400 mc receiver is only one of many examples of the ability of Bell Aircraft's new *Avionics Division* to design, develop and produce avionic systems, units and components for any needs, however complex. If you have design or production problems in this field, write, wire or phone: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, New York.

**THIS NEW BOOK** telling of many new and unusual developments in the field of Avionics is yours for the asking. Send request on your letterhead to: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, N. Y.

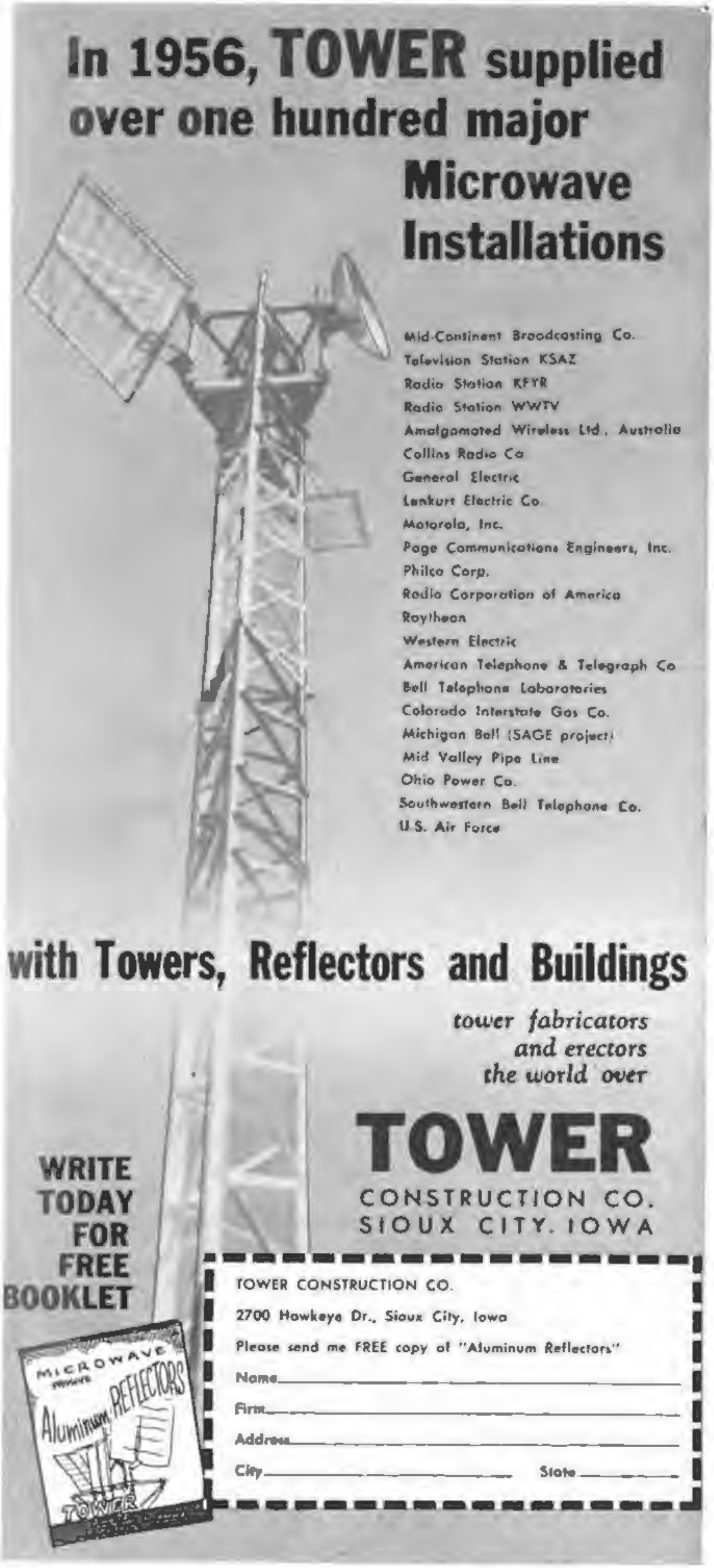
### ELECTRICAL SPECIFICATIONS

**TYPE:** FM 300 KC Deviation
**TUNING RANGE:** 406 to 420 megacycles
Plug-in assemblies to extend range to 500 mcs available
**OSCILLATOR:** Crystal controlled
**SENSITIVITY:** 5 microvolts or better for 10 db quieting
**INPUT IMPEDANCE:** 50 ohms
**BANDWIDTH:** 1.15 mcs ± .1 at 3 db
**IMAGE AND SPURIOUS RESPONSE:** Better than 60 db
**OUTPUT:** ± 0.5 db 40 cps to 40 kc 3 db at 100 kc
3.5 volts RMS 500 ohms closed circuit
**SQUELCH:** Adjustable squelch relay from 10 to 100 microvolts input
**POWER INPUT:** Less than 50 watts. Power supplies available for 115V - 400 cps or 28VDC

### MECHANICAL SPECIFICATIONS

**DIMENSION:** 3.6 x 5.5 x 15.25 inches
**VOLUME:** 300 cubic inches
**WEIGHT:** 10 pounds
**MOUNTING:** Solid — 9 mounting screws
**OPERATING ENVIRONMENTS:** 15 g's
5 to 2000 cycles -55° to +72°C

BELL
*Aircraft* CORP
Avionics Division
BUFFALO, N. Y.



## NEW PRODUCTS

db, and collector efficiency of better than 40% has been achieved. This unit is a p-n-i-p diffused emitter and base transistor, in which a near-intrinsic or "neutral" layer of silicon separates the collector from the other elements.

Alpha cutoff is about 100 megacycles per second, and when used as an oscillator, laboratory samples have produced as much as one watt output at 100 megacycles per second. Input and output impendances are on the order of 20 ohms and 300 ohms, respectively.

Further improvement in the diffusion process, packaging, and other features is expected to result in a transistor which is highly reliable and relatively easy to manufacture.

### *Unique Air Rescue Facility*

Given the problem of developing a lightweight control center which could be towed in a trailer or packaged in a helicopter for transport to the nearest possible site of a disaster scene, Instruments for Industry, Inc. of 150 Glen Cove Rd., Mineola, N. Y., has developed a new type of lightweight radio control center uniquely meeting such demands.

The complete AN-GRC-47 assembly is mounted on a 2-wheel trailer and the radio equipment inside the shelter is encased in watertight, shock-resistant carrying cases specially developed for this application.

Sitting within this control center, an operator can make contact with other aircraft in the vicinity, with ground teams, or any other mobile communications group cooperating in the rescue program.

In addition to facilities for both heating and air conditioning provided in the well-insulated shelter, this Air Rescue Facility offers two unique features: the entire shelter can be folded up like an accordion into a package and only two men are needed to transport, set up and put the center into operation within 15 minutes after the operating site has been reached.

### *Completely Transistorized "Multiverter"*

The first commercially-available, completely transistorized analog-to-digital and digital-to-analog converter has been announced by Packard-Bell Computer Corp., 11766 W. Pico Blvd., Los Angeles 64, Calif.

Called the "Multiverter," the unit provides for high-speed conversions f voltage to digital and digital to oltage at accuracies of better than 01 per cent. Speeds in excess of .5,000 per second are achieved in nalog to digital conversion and 00,000 per second for digital to nalog conversion.

Claimed to be the most accurate onverter ever produced, the Multi-erter is the first all-electronic device hich permits multiplication and di-ision in the process of conversion. oreover, when supplied either as an ncremental or as a whole number onverter, this unit can interchange peed and accuracy so as to follow igh frequency signals at reduced ccuracies.

## New Literature

### *Chart For Reference Data On Capacitors*

A convenient chart for providing excellent reference data on capacitors in a quickly-available form may be obtained free of charge from the Electronics Division, Erie Resistor Corp., Erie, Penna.

Measuring 7⅝" x 4⅛", the plastic card shows dielectric qualities and temperature coefficients of Erie tubular and disc-ceramicons as well as maximum available nominal capacities in MMF. On the reverse side, dimensions of Erie ceramicons and PACs are given.

### *Muirhead Magslips*

Publication "E-1000, Muirhead Magslips, Applications and Methods of Use," a unique 60-page volume offering the would-be designer complete information on Muirhead Magslips and Synchros, is now available from Muirhead & Co. Limited, Beckenham, Kent, England.

Illustrated throughout by photographs, graphs and circuit diagrams, the work opens with a brief note on the history of remote indicating devices, sketches the development of the Magslip and then elucidates the theory of operation.

A simple explanatory first chapter is included for the guidance of those having only a slight acquaintance with the subject. Later chapters deal more fully with technical data concerning design, operation, and application of Magslips and Synchros.

Covering varied aspects of usage, such as remote control and remote indication, design and layout of new applications, and tests and fault location, the book concludes with a comprehensive subject index.

### *The Coming Electronic Communications Revolution*

Forecasting the radical advance of electronic communications and its revolutionary impact upon the total marketing process for every phase of American industry in a staggering short period of 10 years, E. B. Weiss' study-in-depth is now available at no charge from Doyle Dane Bernback, Inc., 20 W. 43rd St., New York 36, N. Y.

Building upon the fact that faster communications means faster marketing, this 63-page booklet explores the exciting consequences for marketing to come with the development of fascinating new communications systems such as international TV circuits, machine translation of foreign languages, electronically controlled trucks and automobiles, automated libraries, equipment which will type as you dictate, televisionfone (a wrist telephone combining both sound and sight), electric stock market speculation, and robot retailing.

Weiss enthusiastically predicts the the resulting outgrowth of an exciting new future for industry, an era of scientific automated marketing.

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DUDLEY A. BUCK, recipient of the **IRE Browder J. Thompson Memorial Prize Award, 1957** . . . for a manuscript by an author under 30 years of age which is the best combination of technical contribution and presentation of the subject.

## *for smaller computers*

**IRE congratulates *Dudley A. Buck* for helping government and American business keep ahead of its work load. His paper entitled "The Cryotron—A Superconductive Computer Component," describes a new active circuit element which introduces large scale electronic digital computers that take up only one cubic foot of space. The new and totally different Cryotron can be easily and inexpensively constructed to help solve problems for science, government and business.**

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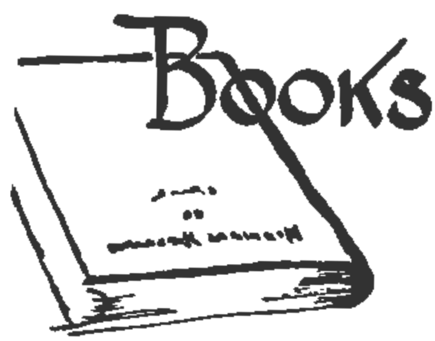

### HE PROSPECTS OF NUCLEAR POWER AND TECHNOLOGY, *by Gerald Wendt. D. Van Nostrand Co., Inc., Princeton, N. J. 330 pages, $6.00.*

This book presents a vital report—ternational in scope—on the present status of nuclear fission, toether with a thoughtful appraisal of e future of industry and society n a nuclear age.

Under the heading, "Power," Part discusses the broad ramifications f "atoms for peace." An overall picure of actual and projected atomic lants, in the U. S. and abroad, is given with consideration of the new problems they introduce in such realms as finance, insurance, and governmental control. Dr. Wendt gives serious attention to the immense economic and social upheaval inevitably to result in the new era.

Part II, entitled "Technology," furnishes the important technological background needed to comprehend a totally new concept of industry. The author details the mineral resources available, the nuclear fuels needed, the new metals and materials used in the construction of nuclear reactors and the design of the various types of reactors. Problems remaining to be solved with regard to fission products are discussed. The author indicates the great potential of the nuclear industries in the generation of power, in transportation and in the manufacture of isotopes and other materials with resulting advances affecting the lives and well-being of every citizen.

### THE SIGNAL CORPS: THE TEST, *by George Raynor Thompson, Dixie R. Harris, Pauline M. Oakes and Dulany Terrett. Office of The Chief of Military History, Dept. of The Army, Washington, D. C. 621 pages, $4.50.*

In the series, *U. S. ARMY IN W. W. II*, this volume is the second of a subseries concerning the history of the Signal Corps in the Technical Services and describes the crucial "Test" put to the Signal Corps during the first 18 months of America's involvement in W. W. II.

How the Signal Corps met the challenges, frustrations and overwhelming demands to develop during that period is the theme of the book.

The extent to which the communications systems tie into the tactical systems caused the Signal Corps to receive the brunt of the first calls for men and equipment. To meet the crisis, an amazing expansion of the communications industry in close partnership with the Signal Corps resulted.

The achievements related do not seem to differ greatly from tasks met by other technical services similarly burgeoned under wartime stresses. However, the authors contend that Signal problems are unique. "The science of electronics recognizes no international boundaries; it is all-pervasive; it keeps bursting the lid."

The desperate race with the enemy to produce electronic weapons and counterweapons provides a fascinating story for electronics experts and laymen alike. Ample illustrations and maps vividly picture the events leading to the Test's successful outcome.

The book ends with an account of the crisis which was brought on by the Signal Corps' belief that electronics must be controlled from the very top echelon of War Department authority.

### DESIGNING FOR INDUSTRY, *by F. C. Ashford. Philosophical Library, New York. 210 pages, $6.00.*

The purpose of this book is to provide an overall reliable picture of the profession of product designing, in a manner of general guidance, rather than detailed instruction.

With the advance of technology and the growth of competition, the role of the designer becomes increasingly important not only to those who aspire to practice but also those whose occupations create a need for an appreciation of the various aspects involved.

The boundaries of mechanics and economics within which the creative artist must work are discussed together with sociological and aesthetic restrictions. Practice and some of the executive aspects are extensively treated.

Together with a certain capacity for variety, the task of keeping alive the human scale no matter through what phase of technology we may pass, is finally entrusted to the designer for industry.

### TRANSISTORS HANDBOOK, *by William D. Bevitt. Prentice-Hall, Inc., Englewood Cliffs, N. J. 410 pages, $9.00.*

For the practicing engineer, the radio-TV serviceman, the experimenter or the radio amateur, this manual offers complete practical information on transistors and their specific applications.

With a minimum of mathematics and no complicated theory of physics, the handbook discusses why transistors make electronic circuits simpler, more efficient and more compact, and shows how they make new circuits possible. For convenient reference. a chart is included which lists 56 types of commercially available transistors along with their number, manufacturer, typical operating characteristics and specific applications.

Instruction is given on how to connect transistors in the 3 basic amplifier circuits, how to build inexpensive test devices and compact receivers, and how to employ transistors in gate circuits.

Scores of circuit diagrams, each with typical values of circuit elements, are provided to serve as examples of good transistor circuit design. 380 illustrations supplement the work and a detailed index is included.

### RADIO OPERATOR'S LICENSE Q & A MANUAL, *by Milton Kaufman. John F. Rider Publisher, Inc., New York 11, N. Y. 720 pages, $6.60.*

Designed as a study aid or reference volume, this new edition provides information in complete accordance with the FCC Study Guide now being used as a basis for radio license examinations.

Having been brought up to date particularly with regard to new operating procedures and new frequencies, questions are renumbered according to the new Study Guide. Answers are given in logical simplified form and are followed by supplementary discussions to provide the reader with maximum background information and thorough explanation of the question.

All 8 Elements, including E. 7 on Aircraft Radiotelegraph and E. 8 on ship Radar Techniques are covered. Subject matter is arranged according to Element to agree with the FCC exam presentation. However, a complete index offers convenient study or reference by subject.

This volume also contains valuable appendices on Small Vessel Direction Finders and Automatic Alarm. claimed to be exclusive with this book.

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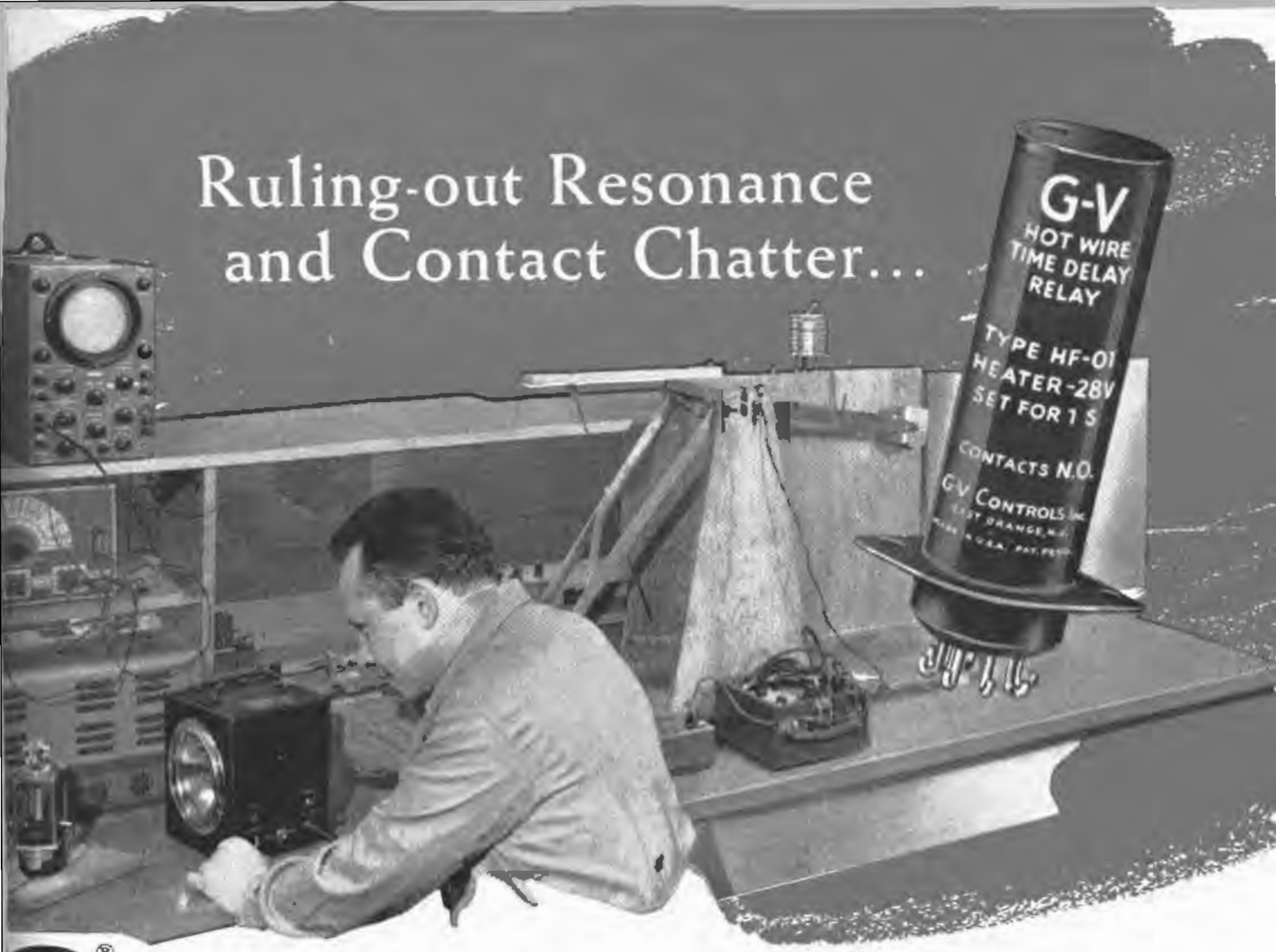

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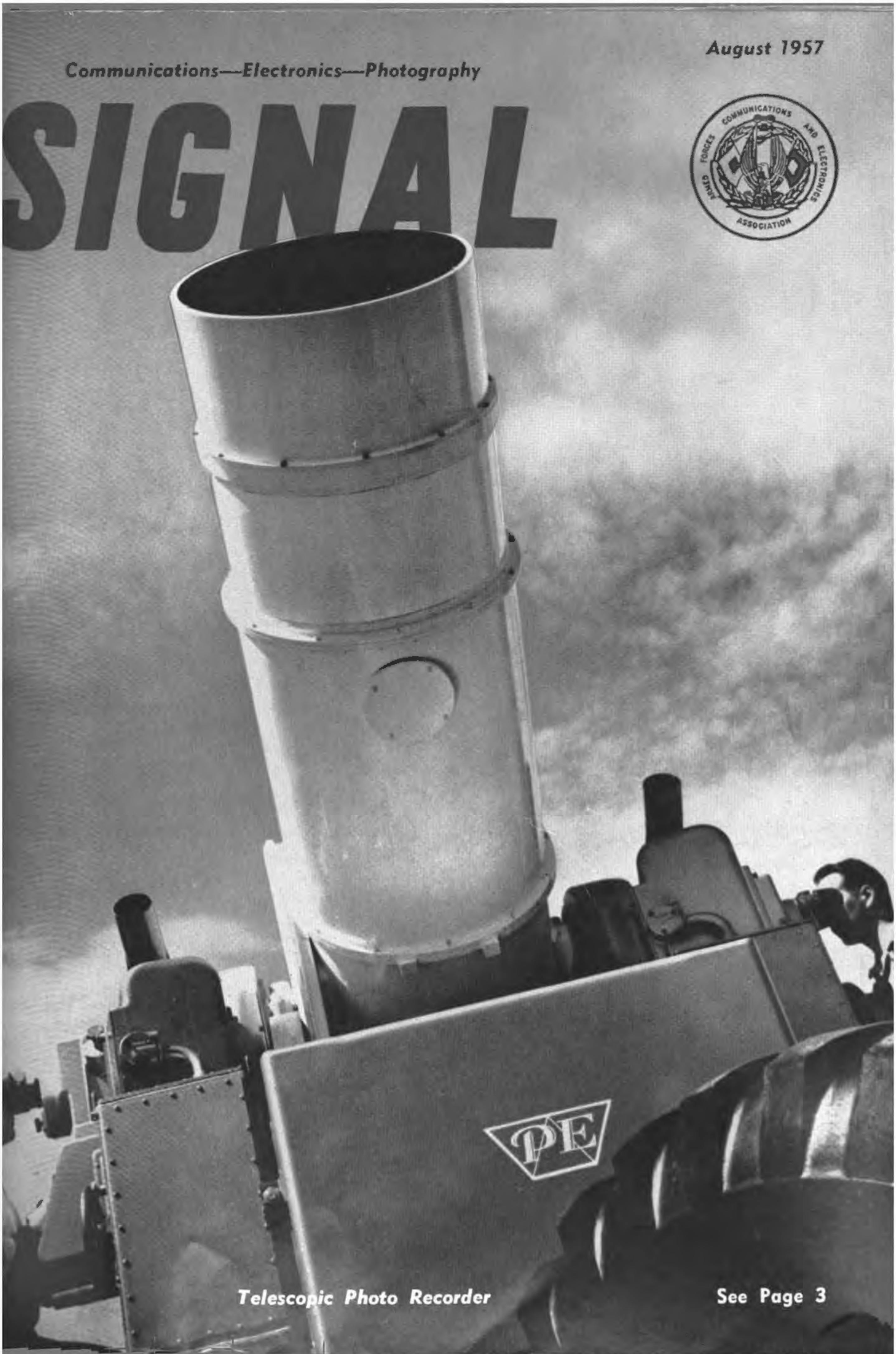
August 1957

Communications—Electronics—Photography

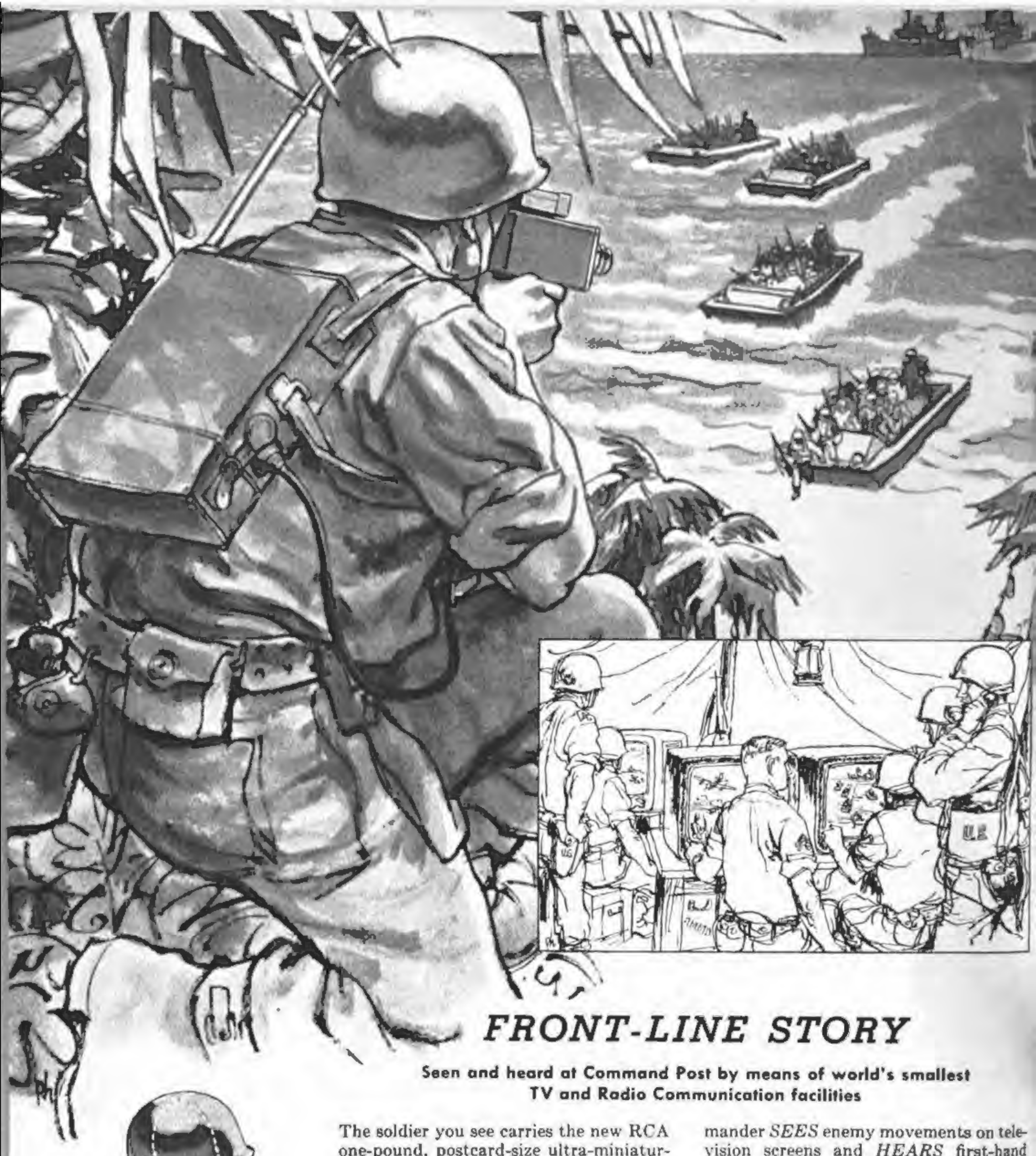
# SIGNAL

Armed Forces Communications and Electronics Association



***Telescopic Photo Recorder***

**See Page 3**



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Transistorized radio receiver transmitter completely concealed in helmet has up to 5-mile range.

"Telemite," smallest TV camera, features newly developed RCA ½-inch Vidicon tube, size 1⅞'' x 2⅛'' x 4¾'', weighs about one pound.

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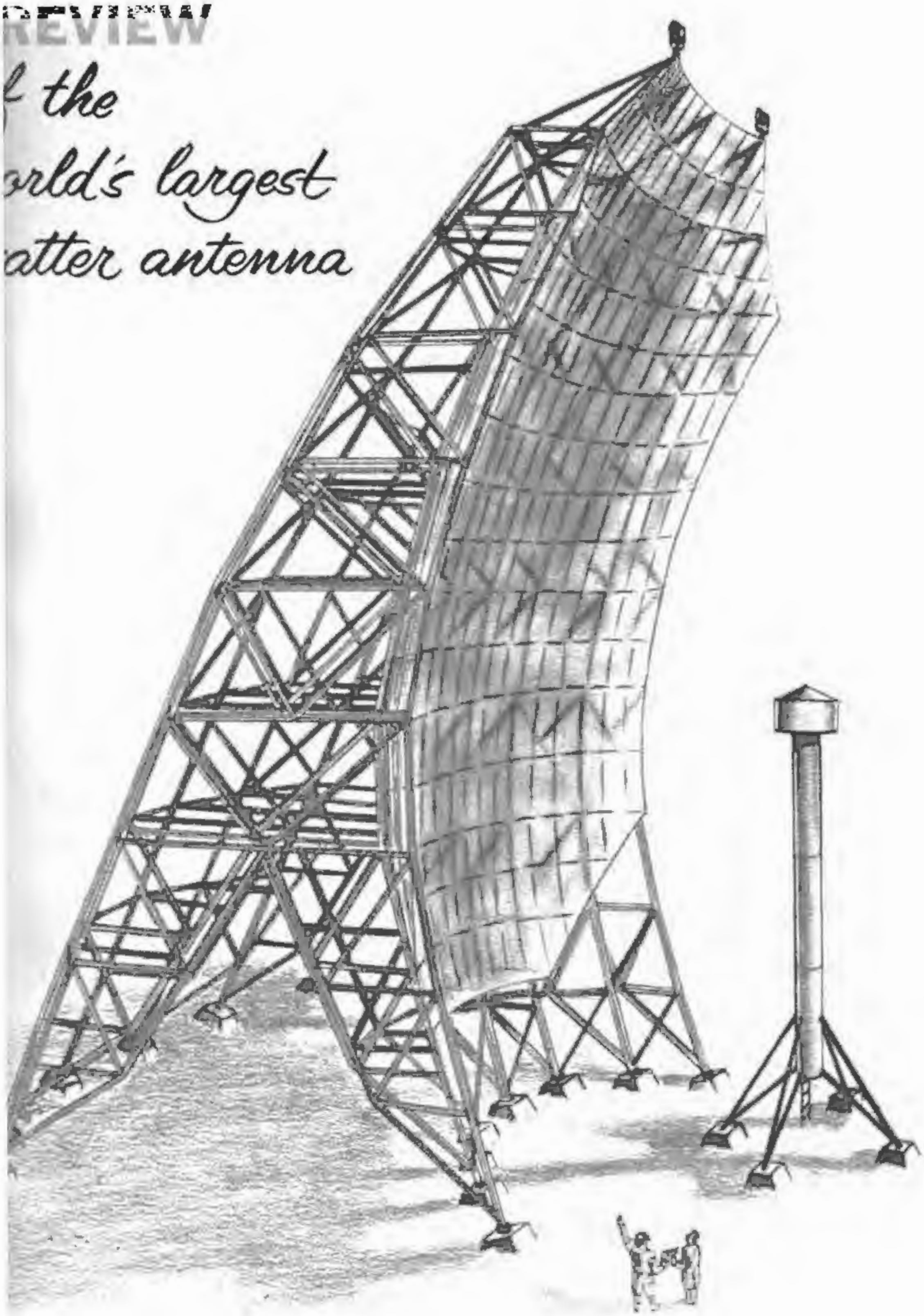

## **WARNING** -- *Radar Trap!*

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When an intruder approaches, his range, bearing, course and speed are instantly flashed to the Continental Air Defense Command, along with voice and intercept command signals. This information, "multiplexed" by Lenkurt single-sideband carrier equipment, rides ashore on a microwave radio beam.

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# SIGNAL

**Communications-Electronics-Photography**

Journal of the Armed Forces Communications and Electronics Association

**VOLUME XI** **AUGUST 1957** **NUMBER 12**

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### Coming in the September issue . . .

*"The White Alice Story"*—a timely report on the vast new communications system being forged in Alaska, written by William E. Burke, Vice President, Defense Projects Division, Western Electric Company.

*"The Golden Era"*—Don G. Mitchell, Chairman of the Board and President of Sylvania Electric Products, Inc., deals with technological progress in two major industries, electronics and photography.

*"Production Performance and Engineering"*—Lieutenant General C. S. Irvine, USAF, Deputy Chief of Staff, Materiel, outlines a new Air Force concept, the "Sub-system Approach," which was adopted to give direction to design, development and production efforts of the Air Force.

### Cover

SIGNAL's *cover picture shows the Nation's first completely mobile optical tracking system, the Telescopic Photographic Recorder. Capable of photographing a 2 by 7 inch subject at an altitude of 4 miles, the device will be used to record the flight history of missiles, aircraft and bombs.*

*Delivered to the Air Research and Development Command, the six-ton system will soon undergo range evaluation tests at Eglin Air Force Base, Florida. It was designed, developed and built by the Perkin-Elmer Corporation of Norwalk, Connecticut.*

**1624 Eye Street, NW**
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**Phone: EXecutive 3-3033**

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## THE STORY BEHIND THE STOR

**MISSILE CRUISER**–Problem: To launch a missile 1500 miles from target. An error of only 1 degree in launching information would cause a 25-mile target miss.

**SUPERSONIC BOMBER**–Problem: To navigate undetected for thousands of miles to exa tion in space for release of bombs or missiles.

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U. S. strategy for maintaining peace by making aggr unprofitable is based on our ability to deliver a crushing atory blow anywhere in the world. Accurate means of dir such blows at long range, high speeds and extreme alt make would-be aggressors wary of breaking the peace.

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**RAdm. Joseph N. Wenger, USN Director, Communications and Electronics, Joint Chiefs of Staff**

*Convention Symposium*

# SCATTER PROPAGATION

- ***RAdm. Joseph N. Wenger, USN, Panel Moderator.***
- ***Colonel W. A. Ross, USA, Acting Assistant Chief, Army Communications Service Division, Office of the Chief Signal Officer.***
- ***Captain W. A. Ellis, USN, Head, Plans and Policy Branch, Naval Communications Division.***
- ***Colonel Robert C. Sears, USAF, Chief, Engineering Branch, Office of the Director, Communications-Electronics, USAF.***

*Note: This presentation will appear in two installments. Part II will be published in the September issue of* SIGNAL.

*Admiral Wenger:*

At the request of the Directors of AFCEA, the joint Communications-Electronics Committee of the Joint Chiefs of Staff have undertaken to prepare and present a joint discourse on some of the operational aspects of scatter propagation as seen from the military viewpoint.

In discussing this important subject, my role will be primarily that of introducing the representatives of the Army, Navy and Air Force who are to be the principal speakers. They will discuss the uses of scatter mode propagation by heir respective Services.

Before proceeding with our program, I should like to nsure that we are all on common ground for the discussions. Since scatter mode propagation, as applied to communicaions, is a relatively new technique, some of you may not ave had the opportunity to become familiar with the basic principles and phenomena involved, and others perhaps would like to refresh your minds. Therefore, I shall attempt to review briefly a few of the fundamentals.

Communication beyond the horizon in the high frequency portion of the spectrum is made possible primarily by the reflection of radio waves by the F-layer of the ionosphere. This is the normal method of long range communication with which we are all well acquainted (See Figure 1).

At frequencies above the maximum useable frequencies for this F-layer propagation of radio waves, partial reflection or scattering takes place at the E-layer. This phenomenon has been likened to a glass which has been lightly silvered to give a partial mirror effect. The portion of the transmitted energy thus reflected is minute when compared to the portion of the transmitted energy reflected from the F-layer in the high frequency mode. However, small as it is, the available energy scattered in the E-layer can be usefully employed for communication purposes provided certain measures are taken to enhance the signal at the receiver. This mode of propagation is known as Propagation by Ionospheric Scatter. It is most feasible in the 30 to 55 megacycle band and can provide reliable communication from about 600 to 1400 miles.

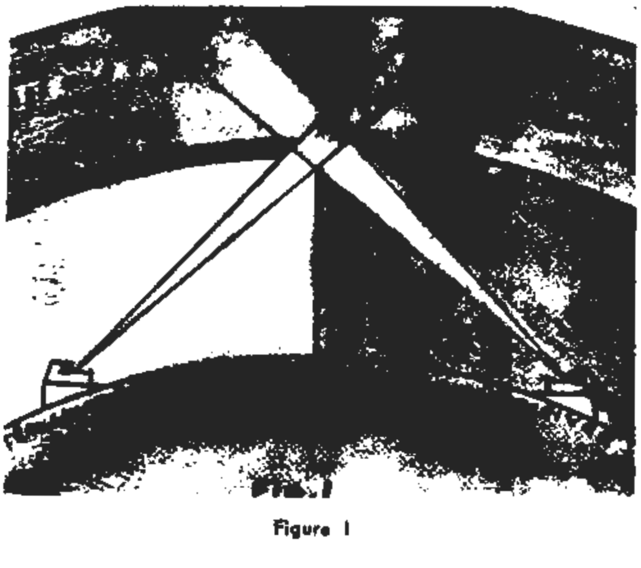

Figure 1

In order to communicate by ionospheric scatter, three conditions must be met. First, the transmitter must be operated at high power, about 40 KW at the present time; second, the receiver must be very sensitive; third, the antennas on both ends of the circuit must be of such design as to give high gain, narrow beam width, and a minimum of radiation in other than the forward direction.

Antennas which have been used with acceptable results are the rhombics, Yagis and corner reflectors. The latter have given best results. Both space and polarization diversity have been used to enhance the reliability of the received signal. In fact, space diversity is considered a requirement on present scatter circuits. In order to achieve the necessary high gain at the operating frequency, the antennas must be physically large. For operation in the far northern latitudes, ice and wind loading are, therefore, important considerations in the design of antennas.

In the auroral zone high frequency operation is often "blacked-out" for long periods as a result of high sun spot activity. During these black-outs the ionospheric scatter mode is enhanced, offering a reliable means of communication during these periods. The use of highly directional antennas further improves our capability in this area.

The requirement for the Armed Forces to operate and communicate in the high northern latitudes has thus brought about installation of the first operational ionospheric scatter circuits in the auroral zone. These will be discussed further in the presentations that follow.

Another scatter technique, which differs somewhat from that just described, is known as Tropospheric Scatter. (Figure 2). The scattering phenomenon in the troposphere takes place primarily when operation is in the UHF range. Transmitted powers in the order of 1 KW to 10 KW, depending on

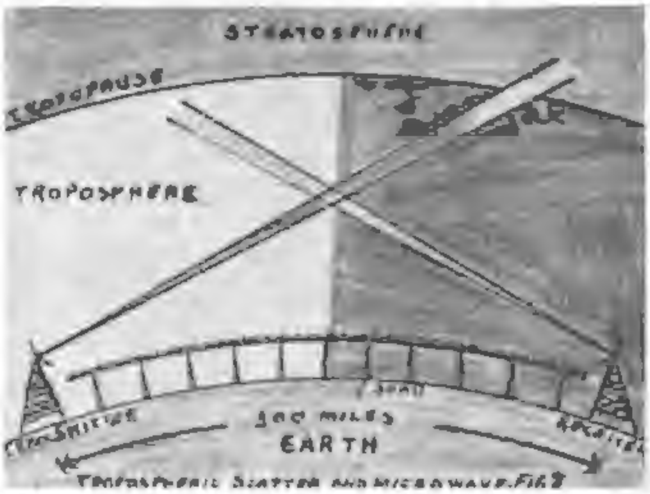

Figure 2

the path requirements, in conjunction with sensitive receivers and high gain antennas, give exceptionally reliable communications. The antennas are paraboloids in the order of 30, 60 or 120 feet in diameter, again depending on the path requirements. Here, too, space and polarization diversity are engineering considerations to enhance the received signal.

Tropospheric scatter mode can provide many channels of voice and teletype up to distances of 350 miles at the present time. It is a desirable substitute for microwave under certain conditions. Short over-water hops, impractical for microwave, are easily bridged by tropospheric scatter. But even over land, where microwave is usually relayed every 25-30 miles, tropospheric scatter can cover 250-300 miles between relays or terminals. This factor not only reduces the number of stations to be maintained, but provides a greater degree of physical security to the system due to the reduced number of stations to be guarded, and a greater degree of equipment reliability due to the reduced quantity of equipment which can fail.

The Joint Communications-Electronics Committee of the Joint Chiefs of Staff has developed a plan for overseas military ionospheric scatter circuits. The plan is world-wide in scope and is completely joint in relation to the Armed Services. This plan has the approval of the Secretary of Defense.

The joint plan designates in specific areas of the world a single military service to provide the ionospheric scatter circuitry to be used by all military departments. The Navy is charged with providing circuitry and facilities across the North Atlantic Ocean and between the Continental U. S. and Alaska. The Air Force is responsible for circuits from the Continental U. S. to the Mediterranean area. These circuits are in addition to North Atlantic ionospheric scatter circuits now in operation. The Army is responsible for scatter circuits in the Western Pacific area. Further details of this plan will be given by the speakers who will follow me.

In their presentations, specific data will also be given concerning the reliability and economy of scatter circuits. It should be emphasized that although scatter techniques have been used for communication for only a few years, they already have provided the Armed Forces with means of communicating reliably in areas where communication has been difficult at best. We must accept the cost involved to obtain the required reliability. However, the actual cost has not been unreasonable for the results attained.

During the extremely high level of sun spot activity, which we are now experiencing, the maximum useable frequency (MUF) for high frequency communication has risen into the low VHF band. This is the band in which the ionospheric scatter circuits have been operated because of technical consideration. With the advent of a high MUF, some of the ionospheric scatter circuits have been operating in the F-layer reflecting mode, as well as the scatter mode from the E-layer. The high power and high gain antennas, coupled with an exceptionally high MUF, have caused some interference with mobile communication in the low VHF band. These same factors have caused low power transmitters for mobile use to interfere with our received signal. As has been previously mentioned, this interference is caused primarily by the extremely high level of sun spot activity which is now occurring, and the degree of interference now experienced can be expected to lessen after the solar maximum has passed.

We do not look upon these two scatter techniques as the solution to all of our communications problems. Both techniques require further study, and, as more information is obtained about the scatter phenomena, surely we can expect to come closer to our goal of 100% reliable communication. Thus far, these scatter techniques have permitted us to increase the reliability of communication in the far North.

The siting problem, dictated by the size of the antennas, the requirement for space diversity, and the critical requirements of terrain for suitable Fresnel zones, imposed a formidable obstacle in some locations. The range limitation was also an important factor. In some cases the high power required for the extreme range forced us to abandon scatter in favor of our old friends, high frequency and microwave.

In summary, I think one can safely say that, although ionospheric and tropospheric scatter are by no means the answer to all of our military problems, they do represent new techniques of great importance to the military Services. Why this is so, I think will be made clear in the detailed discussions that follow.

The next speaker is Colonel W. A. Ross, U. S. Army, Acting Assistant Chief of the Army Communications Service Division, Office of the Chief Signal Officer, who will deliver the Army's presentation.

## *U. S. Army Presentation*

I would first like to discuss some of the tactical considerations of scatter communications. Generally speaking, we believe that tropospheric scatter has the most promise for tactical applications, at least for the immediate future.

The threat of atomic weapons must be considered in the planning of communications networks. Defense against atomic attack calls for troops to be dispersed in small groups with the ability to group for attack. These groups must disperse again rapidly when objectives have been obtained, so as not to present a favorable target. Furthermore, the concept of dispersion will mean that there will exist islands of resistance, with unheld territory between, or even with enemy forces occupying some of the territory between groups of friendly troops.

If the territory in a combat zone must be subject to rapid change of control, the communications networks must be able to function across these unoccupied or enemy held areas. If this area is not held by the enemy, wire may be used but where the enemy controls this area, radio relay or scatter may provide the necessary communications. Let us assume conditions where this area becomes large, so large that the usual radio relay cannot span this area. Attention is then focused on tropospheric scatter which can span the distance of many radio relay links. When such a long span is used the tropospheric terminal equipment may become large and heavy. Antennas about 28 feet in diameter and weighing nearly a ton might be required. Mobility is reduced with heavy equipment and for air lifting the problem becomes especially serious. However, for large areas, such as I have discussed, tropospheric scatter becomes attractive, even with these limitations.

The size of equipment necessary for this means of communications is at present too large. For tropospheric propagation, about 15,000 cubic feet of equipment weighing about 12 tons is necessary to transmit 10 KW. This equipment could be made mobile, but good roads are needed, when the equipment is moved.

For tactical operations, further evaluation is required on presently developed equipment and that to be produced in the future.

If equipment size is reduced, it then becomes more attractive, but along with size reduction must come consideration of the various types of modulation, power, antenna structures and frequency of operation.

ctually the future ability of scatter propagation to contribute the Army communications network appears good. There re- in the jobs of selection of equipment parameters, field testing integration into the communication network. This will take e. *Initial* equipment will not have the maximum use capability, will point the way for future development to more nearly *isfy* our needs.

he Signal Corps, in meeting the requirement for multichannel dium distance communications, plans to take advantage of the *pospheric* scatter mode of transmission. To meet this require- nt, the equipment must be mobile, easily installed and require minimum amount of power. For tactical applications, Radio *AN/TRC-60* is proposed and is expected to be available for in approximately one year.

our vehicles will contain the equipment, as follows:

ruck #1 contains the operating 1 KW power amplifier.

ruck #2 contains modified AN/TRC-24 receiving terminal r, with low noise front ends, diversity combiners and a phone Terminal AN/TCC-7.

ruck #3 contains a standby 1 KW power amplifier which is nected to the diversity antenna but which is non-operative under mal conditions.

ruck #4 is used to house and transport the dual diversity enna system.

he AN/TRC-60 will provide 12 voice channels. This channel ability will be obtained using modified, existing, standardized litary radio relay and wire terminating equipments as the basic vices.

Figure 1 shows a comparison of radio relay and the AN/TRC-60. you can see there are both advantages and disadvantages. A y obvious advantage of scatter in this particular comparison the reduction of personnel required.

mparison of 100 Mile Radio Relay & Tropo Scatter Systems

| | Total Weight in Tons (Uncrated) 100 mi. | Total Weight in Tons (Uncrated) 200 mi. | Total Volume in Cubic Ft. 100 mi. | Total Volume in Cubic Ft. 200 mi. |
|---|---|---|---|---|
| nventional Radio Relay stem (AN/TRC-24) th 25 mile hops. | 7.83 | 15.25 | 650 | 1266 |
| opo Scatter System N/TRC-60) with 0 mile hops. | 5.18 | 10.35 | 770 | 1540 |

| | Estimated Cost 100 mi. | Estimated Cost 200 mi. | Estimated Station Personnel 100 mi. | Estimated Station Personnel 200 mi. |
|---|---|---|---|---|
| nventional Radio Relay stem (AN/TRC-24) th 25 mile hops. | $122,000 | $234,000 | 26 | 50 |
| opo Scatter System N/TRC-60) with 0 mile hops. | $105,000 | $210,000 | 12 | 24 |

Figure 1. All figures exclude power units and vehicles.

One of the characteristics of tropospheric scatter is the linear rease in reliability for distance covered for a given case of ed parameters, i.e., same power, antenna size, band width, etc.

Figure 2 indicates the expected performance of the AN/TRC-60. The left hand column indicates the relative decrease in relia- ity of voice transmission for 25% incremental changes in dis- nce between two terminals. While it is true that increased wer would compensate for longer distance coverage, practical pects of tactical communications will limit the size of the power plifiers and the antennas and consequently the radiated power.

Performance of Radio Set
AN/TRC-60

% of Time Terminal Trunk Performance is Obtained

| Miles Per Jump | No. of Jumps | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 75 | 99.8 | 99.6 | 99.5 | 99.2 | 99.0 | 98.7 | 95 | 91 |
| 100 | 97 | 93 | 90 | 86 | | | | |
| 125 | 78 | 62 | | | | | | |
| 150 | 50 | | | | | | | |

Figure 2.

For a 150-mile circuit with no repeaters, the reliability is shown be 50% as compared to a single 75-mile jump with the same ower and equipment producing 99.8% reliability.

Two 75-mile hops, which would provide the 150-mile service, would give an overall system reliability of 99.6% as compared to 50% for the single jump system. For the case of a 300-mile system, the relative reliability would be the determining factor between a 4-jump, 75-mile tandem system giving 99.2% reliability as against a 3-jump, 100-mile system producing only 90% reliability—longer tandem jumps being impractical from a reliability point of view.

Now I would like to discuss the use of scatter circuits for long range strategic communications. Probably, the most useful range of tropospheric scatter is two or three hundred miles; therefore the use of this mode in long range communications is obviously limited. Relays provide a partial solution, but there are many cases, such as over-ocean areas, where relays cannot be used. Even where relays are possible there is still the problem of logistic support and physical security. Ionospheric scatter appears to be well adapted to medium range point-to-point communications. In those areas where relay points are available, ionospheric scatter networks, supplemented by tropospheric scatter feeder circuits, may provide an important addition to the long range strategic communications system.

The Army has established an ionospheric scatter system in Alaska and a tropospheric scatter system between Washington and Fort Monroe, Va. Most of the Army's experience in the operational aspects of scatter has been obtained from these two systems.

In 1952 studies were made to determine an appropriate link in the Army global communications network where an ionospheric scatter circuit could be established and where the theoretical advantages could be realized.

It was decided that an ionospheric scatter circuit between Southeastern Alaska and Central Alaska would be satisfactory for this purpose and would fill an operational requirement during the period of experimentation.

A contract was awarded to the Page Communications Engineers, who first made preliminary engineering studies to determine the feasibility of establishing such a circuit and to select appropriate sites.

Sites were eventually selected at Juneau and Kenai, a distance of 607 miles.

Detailed engineering plans and cost estimates for the establishment of this circuit were prepared.

In April 1954, the contractor was authorized to proceed with erection of equipment shelters, antennas, and the installation and testing of the equipment.

The final installation and testing was completed in December of 1955.

Two National FSK-2 equipments were used and provided for 8-teletypewriter-channel operation. This required the use of two AN/FGC-5 time division multiplexers. In addition, a third modulation equipment was installed which provided a narrow band FM voice channel. This voice channel could be used in place of one of the 4-channel teletypewriter groups.

The major items of the transmitter terminal equipment are the two FSK-2 equipments and the voice exciter.

The major items of the receiver terminal equipment are the receiver, monitors, and distribution equipment.

The FSK-2 exciters employ frequency shift modulation using a frequency shift of ±3 KC. The center frequencies of the FSK-2 exciters are operated 10 KC apart. The narrow band FM voice channel is operated on a third sub-carrier frequency which is 11 KC lower than the assigned frequency. The total band width required is approximately 27 KC.

The antenna system consists of three identical 60° corner reflectors. One is for transmitting and two are for receiving.

Each antenna consists of four full wave colinear dipoles fed in phase. The 60° corner reflector is supported from a 9-tower array. The antenna is over 100 feet high. It is about 160 feet across the front. This antenna has a free space gain of approximately 20 db. There is another detail which is of passing interest. This is the moose guard. There were several occasions when moose got all tangled up in the antennas. It was necessary to build a fence around the antennas to keep the moose out.

The equipment is housed in prefabricated steel panel buildings. The small building contains the auxiliary power generators (See photo on page 11).

The circuit from Juneau to Kenai used a frequency of 34.4 mc. The circuit from Kenai to Juneau used 36.4 mc.

Prior to turning this installation over to the government, the contractor conducted basic studies in several areas.

Studies of binary error rates at various pulse repetition rates were made and shown as a function of observed signal to noise ratio. Bit rates of 150 to 1500 bits per second were employed. These studies provided a basic method of measuring system reliability.

The radiation patterns of the corner reflector antennas were measured and found to be in close agreement with the theoretical pattern.

(*Continued on page* 11)

This circuit offered the first opportunity to evaluate the newly developed FSK-2 equipment. The use of the FSK-2 equipment on his circuit proved the equipment to be highly satisfactory.

A study was made using on-path and off-path antenna pattern orientations. This was to determine the relative signal contributions from both meteor reflection and scattering. It was observed that the signal received with the off-path orientation was greater than the on-path orientation during periods of low signal intensity and high meteor activity. This was especially noticeable during the early morning hours. The tests confirmed the value of additional investigations in this area.

The expected propagation reliability of approximately 99% for this circuit using 4-channel multiplex was confirmed. On 1 January 1956, the contractor turned this installation over to the Government for operational use by the Alaska Communications System.

Both telephone and teletypewriter traffic was handled during the period of operational employment.

Due to the rise in solar activity during 1956, long distance sky wave transmissions from Kenai caused serious interference to other services in California and it became necessary to silence the transmitter during most of the daylight hours.

When the transmitter could be operated, performance of the circuit continued to be highly satisfactory with only about a 1% outage due to propagation and a 2% outage due to other factors.

This interference problem could have been resolved by operation at a higher frequency. The change to a higher frequency was not practicable since it required complete antenna redesign and other extensive transmitter modification.

Operation at the higher frequencies tends to lower the reliability of the circuit due to a decrease in the signal strength as the frequency is increased. The higher frequencies avoid long-distance sky wave interference and lower frequencies provide higher signal levels.

The Juneau to Kenai ionospheric scatter system was a successful application of ionospheric scatter as a reliable means of communication. The expansion of other communications facilities in Alaska and an urgent need for this equipment elsewhere led to a decision to deactivate this circuit. This circuit was deactivated in October 1956.

I believe that now would be an appropriate time to discuss some of the equipment aspects of ionospheric scatter.

### *Transmitting Equipment*

In order to satisfy stated military characteristics for radio transmitting equipment for scatter use, the U. S. Army Signal Engineering Laboratories are currently directing the development of Radio Transmitting Sets AN/FRT-32 and AN/FRT-34. These equipments are intended to provide maximum reliability and utility for military scatter application. The design and construction work has been undertaken by Continental Electronics Manufacturing Co. of Dallas, Texas.

The equipments are designed primarily for A3a and A3b emissions, with provision also for A-1, F-1 and F-3 emissions. There are three amplifiers which make up these transmitters. Power output capabilities are intended to be 32, 100, and 600 kilowatts peak envelope power for A3a and A3b emissions. We expect to run at 16, 50 and 300 kilowatts carrier power for A-1, F-1 and F-3. So, we generally refer to the three amplifiers involved as the 16 KW, 50 KW and 300 KW units.

Radio Transmitting Set AN/FRT-32 includes all amplifier units, while Radio Transmitting Set AN/FRT-34 includes only the so-called 16 KW and 50 KW units. The sixteen-kilowatt unit has no "set" nomenclature as yet.

The exciter unit employs circuits operating at relatively low frequencies for generation of the various types of modulated signals. These are multiplied or converted to a common frequency of 18 megacycles, where they are in turn converted to the output frequency by an internal crystal oscillator. Input connections are available for external excitation at 18 megacycles, or for variable frequency oscillator insertion in place of the crystal oscillator.

The sixteen-kilowatt amplifier is designed primarily as driver equipment for the higher powered amplifiers. It can be operated directly into antenna systems for emergency use, or for circuits requiring lesser amounts of power. The control system provides for operation of this equipment with either the 50 KW or the 300 KW amplifier as an integrated transmitter unit.

Single tubes, operating Class B for all services, are employed in each of the power amplifier stages.

The sixteen-kilowatt unit employs an Eimac 4X500A, driving an Eimac 4W20, 000A in grounded cathode circuits. It contains circuitry for both unbalanced and balanced output.

The 50-kilowatt stage employs a Machlett Type ML-5681 in a grounded grid circuit. The 300-kilowatt stage employs an RCA Type A-2332-D in a grounded cathode circuit. Both these stages use tank circuits consisting of capacity loaded lines.

Balanced output networks for each stage are contained in additional cabinets. The tube selection, operation and circuit configuration were chosen to minimize harmonics and spurious problems consistent with other requirements. The frequency range is covered in not more than three bands for any of the system components. Standing wave ratio and power output indicators are employed for all tuning functions.

Water and forced air cooling are employed for each equipment. Heat exchanger design is based on maximum temperature and altitude likely to be encountered. Because of this consideration the 50 KW and the 300 KW heat exchangers are each divided into two sections. It is expected that only one section for each amplifier will be required for adequate cooling in most installations. The exchangers may be located some distance from the transmitters if necessary. For locations having adequate natural water supplies, a water to water exchanger of much smaller dimensions can be supplied, eliminating all radiators and their cooling fans.

Automatic regulation of all tube voltages and extremely low impedance power supplies have been employed. Plate supplies are three-phase full wave rectifiers. The 300 KW stage employs two such supplies operating in series because of limitations on the peak inverse ratings of the rectifier tubes at high temperature ambients.

Transformers and filter inductors are capable of outside installation except under extreme arctic temperatures. "Electronic crowbar" circuits are provided for protection of the 50 KW and 300 KW tubes against damage due to internal arc back. Key interlock systems coupled to grounding arms on all high voltage circuits are provided. Fault locating systems are included in the control circuitry. Primary distribution and control are contained in cabinets rather than the usual wall switch gear.

The use of ceramic insulation has been avoided wherever possible to minimize the necessity for disassembly of the major components of the equipment for shipment.

A 300-kilowatt dummy load is available for test purposes if required; however, this is not included as part of the equipment. RF switching, water de-ionizing equipment and provision for intake and exhaust of cooling air are considered part of the station installation; likewise, these are not included with the transmitters.

It is expected that the completion of this development will provide all the Military Services a series of radio transmitters which will meet their requirements for use in scatter propagation in the VHF range.

The Army has recognized the potentialities of tropospheric scatter in meeting certain Army fixed plant operational needs. In 1953 it was decided to establish a tropospheric scatter circuit on a quasi-experimental basis using off-the-shelf equipment if possible. This circuit would be used as a testing facility to evaluate the performance of various assemblages of equipment and to gather empirical data on long term circuit reliability.

A study was made of available Signal Corps equipments to determine those which could be used on tropospheric scatter circuits. It was determined that with the exception of high powered RF amplifiers and suitable antennas, useable components were available in the Signal Corps Supply System.

After suitable studies, a circuit between Woodbridge, Virginia, and Ft. Monroe, Virginia, was selected as an appropriate path for establishing the experimental circuit. The path length of approximately 145 miles was considered adequate to reveal the capabilities and limitations of a system made up of available equipment.

A contract for the installation of this system was awarded to RCA. RCA modified the buildings, supplied the 10 KW amplifiers and the parabolic antennas, installed the Signal Corps furnished equipment, tested the system and turned the operating installation over to the Army in May of 1955.

The terminal equipment is comprised of the following:

A cabinet which contains Telephone Terminals AN/TCC-3 and Telephone Carrier Terminals AN/TCC-7;

A second cabinet which contains the AN/TRC-24 Transmitters and Telephone Carrier Terminals AN/TCC-7;

A third containing test equipment and the AN/TRC-24 receivers;

Fourth cabinet containing more test equipment and the VF Ringing equipment, and 4 additional cabinets containing the 10 KW amplifier (See photo above).

The antennas are parabolic dishes 28 feet in diameter, constructed of perforated aluminum and weighing 1100 pounds. (See photo below).

Test operations were conducted by the Army for a year. Considerable data was gathered on equipment reliability, median signal strength, rate of occurrence of telegraph errors and reliability of telephone channels.

An analysis of this data revealed that the circuit did not provide the year round reliability needed for Army fixed communications. During the summer months the circuit performance was highly satisfactory. During the winter months the circuit was not satisfactory a large percentage of the time.

It was determined that several steps could be taken to improve the operation during the winter months. The receivers could be improved for this mode of operation by providing low noise preamplifiers and narrow bandwidth IF amplifiers. Diversity reception could be used to provide additional improvements. Our calculations indicated that with these changes the circuit could be expected to provide the required reliability on a year round basis.

At the present time the terminals are maintained in a stand-by status, pending modifications. It is expected that the improvements will be completed by August 1957, at which time the evaluation of circuit performance will be resumed.

After a period of successful performance the circuit will be employed for operational traffic. The experience gained in this effort will be used as the basis for future Army fixed-plant installation of this type.

With regard to our future plans for other scatter circuits, I can say that we are planning on a scatter system in the Western Pacific, which will supplement some of the existing HF radio circuits.

There are many problems involved in the planning and installation of military scatter systems, or any scatter system.

The selection of routes is often dictated by the availability of suitable relay points. Selection of these relay points and terminals requires a consideration of many factors. I will mention only some of the factors which must be considered in their selection:

The station function or mission.
Geographical factors.
Present land occupancy and ownership.
Siting criteria for the equipment.
Horizon clearances.
The climate and atmospheric conditions.
Availability of power and utilities.
Access roads and bridges.
Local communications.
Local transportation.
Local population, its language, its customs and its economy.
Civic development.
Availability of Government facilities, if any.
Subsistence and quarters.
Recreational facilities.
Medical and dental facilities.
Office facilities.
Shipping and warehousing facilities.
Availability of construction materials and equipment.
Availability of subcontractors.
Legal requirements.
Banking and financing facilities.
Local hiring problems.
Security requirements.
Air hazard conditions.
Other radio facilities in the area.
Communications center inter-connections.
Availability of petroleum, oil and lubricants.
Postal service.
The morale of the operators.

### *A Look at the Future*

Recent experiments conducted by the U. S. Army Signal Engineering Laboratories in conjunction with Lincoln Laboratory have successfully demonstrated communications over a path in excess of 1900 miles utilizing a frequency well above the predicted maximum useable frequency for that path. Signal reliability was exceptionally good. This appears to offer a new and useful extension in range of scatter communication when it is realized that optimum performance of ionospheric E-layer scatter is 600-1400 miles. Before we become too enthusiastic, I must point out that a large amount of radiated power is required and the circuit is subject to considerable multipath distortion. Tests will be continued and it is hoped that good reliability may be experienced.

If we look into our crystal ball, I am confident we can see the Army Signal Corps continuing in its historic mission of communications. But in the scene we see, have the scatter modes taken a position of pre-eminence in the radio field, or are they found among the noble experiments of our day? We believe neither. Rather, we see the particular advantages of these techniques understood and being used—but not without the problems they still present in that future day—and we see them as having taken their due place among other modes and media of communication in the Army Signal Corps. With the frontier of the useful radio spectrum being pushed upward, we see also the new and now unsuspected discoveries of a future day, the equivalent of the scatter modes today, and I think I see a panel such as this discussing their pro's and con's. I wish I could stay to ask them some questions, but this concludes my presentation. (*Continued page 20*)

**Maj. Gen. R. P. Hollis, USA**
***Commandant***

*Editorial*

## The Industrial College of the Armed Forces

# CIVILIAN-MILITARY TEAM EDUCATION

☆ ☆ ☆ ☆

Much has been written about the Civilian-Military Team concept from n industrial or military viewpoint. During the next decade, it is safe to ay that much more will be written. Precisely so during this age of the second Industrial Revolution when echnological progress in our time is strengthening the cornerstone of our national security.

But, very few are privileged to write from experience about the industrial-military team concept from an educational viewpoint. The establishment of a curriculum to bring about the development of an industrial-military team for a postgraduate course is indeed a unique accomplishment. This is especially so, when the curriculum must he designed to prepare students to recognize problems in the interrelationships of economic factors with the political, military and psychological aspect of national security, and to determine the issues involved in these interrelationships, evaluate and relate facts, and reach considered conclusions.

The curriculum of the Industrial College of the Armed Forces is designed to do just this and much more. When one stops to think that our national security—in fact, our survival as a Nation—depends on the best efforts of the civilian-military team, we must admire the Industrial College of the Armed Forces for its dedication to the achievement of a better understanding, closer cooperation, and smoother functioning of this concept. The civilian-military team can function effectively only if all members of the team know the problems they are to face, know each others problems, capabilities and limitations.

To achieve this happy situation, the Industrial College, operating under the Joint Chiefs of Staff, conducts three courses—all closely related—but of different types and lengths, to fit the students' time and availability. They are the Resident Course, the National Resources Conferences, and the Correspondence Study Courses.

The major effort of the College is devoted to a ten-months resident course, conducted at Fort McNair in the heart of the Nation's Capital. The responsibility for managing this highest military college of learning falls on the shoulders of Major General Robert P. Hollis. As Commandant, he is doing a commendable job and deserves special recognition for his management and executive ability.

Recently he stated, "In wartime, we realize that we must be prepared to mobilize in support of the Armed Forces, not only the manufacturing, service and extractive industries, but all the productive resources of the nation, including the great private enterprise system which gives drive, direction and effectiveness to these productive resources. It has become increasingly essential that military men have an understanding of how our economic system is organized and run, what makes it tick, and what are the obstructions and hazards which lower its efficiency and output."

It is remarkable to think of a college established in the Military with a ten-months resident course, and incidentally, the only college of its kind in the world, to study such subjects as economics, government, business administration, public finance, and embracing raw materials, manpower, procurement, production, industrial services, implications of nuclear warfare, and other related economic subjects on the national and international level. At the Industrial College, these are some of the subjects which form the core of the curriculum.

Each year the resident course is attended by approximately 145 students. The students come from all Military Services, and 25 students are civilians from the executive agencies of the Federal Government. Admission is based on selection. Only those who have demonstrated outstanding proficiency over a period of years and have a potential for general or flag officer rank are recommended for attendance. Instructor guidance and direction is provided by a matchless combination of highly trained civilian professors and military educators. Backing up the Commandant and to insure modernism is a Board of Advisers (all top flight), representing various fields of industry, education and military. One of the major accomplishments of the resident course is the forward step toward integration, coordination and cooperation among the Defense agencies. This is brought about by the intermingling of civilian and service personnel in committee or seminar groups to develop facts relating to important problems effecting our national security. Another very active phase of the resident course is the study connected with economic and military potential of other nations, including the Soviet Bloc, and their capability to wage war, either hot or cold, with or against the United States. And, largely, the resident course as a whole enables the students to evaluate intelligently the

*(Continued on page 18)*

# automation IN THE U.S.S.R.

**by W. H. Brandt**
**Manager of Engineering**
**Director, Systems Department**
**Westinghouse Electric Corp.**

AUTOMATION IS THE USE OF machines instead of men, to do jobs that the machines do better. Under such a definition, automation is a rather good measure of industrial progress in a country. From this rather broad viewpoint, this article will consider automation in the Soviet Union.

In Russia, since everything is owned or controlled by the government, it is possible to draw up a giant organization chart covering virtually all activities in the country. The part of this chart with which we are particularly interested concerns the Industrial Ministries, the Development Laboratories, the Research Laboratories, and the Educational System (Figure 1). During my visit to the U.S.S.R., our host was the Ministry of Machine Tool and Instrument Manufacture which controls all machine tool plants in the Soviet Union. We visited the Ordzhonikidze Machine Tool Plant and the Red Proletariat Machine Tool Plant. The Institute of Machine Tools reports to this Ministry and does development work for the entire industry. Reporting to the Institute is an experimental machine tool plant that may be thought of as a pilot plant serving the entire industry. At the same level as the Industrial Ministry on our chart, is the Academy of Sciences which operates Research Institutes. The two we visited were the Institute of Precision Mechanics and Calculating Technology and the Institute of Automechanics and Telemechanics. Actually, it would be equally proper to place the Academy of Sciences at a level above the Industrial Ministry with a dotted-line relationship to the Council of Ministries. The Academy of Sciences plays a considerable part in determining policy in the Soviet Union through its influence on the Council of Ministers.

The Ministry of Higher Education is on the same level as the Industrial Ministry and controls the colleges and universities.

The picture then is an organization in which a policy on automation may be put into effect in the Council of Ministers, carried out in the factories, in development laboratories, the research laboratories and in the educational system. Operationally speaking, this is the major difference between the Soviet system and our own. There are some important strengths inherent in this system, but there are serious weaknesses as well.

Men engaged in the engineering profession are very well off in the Soviet Union, but there is an ascending scale of prestige within the profession itself that ascends roughly from left to right on our chart. At the bottom are engineers in industry; at the top are college professors.

Points of interest which were observed in the Soviet Union will be discussed in the reverse order, starting first with the educational system. Figure 2 is a picture taken on the campus of the University of Moscow to give some idea of the size of the building and some idea of its architecture. The point here is that the Russians are sparing no expense in building up their educational system. This building is the finest building in the Soviet Union. The cost of plant and buildings in this area alone was about three billion rubles, equivalent to 750 million dollars based on exchange rate, or about 300 million dollars based on purchasing power. I doubt if any single American university can boast an equal expenditure.

An expensive building of course is no measure of quality of a university. We visited the Physics Laboratories and found them over-crowded but the equipment was good. They have a pro[illegible]ansion aimed at alleviating the [illegible]wded conditions. Equally impr[illegible] are the

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[1] Dr. Norman P. Aubo[illegible] "Russia's 'New Look' in Higher Education." *The Akron Alumnus*, Winter 1956.

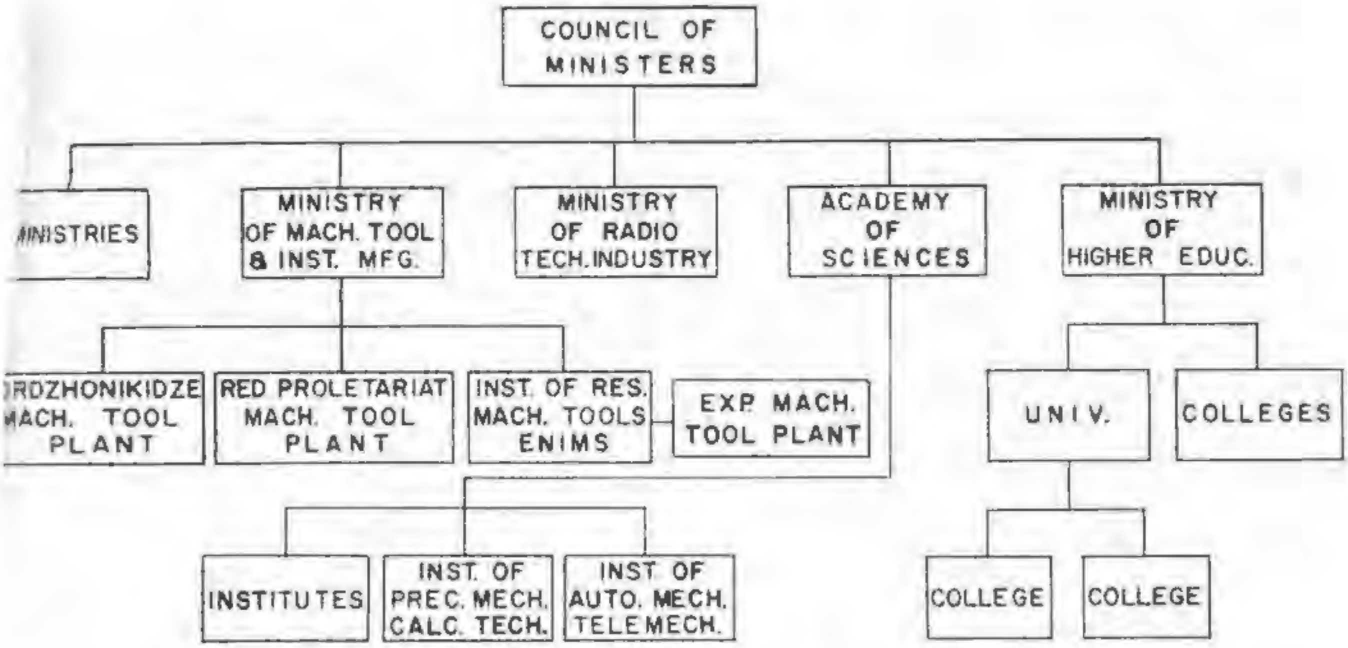

Figure 1

alaries paid by the educational sysm. The average engineer employed n industry made about 1400 rubles er month in December 1955. The ollege professor made 5500 rubles er month, approximately four times he average pay of engineers in inlustry. For comparison, the average vorker makes about 100 rubles per nonth. The exchange rate is four ubles to the dollar, but purchasing ower is nearer 10 or 12 rubles to he dollar.

The University of Moscow is not n engineering school. We did not ave time to visit the Engineering School. We did not obtain figures on engineers trained in the Soviet Union, out there are figures available indicating that they are training about wice as many engineers as we are. However, half of the students at the University of Moscow are trained in technical subjects such as mathematics, physics and chemistry, and such figures as I have found indicate that training in these fields runs roughly in the same ratio. We saw good work going on in the research laboratories and in fields related to automation. At the Institute of Precision Mechanics and Calculating Technology, an opportunity was afforded to see the Russian BESM computer, used entirely in solution of scientific problems such as reduction of data for contour mapping and computation of tables of integrals. It is something like an IBM 701 or IBM 704, but is claimed to have some advantages. It contains 5000 tubes and four types of memories. It seems to make good use of these memories and has very efficient print-out devices. It is down 20% of the time for maintenance; 8% of the time is charged to error losses, leaving an effective operating time of 72%. This is a pretty good figure for a first model of a computer.

The significance of computers in automation, of course, is that the time is coming when such computers will be used to control large sections of our factories, and perhaps entire factories. When that time arrives, the Russians are showing the necessary technical know-how, at least.

The Institute of Automechanics and Telemechanics would be called a servo and telemetering laboratory in this country. At this laboratory, they work on basic problems in these fields, starting chiefly from the theoretical viewpoint. Laboratory equipment is usually built to prove a point of theory. The analog computer shown in Figure 3 is used in solving servo equations up to the 6th order, linear or non-linear. They demonstrated it on 3rd order equations, and were able to set up such an equation and get the solution in about five minutes. The answer appears on a large scope which is at the left of the console, not shown in the picture. It is a compact computer and very convenient to use. It would be incorrect to say that they are ahead of us in automation research but they are doing good work. In some places, they come pretty close.

At the Institute of Machine Tools, they operate a pilot plant and it was impressive to see the machines with which they work. Shown in Figure 4 is a large two-spindle hydraulic fol-

Figure 2

Figure 3

Figure 4

lower machine similar to a Hydrotel with a large planer to be seen in the background. A balancing machine was under development which takes the rotor of an electric motor, spins it, measures unbalance and position in magnitude, and then removes automatically the right amount of metal to put the rotor in balance. When we saw it, it required an operator, but it was very clear from its design that it is intended to fit into an automatic line and to operate without human attention.

At this Institute, they not only design individual automatic machines, but they design complete lines of automated equipment to do a specific manufacturing job. Their outstanding achievement and the high-water mark of Soviet automation is the automatic bearing line at the Kaganovich State Ball Bearing Plant No. 1 in Moscow. At the beginning of the line are two hoppers (Figure 5)—one for inner bearing races, one for outer bearing races. Rough forgings are placed in these hoppers and are conveyed then to the large lathes. There is an assembly operation on the line, a gauging station, and a packaging machine connected with a belt conveyor.

When we saw this line in operation, we saw one actual operator with at least 10 or 12 maintenance men. We were not sure if further operators were not normally required but temporarily absent from their stations during the visit. In a recent article, it is reported that this line is now operating without a single operator.[2]

It is the writer's opinion that we would be very proud of this automatic line if we had it in this country. It is certain that in designing and building it, the Russians have shown ability to provide automation in their factories of a very high level.

In this same factory, most of their production is done with old equipment. Only a small portion of their productive capacity in that plant is represented by this automatic line. However, where they have automation, it can be very good.

At the Red Proletariat Machine Tool plant, there was an assembly line for lathes in operation with a capacity of 54 lathes per day (Figure 6). I know of no assembly line in America that can operate at that capacity. We did feel, however, that the Russians used many general purpose machine tools where special purpose machine tools are used here. We therefore infer that they have overstandardized machine tools to permit them to manufacture on assembly lines such as this. This is certainly costing them efficiency in the plants using this equipment. Assembly line runs away from the observer almost at the center of the picture: subassemblies are made in an aisle to the right and are moved over to the line with monorail hoists.

In the factory—such as automobile factories—working conditions, housekeeping, etc. vary from rather good on the final assembly lines to rather poor in the area where they manufacture parts. The assembly line for the Pobyetta at the Gorki Plant moves in counter-clockwise fashion with the cars mounted on stands in the overhead position. Lighting is good; cleanliness is good; and the line is very orderly. However, if you look at the picture (Figure 7), you will note that there is only one workman present and no evidence of material moving to the line. This gave the distinct impression that the operation of the line was "staged" for our benefit.

Figure 5

Figure 6

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[2] Peter Trippe, "Russia's 'Automatic Factory'," *American Machinist*, January 14, 1957.

Figure 7

Figure 8

On the punch press line, you will note (Figure 8) rather large clumsy tote boxes used for materials handling. At the far right are hand trucks used for the same purpose. The picture carries its own evidence that heating, lighting and cleanliness are rather poor. We saw many conditions in Russian factories that were poorer than this, but this was about the poorest condition under which we could get a reasonably good picture with available light.

I have told you that automation, where they have it, can be very good, but that it represents a small part of their productive capacity. What is the comparative productivity of a Russian and American plant of the same type? *Our team estimated that the average Russian plant was less than one-half as productive as a corresponding American plant.* It happens that in the Gorki Plant, figures were made available to us that permitted a rough check of productivity. The Pobyetta car, we were told, sells for 20,000 rubles. The average Russian worker makes 1000 rubles per month. It, therefore, takes 20 months' salary to buy a Pobyetta. The average American worker can buy one of the three low-priced cars for six to seven months' work, and this ratio is about 3 to 1, taking no account of the fact that the American automobile is far superior. It seems fair to state then that the productivity of a Russian automobile plant is about one-third that of a corresponding American plant, and it is the writer's estimate that this probably applies to other plants that we saw.

In Stalingrad, there was a crowd gathered in front of a department store; they heard that there were rugs for sale in the store. The crowd gathered to get some of the rugs before they were all gone. Consumer goods are scarce in the Soviet Union; prices are high, and their standard of living is poorer than our standard of living was in the worst days of World War II.

The Russians are putting tremendous effort into their educational system, they are doing good work on automation, in the research laboratories, and the development laboratories, and while one sees relatively little automation in the non-military factories, what automation they have is good. It is the writer's opinion that under the Russian system, problems large enough to be given consideration by the Moscow planners are solved, and are solved well. It is not felt that this system will be able to catch up with America for years—if ever—in providing a high standard of living for its people. There are too many small problems that do not get solved at all.

However, it must be remembered that we saw no military plants; it was notable that the Russians were making large numbers of good machine tools, but that few of these machine tools were seen in the automobile and tractor plants. One infers that many of these new machine tools are going into plants for the production of military items.

In producing for the military, the Russians have several advantages under their monolithic organization. All military production must be planned and they are used to planning. Secondly, because they do not have a high standard of living, the Russians are able to devote a large share of their productive capacity to military production. This is reason enough why we should not be complacent about our ability to out-perform the Russians in production for the military.

• • • — • —

**Civilian-Military Team**

*(Continued from page 13)*

economic, political, military, psychological, and industrial aspects of mobilization problems. Yes, the students must learn to solve future military problems without placing insurmountable burdens on the national economy.

Besides the ten-months resident course, the Industrial College sponsors two extension courses, the National Resources Conferences and the Correspondence Study Course. The National Resources Conference is a condensed version of the resident course. It is presented each year in sixteen cities covering the major industrial population centers of the Nation. The course runs for a period of two weeks. To date, courses have been presented in approximately 100 cities, covering 29 subjects and received by 38,000 officers and civilians.

The Correspondence Study Course is also based on the resident curriculum and is conducted for qualified individuals who cannot attend the resident course, as well as graduates of the National Resources Conference. Both of these courses are designed and conducted for selected industrial executives, educators, writers, representatives of labor, religion, medicine, and agriculture (to mention a few) and other prominent citizens, also officers of the National Guard, inactive Reserves of the Army, Navy, Air Force and Marines. The purpose of the two extension courses is to expand the nucleus of informed individuals who may be called upon to help formulate policy in the management of our country's economy during peace time or an emergency.

Today, more than at any time in our history, we must face up to the challenges which confront us in this changing age, an age of technological progress, social and industrial revolution. In these post-war years, the more thoughtful citizens, the more responsible members of the business community have become increasingly aware of the fact that war is no longer the monopoly of the military. Security is everybody's business and the facts are needed.

It is my unshakable conviction that the members of the Armed Forces Communications and Electronics Association and their friends will get the facts and enjoy a refreshing experience if they attend at least one of the National Resources Conference lecture courses which will be given in the following cities during 1957-1958.

| | |
|---|---|
| Burlington, Vt. | 23 Sep – 4 Oct 57 |
| Sioux Falls, S. D. | 23 Sep – 4 Oct 57 |
| St. Louis, Mo. | 21 Oct – 1 Nov 57 |
| Boise, Idaho | 21 Oct – 1 Nov 57 |
| Pittsburgh, Pa. | 11 Nov – 22 Nov 57 |
| Memphis, Tenn. | 2 Dec – 13 Dec 57 |
| Fresno, Calif. | 13 Jan – 24 Jan 58 |
| Indianapolis, Ind. | 13 Jan – 24 Jan 58 |
| Los Angeles, Calif. | 10 Feb – 21 Feb 58 |
| Boston, Mass. | 10 Feb – 21 Feb 58 |
| Charleston, W. Va. | 17 Mar–28 Mar 58 |
| Philadelphia, Pa. | 17Mar–28 Mar 58 |
| Rochester, N. Y. | 14 Apr – 25 Apr 58 |
| Fort Worth, Tex. | 14 Apr – 25 Apr 58 |
| Montgomery, Ala. | 12 May–23 May 58 |
| Bridgeport, Conn. | 12 May–23 May 58 |

The College serves not merely to ameliorate the spirit of cooperation among the Services, but is unequaled within the military educational system in that it serves to foster understanding and appreciation by the military of the problems of industry. How significant this contribution is may be measured by a quotation from the President of the United States, made at the time he was commanding SHAPE. He said.

*"The strength that a nation or a group of nations can develop is the product obtained by multiplying its spiritual or moral strength by its economic strength, by its military strength. It is the product, not the sum; consequently, if any one of these factors falls to zero, the whole is zero. There can be no army unless there is a productive strength with a productive power to support it. There can be neither a strong economy nor an army if the people are spiritless, if they don't prize what they are defending."*

To sum up the accomplishments of the Industrial College is a little hard to do. I know of no yardstick to measure the results. The best I can do is to tell you that due to their efforts, this year alone, about 6,000 people are more interested in national defense. They have a better understanding of the problems that must be solved and the price we must pay to ensure the survival of the American way of life.

Since a virile and healthy economy is a requisite for a strong defense, it follows that military action to ensure our national security must not impair our economic strength. The complex and interrelated problems of building our military strength without reducing our economic strength is the special field of study of the Industrial College. Its motto, "Industria et Defensio Inseparabiles," symbolizes the College's importance. Through education, the civilian-military team is truly inseparable.

The Editor

## "Could'a been real rough without Tacan*"

Finding a pitching carrier deck or a socked-in air field can be rugged at times. Yet with TACAN, getting home safely through the soup is routine. The compact Hoffman airborne TACAN unit assures all-weather safety, provides continuous course data every second in flight, automatically computes distance and direction to a ground or moving shipboard station. It's another outstanding example of...

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NAVIGATION
ELECTRONIC COUNTER MEASURES
RADAR
SEMICONDUCTOR APPLICATIONS

*(Continued from page 12)*

The next speaker is Captain W. A. Ellis, U. S. Navy, Head of Future Plans and Policy Branch of the Office of The Director Naval Communications.

## *U. S. Navy Presentation*

One of the major objectives of the Naval Communications Improvement Program is the exploration of new phenomena and the exploitation of new techniques. To this extent the Navy is naturally interested in the possible application of any and all modes of radio propagation which will facilitate the accomplishment of the Navy's role at sea.

My colleagues of the Air Force and Army will tell you much regarding the application of the scatter technique to the long haul point-to-point circuit. The Navy's interest in this respect is equal, and we are cooperating fully in the development of the Navy's portion of the Joint Ionospheric Scatter System to be installed in accordance with the world-wide plan formulated by the Joint Communications-Electronics Committee of the Joint Chiefs of Staff. This effort will include the establishment of a system across the North Atlantic Ocean area between the United States and the United Kingdom, and another system in the North Pacific Ocean area running between the United States and the Aleutian Island Chain. At the present time the Navy is still engaged in the site survey phase of these two projects. However, it is contemplated that these systems will be in operation between Fiscal Years 1962 and 1965.

As you can well appreciate, the Navy's first interest is the sea and the ships which are charged with the responsibility of maintaining our supremacy on the seas. Thus, it is only natural that our foremost hopes for scatter lie primarily in its possible application to the communications of our forces afloat—both for tactical and ship-shore linkages. Therefore, to preclude being repetitious, it is the purpose of the Navy presentation to give you a brief look at what our investigations over an all-seawater path have revealed, rather than to dwell further on the point-to-point application. Hence, my discussion will be confined to tropospheric forward scatter and another form of scatter known as meteor burst, the two modes of radio propagation which presently show the most promise for ship-to-shore and ship-to-ship communications.

Most of the work and the resulting scientific and engineering data obtained on forward propagation by tropospheric scatter has been obtained between fixed points with all over-land or mixed over-water and land paths. Based upon this information only a "guesstimate" could be made regarding the feasibility of its use over an all-water path. Hence, in 1953 and 1954, the Naval Research Laboratory commenced a series of preliminary investigations in the Chesapeake Bay area. The results obtained from these very limited tests were so significantly promising as to indicate the desirabilty of further and more extensive exploration.

The middle of calendar year 1955 marked the beginning of experiments using a Naval vessel as the receiving end of an all over-water transmission link with the transmitting facility located on the coast.

The transmitting facilities used for these tests were located at the Lincoln Laboratories, Round Hill, Massachusetts, site. The shipboard receiving facilities were installed aboard the *USS Achernar* (AKA-53) and later aboard the *USS Thuban* (AKA-19).

The Round Hill transmitter was operated on CW and voice using 10 KW and 40 KW UHF transmitters and high gain dish antennas.

The shipboard receiving installations consisted of modified, WW II vintage, steerable, high gain paraboloid radar antennas with accompanying pedestal mounts and controls, sensitive receivers and signal level recorders.

In the tests the ships involved steamed in and out on fixed bearings from the shore transmitting stations, while continuous recordings were made of the received signal levels.

The transmissions from Round Hill were periodically modulated (narrow-band FM) by voice and music samples previously magnetic tape recorded. The received transmissions were tape recorded aboard ship. Excellent quality recordings were consistently obtained at distances out to about 300 miles. Beyond 300 miles, deep fading of the signal caused some short period outages, but in general the quality remained excellent.

Frequent two-way voice communications were also conducted between the ships and Round Hill, using an AN/TRC-24 FM transmitter aboard ship at 80 watts transmitter power into the modified radar antenna. Good results were obtained out to about 250 miles. On one of the test days a two-way circuit was set up between the Naval Research Laboratory and the ship using commercial telephone line between NRL and Round Hill, and a two-way scatter circuit between Round Hill and the ship. For a period of approximately one hour very successful two-way communic tion was maintained between personnel aboard ship and at NR At this time the ship was approximately 200 nautical miles fro Round Hill.

The quality of reception during these tests was relatively goo even under the fading conditions out at the maximum range. would appear, therefore, that there is little or no difference the tropospheric scatter mode, whether its path be over-land all over-water. To us in the Navy, this is most encouraging.

As previously mentioned, the Navy is also interested in possibilities of another form of the scattering technique, viz., field of meteor burst or meteor trail communications. I reg that for this discussion I do not have any visual aids or recordi to relieve you of the monotony of my voice. Therefore, I your indulgence for the next few moments while I tell you bri something of the results of the Navy's investigations in this ar

Investigation for Naval application was initiated at the N Electronics Laboratory, San Diego, California, in June 1955. T work is being accomplished in cooperation with the Stanford search Institute of Stanford University, Palo Alto, California. tual tests were begun in July 1955 with the monitoring at S Diego of a Stanford transmitter on 43.5 MCS. In order to poi toward the eventual desired utilization of this mode of transm mission in ship/shore and ship/ship communication circuits, teor burst signals from the Stanford transmitter were later mo tored by a Navy ship off the coast of Southern California November 1956. Like the early tropospheric tests, results w promising and an experimental communications link is being up at the present time between the laboratory and Stanford which bursts of time-compressed teletype information will be tra mitted from NEL, received at Stanford, and automatically retra mitted to NEL during the presence of suitable meteor trails.

In this experimental link transmitters with an expected outp power of about 1 KW and relatively low gain, low directivity tennas are being used. Frequency shift keying (FSK) modu tion is used to transmit teletypewriter information which is fi recorded on magnetic tape at 60 words per minute, then rep duced for transmission at 4800 words per minute, an 80 to compression ratio. In operation, the transmitters and receivers both locations remain on continuously. The reception at NEL o sufficiently strong meteor echo of the NEL signal, retransmitt by Stanford, indicates the formation of a closed loop which st the information transmission at NEL. The decay of the mete echo to a critical amplitude, causes the transmission of inform tion to cease.

As previously noted, the Navy studies and experiments in t fields of tropospheric scatter and meteor burst communicatio are pointed toward the use of these modes in Naval shipboar communication applications. However, the use of such mode aboard ship introduces many difficult problems yet to be solve The most obvious, perhaps, is the antenna problem. A high ga antenna is of significant size and weight. In addition, it must main accurately oriented on its shipboard platform which rol pitches and yaws at the mercy of the sea and changes of cour Nevertheless, tropospheric scatter terminals appear feasible f shipboard installation from the standpoint of weight and s since a relatively high gain antenna at the ultra high frequenc is within reason and not significantly larger than some of the ra antennas now carried aboard our ships. On the other hand, a tenna orientation on the mobile platform of a ship is not as di cult as it might seem. For a number of years many of our sh have had stable elements on board for stabilizing fire control d vices and automatically compensating for roll and pitch in g positioning. Servo information from the ship's gyro compass, f into the antenna azimuth control mechanism, can correct for ya and course changes, and automatic tracking also can be provided, so that once the antenna has been positioned and is receiving th signal, the signal itself can be used to keep the antenna pointed into it.

Another problem in the use of the scatter modes in a mobile environment is that of the high transmitter power required. This is an aspect which makes meteor burst communications appear attractive for shipboard use. However, in the meteor burst technique, a more difficult antenna orientation problem may be presented because of the automatic tracking element that enters the problem.

These are only a few of the problems that confront the Navy development effort today. As in the past we are confident all obstacles will be hurdled; the ingenuity and inquisitiveness of our engineers and scientists will triumph. Application of these new techniques to shipboard use is not just around the corner, but as the state of the art progresses, it is our fervent hope that scatter will provide us with the capacity, reliability, range and speed we desire in our modern communications and our data transmission systems.

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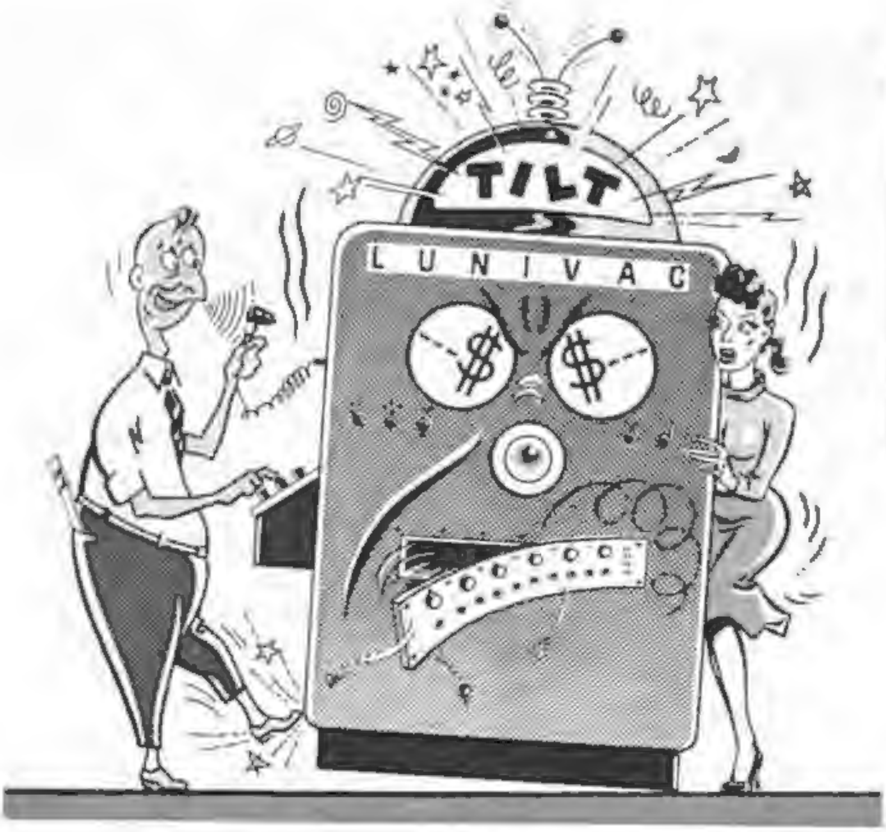

by

**Christopher James**

ON THE OCCASION OF THIS writing, I would prefer to restrict my readers to that small but exclusive percentage of AFCEA members who are truly intellectuals.

Not that I am against that great majority of non-intellectuals of which I am a member, but rather, to conserve manpower, why waste important peoples' time unnecessarily, when by appealing to the intellectuals alone, I can reduce the total manpower loss to a very small figure.

How do I define an AFCEA intellectual? Easy—here are the premises:

(1) Men and women are equally intelligent, differing only in shape and number.

(2) Even more important, women and men members are equally stupid; in fact, more so, or vice versa.

(3) Most AFCEA members can read—(one can't write).

(4) Now mathematically, if

X = readers' dollar annual income (earned, but not necessarily deserved)

Y = age

Z = mental agility—i.e. $\frac{X}{Y}$ (approx.) or more exactly Z = $\frac{2\ \text{Xmax}}{\text{Ymax}} \cos^2 \theta \ (\frac{x}{\lambda} - ft)$

We quickly grasp from this familiar equation, with the usual connotations, that the average value of Z throughout a life-time is obtained from the fact that the average of the cosine square is ½. Therefore, if you are still reading this and want to be an average square-headed cosine, you can consider yourself as a half-wit and have qualified to write a letter, if also an optimist, to the Editor of SIGNAL asking for a refund on your national dues, and you need read no further.

Now that my reader-audience has become more chummy, and we are a small group, let me pose the questions to which we dedicate this loss of printer's ink—to wit and/or to wits, if you prefer:

(1) Who reads all the scientific reports being generated today?

(2) Do the authors read as many as they write—or should they?

(3) Could the paper industry survive if the military and its contractors worked 10% more and wrote 10% less?

(4) And, finally, how can the poor guy doing research ever find out what the true state of the art is, or again, more properly, why should he?

Our problem thus, generally centers about the relative importance of the status of literature and particularly rules for determining:

(1) What is the state of the art Unclassified?

(2) Is there a state of the art Confidential?

(3) Is there a state of the art Secret?

(4) Is there a state of the art Top Secret?

(5) What is NATO doing?

(6) How about Intelligence Data?

(7) What is the state of the art as described by our publicity offices or sales departments?

Easy, say I—and here comes my invention.[*] I call it the LUNIVAC: it is worse than human, it is lunivistic!

Of course, I use transistors; in fact, I use solid state MASERS and even now am working on an improvement using the new Yttrium garnet solid state microwave amplifier, working at room temperature instead of that Iadolium[**] stuff requiring liquid helium temperatures. And memory devices—I have built in more memory than a wife who thinks her husband is untrue; more memory than a collector of internal revenue; in brief, memory like a guy from whom you borrowed five bucks last year.

(*Continued on page* 24)

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[*] If Pravda wishes to claim first rights to this invention, they can have it with my compliments.

[**] My stenographer misspelled this word, but it makes better sense her way.

# "This refers to yours of the 10th..."

Some people still hammer out communications one character at a time.

Others use DATAFAX—the fast Stewart-Warner electronic way to transmit all data over standard telephone lines.

Datafax transmits and records any material: correspondence, drawings, pictures, printed matter, even handwritten notes. And since copies are exact duplicate images of the original, chance for error is fully eliminated.

**Cost?**

Automatic transmission and recording eliminate need for full-time operator; recorders will even respond to transmissions sent after the office is closed for the day. Datafax also eliminates retyping, proofreading, intermediate handling, intransit delays—and their clerical costs. The clear, smudge-proof, permanent Datafax copy costs less than 2¢ for a letter-sized unit, plus pro rata line charge.

Chances are your operations have outgrown Stone Age Communications. If so, you'll want to find out about Datafax.

First, send for your copy of the free Datafax bulletin. Write: Stewart-Warner Electronics, Dept. 15, 1300 No. Kostner Ave., Chicago 51, Illinois.

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Colossal, I say!

Now, here is my idea—

Through use of magnetic tapes, the awful facts of most anything can be recorded—even in triplicate! Supporting this potential: The ferrites permit a distorted one-way transmittal of information (often desirable); the MASER permits great stabilization of information (a new phenomenon); improved condensers allow lots to be stored in little (preferably if condensation occurs without precipitation); transistors provide the means for easily passing everything through a slug of germanium for rectification which is undoubtedly a good idea; and as for free radicals. . . . they should be put in equipment marked clearly "for export only!"

So why not?

I mean, why not take the substance of *all* our scientific findings and store them on a gigantic metallic magnetic sheet which can be played up and down, back and forth, and even in criss-cross directions, introducing harmonic relationships as necessary, combining cross-correlation techniques in accordance with the strict rules of *Information Theory* and the *Second Law of Thermodynamics*, so that we arrive at an equipment potential giving in consonance with *Cybernetics*:

(1) The entire state of the art.

(2) Individual outputs giving abstracts of all information in accordance with clearance and the "need-to-know" of all inquisitors.

(3) Electroencephalographic coupling between scientist and machine to determine "ability-to-know." This will require a ruggedized heavy-duty device.***

(4) An output signal which could tell the engineer that he needs more academic training before the machine can understand his questions, i.e., "ability-to-interrogate." This is the most delicate part of our apparata.

(5) An output signal which could tell the engineer-scientist that he should change jobs and look for a higher salary because of the cleverness of his questions. (Undoubtedly, this reaction would soon lead to the well-known "tilt" in pin ball machine phenomena.) Page 22.

Such a machine would be relatively simple and cheap to construct (like a 4th of July rocket compared to an ICBM). Manpower would be no problem at all, since first, we could draw on that tremendous reserve of technical manpower always playing musical chairs and for which a month or two of delay between jobs would really harm nothing but would actually add more experience, giving them a chance to ask for even more money; second, we could ask that much smaller group now permanently established (Hmmm . . . ?) to devote their prolonged coffee breaks to thoughts along lunivistic lines, instead of—well, you know; and third, there are hundreds of industrial outfits who, although they are still feverishly advertising for new personnel, are running out of work and would be glad to assist in such a noble endeavor (if the charge can be placed elsewhere than on electrons).

So what are we waiting for?

Just around the corner from ASTIA is this wonderful LUNIVAC. A truly complete Technical Documents Center in a flashy console, and as auxiliary equipment, a beautiful female attendant continuously serving people deficient in information and/or in social contacts.

One of these much-in-demand scientists slouches in — complete with two days' beard and incomplete with necktie.

She says, "Clearance please, Doctor . . ." (assuming the Ph.D. because of his wild look and unshined shoes).

He says, "Confidential" and produces appropriate security documents.

She says, "Subject?"

He notes the tight sweater and, with considerable self-restraint, gets back to his secondary interest and says, "Atoms," (though thinking of Eves.)

Then the miracle happens!

A few buttons are pressed — the LUNIVAC goes into rapid motion, and the breeze felt is caused by cards falling into a large receptacle giving abstracts of all information known on ATOMS, carrying no higher classification than "Confidential."

Delighted, the young scientist and six assistants pick up the cards and move with their loot to a secluded corner for several months of perusal (most contracts allow six months for these studies). Efficient always, and not wishing to lose contact with either the operator or the machine, the young scientist periodically plays for new material. But, oh — by some new miracle directive, declassification is going on so smoothly and rapidly, new material is being added to his reading list faster than he disposes of the old!

Alas, more invention is required—including, undoubtedly, a contract extension for the interrogator.

Easy, say I—let's write less! Or is that swapping sense for dollars?

But the paper and pencil lobby says "not so fast, gentlemen, we deserve a living too."

As I am about to make a remark, someone passes peanuts, and I am left stuck with the problem, so I look for a beer. . . .

Months after I submitted the first draft of this article to the good Editor of SIGNAL, I came up with a solution — admittedly a radical suggestion, but unbelievable in its simplicity. Here is the idea . . . !

But wait—how do I know I even have a reader?

• • • — • —

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***See Specification "Infantry versus Tank" USA-MIL-7734.

## BURIED IN "ELECTRICAL" IS NATION'S FIFTH LARGEST INDUSTRY

The world has changed a bit since Ben Franklin flew his kite and Edison invented the electric light. We have telephones, radio, television, automation, radar, sonar, computors, guided missiles, earth satellites and other wonders thanks to radio-electronics—now fifth largest industry in the nation.

If you are looking for facts and figures on this young Goliath in the *Standard Industrial Classifications*, they lie buried in "Electrical", code #36. It isn't easy to conceal an industry employing 1.5 million people with sales at 11.5 billion dollars annually. What will S.I.C. do when, within a decade, sales reach 22 billion dollars as radio-electronics continues to be the fastest growing of all U.S. industries?

Radio-electronics is big, basic and diversified. It is a business with more than 4,000 manufacturers and suppliers scattered over the length and breadth of our country. It already employs almost 100,000 of the nation's 500,000 engineers and needs more to create and manage its remarkable plants and factories.

Electronics has changed modern warfare and has become vital to defense. Electronics is changing commerce and industry. Electronics is influencing the lives of all of us and will change our living patterns and standards even more in the years to come.

Investors consider electronics as having a limitless future. Today, the field is served by a number of important business publications and a big professional Society. *The Institute of Radio Engineers* now has more than 50,000 engineer members as well as 10,000 student members.

By strictest definition, that which utilizes the movement of electrons is electronic. Back in the dot-and-dash era, electrical engineers reluctantly admitted that radio might have some limited value in ship-to-shore communication. Still in the dot-and-dash era, S.I.C. ignores radio-electronics' existence—even if it is the child that outgrew its parent . . . for, by popular definition, electronics has come to mean *everything electrical*.

The next time the Federal Government and the Department of Commerce look over the 1700 *Standard Industrial Classifications*, may they examine code #36 more closely! A giant like radio-electronics can't be buried and expected to rest in peace. You can bet your bottom transistor on that.

**THE INSTITUTE OF RADIO ENGINEERS**

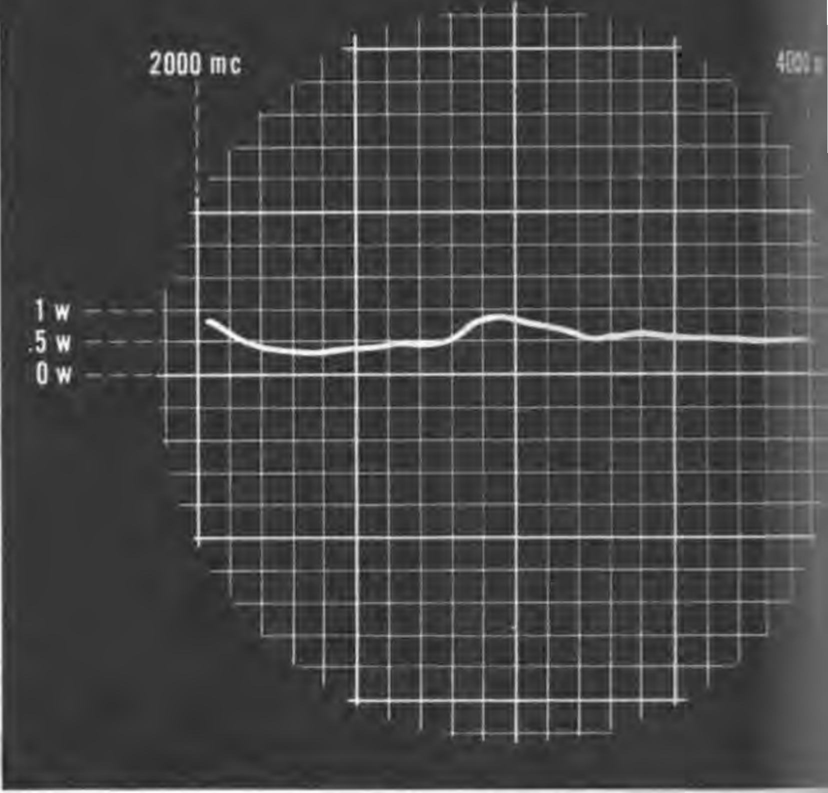
# Proceedings of the IRE

Adv. Dept., 1475 Broadway, New York 36, New York
Chicago • Cleveland • San Francisco • Los Angeles

ABC

R E

**ABOVE:** the GL-6917 voltage-tunable magnetron is extremely small and compact—only ⅝" high and less than ¾" in diameter. **BELOW:** complete cavity and magnet assembly for the GL-6917 has been developed to assist equipment manufacturers.



▲ Observe from the scope presentation above (actual photograph made with a production GL-6917 on test) how power over the entire 2000-mc tuning range is substantially constant, varying only .5 w. Because tube frequency, with voltage-tunable magnetrons, is a linear function of anode voltage, an r-f signal can be tuned at will to any frequency in a wide spectrum.

# New GL-6917 voltage-tunable magnetron combines wide-range tuning, steady output, dependability!

General Electric's GL-6917 voltage-tunable magnetron—first of a new series in development—offers to designers of military and other microwave equipment a simple, efficient means of changing output frequency rapidly with no important reduction in signal power.

The tube is a major breakthrough in circumventing enemy radar-jamming and in other counter-measure work. Also, the GL-6917 **finds direct application in missile tracking and other telemetering . . . . . in air navigation . . . . . broadband test equipment . . . . microwave communications generally.**

Construction is extra-rugged. Fundamentally compact and sturdy, the GL-6917 is a hard-solder type and is metal-ceramic for even greater strength. The tube is designed to operate unpressurized up to 60,000 feet altitude.

General Electric has developed a special cavity and magnet assembly for the GL-6917. to assist designers in applying the tube to equipment on the boards. **For full information on Type GL-6917 and accessories, call your regional G-E power-tube representative!** ***Power Tube Department, General Electric Company, Schenectady 5, New York.***

***Progress Is Our Most Important Product***

**GENERAL ELECTRIC**

[illegible]

# SIGNAL·GRAM

## — GOVERNMENT —

DOERFER NEW FCC CHAIRMAN George C. McConnaughey resigned as chairman of the Federal Communications Commission in July. John C. Doerfer, a member of the Commission since 1953, has been appointed as the new chairman by the President. Mr. Doerfer is a former chairman of the Wisconsin Public Service Commission, a graduate of the University of Wisconsin and received a law degree from Marquette University.

"DEW" LINE IN THE PACIFIC The far-ranging radar picket planes have carried America's Distant Early Warning line 1,500 miles out across the Pacific. Recent activation of two WV-2 "flying sentry" squadrons at Barbers Point NAS, near Honolulu, extended the electronic net of ground and air stations, those already guarding northern and eastern approaches to the continent, westward to the mid-Pacific.

NAVY'S VLF STATION The world's most powerful and effective Very Low Frequency (VLF) radio station will be operating in Washington County, Maine, by 1961. The Navy uses VLF stations for shore-to-ship broadcasts, operating at around 15 to 20 kcs. The Maine transmitter may be rated as high as 2000 kw. A special antenna will be used for this installation which will be a cross between the new German type and Annapolis VLF.

U.S. TO LEASE SHIPS AND LANDING CRAFT TO CANADA According to the terms of a recent U.S.-Canadian Agreement, six ships of the Navy-operated Military Sea Transportation Service and twelve Army landing craft will remain in the North for ultimate leasing to Canada at the conclusion of the 1957 DEW line resupplying operations in the Arctic this summer. Thereafter, Canada's Northern Transportation Company, which now services U. S. electronic defense installations in the Mackenzie River area, will operate the ships in future seaborne resupply of the western Canadian sector of the DEW line.

SIGNAL SCHOOL ADDS THREE NEW COURSES The constantly expanding age of electronics has necessitated the addition of three new enlisted courses at the U.S. Army Signal School, Fort Monmouth, New Jersey. The courses are: Radio Wave Propagation Specialist, Ground Control Approach Equipment Repair, and Fixed Electronic Cryptographic Equipment Repair.

CONTRACT AWARDS: ARMY: Lewyt Manufacturing Corp., radio sets for combat vehicles, $4,210,468; Gilfillan Brothers, Co., engineering services for guided missile development, $1,056,345; Hazeltine Corp., radio beacons, $216,529; North Electric Co., switchboard equipment, $152,187; Western Electric Co., Inc., research and development on NIKE-ZEUS, $1,886,740; Stewart-Warner Corp., receiver transmitters, $1,483,311; Bomac Laboratories, Inc., magnetrons, $194,103. NAVY: Westinghouse Electric Corp., development and delivery of launching system for POLARIS, $10,000,000; Remington Rand, Division of Sperry Rand Corp., UNIVAC-LARC, $3,500,000; Raytheon Manufacturing Co., Sonar training equipment, $1,580,056; Collins Radio Co., radio equipment, $1,516,343; Ampex Corp., magnetic tape recorders, $104,685. AIR FORCE: General Electric Co., development work on nose cone for ATLAS and THOR, $158,000,000; Sperry Gyroscope Co., Division of Sperry Rand Corp., flight equipment for high-performance conditions, $1,298,518; Hoffman Laboratories, Inc., simulators and beacons, $1,056,000; Weston Electrical Instrument Corp., Instrument Landing System cross pointers, $1,212,586; Bendix Radio Division, Bendix Aviation Corp., development of radar set for air traffic control, $2,223,751; Avco Manufacturing Corp., TITAN nose cone development, $111,308,359. CAA: Stromberg-Carlson, a Division of General Dynamics Corp., 263 sets of tactical air navigation (TACAN) test monitor and control equipment, $10,000,000; Teletype Corp., teletypewriters, $3,688,680.

ARMY TESTS EQUIPMENT Heavy testing of the Army's ever-increasing electronic equipment used in its communications systems, missiles, and others began July 1. The program includes eight major field and command exercises. The largest exercise, "Gulf Stream," will last for 20 days in April 1958, at Fort Polk, La., in which some 26,000 troops will participate with training in the use of the ground-to-air guided missile, NIKE-HERCULES.

GENERAL QUESADA SUCCEEDS CURTIS AS AIR ADVISER Replacing The Honorable Edward P. Curtis, Lt. Gen. Elwood R. Quesada (USAF, Ret.) has been named special assistant to the President for aviation facilities planning. General Quesada, youngest retired Air Force general, is vice president of Lockheed's missile systems division.

FAR EAST FLU VIRUS The Department of Defense has issued policy guidance for military to be vaccinated as soon as possible with a special single-strain vaccine to combat a previously unidentified virus which has caused an outbreak of influenza in the Far East. Dr. Frank B. Berry, Assistant Secretary of Defense (Health and Medical), said that the vaccine also will be made available to civilian employees and military dependents on a voluntary basis at overseas stations.

ARMY CONSERVES TIME FOR ENGINEERS How to make the limited number of engineers go further is the object of a new plan being tested by the Army. The idea may also work in industry. Business administration graduates with little or no technical training are being hired for under $4,000 a year to free engineers from routine jobs. The assistants keep records, handle procurement, review publications, etc. This system is expected to conserve up to 50% of the engineers' time.

LOOKING FOR A QUICK $100 IN CASH? The READER'S DIGEST is inviting members of the Army to submit contributions for its well-known "Humor in Uniform" department. Contributions must be true, unpublished anecdotes based on service experience. They should be typewritten, double spaced, and not more than 300 words long. Contributions cannot be acknowledged or returned. Army AFCEA personnel should mail their anecdotes to Chief, Magazine and Book Branch, Office Chief of Information, Department of the Army, Washington 25, D.C., ATTENTION: Humor in Uniform Editor, READER'S DIGEST.

## — INDUSTRY —

EUROPEAN PRIVATELY OWNED RESEARCH REACTOR Europe's first privately owned and operated nuclear research reactor will be designed and built by AMF Atomica, a division of American Machine & Foundry Company. SORIN (Societa Ricerche Impianti Nucleari), jointly owned by the Italian industrial groups, Fiat and Montecatini, awarded the contract for the one megawatt pool-type reactor. The reactor will be used for nuclear research and development, production of radio isotopes, and training of personnel.

N.B.C. DONATES TV ENTERTAINMENT TO DEFENSE DEPARTMENT More than 450 hours of new programming for use on the 23 Armed Forces television stations at U.S. outposts abroad has been donated to the Department of Defense by the National Broadcasting Company. This is the largest single bloc of programs ever made available by any network or other program source for the entertainment of U.S. servicemen around the world. A salute to N.B.C. for their morale boost for our servicemen!

IGY AND THE ELECTRONICS INDUSTRY The electronics industry has done an outstanding job in providing electronic equipment for use during the International Geophysical Year which began July 1. On the monetary line, educated guesses approximated that about 20 to 25 per cent of the $30 million spent thus far on the project went for electronics in some form, which would total about $7 million being divided by electronic firms furnishing the equipment.

ELECTRONIC STENOGRAPHER FOR "LARC" Stromberg-Carlson, a Division of General Dynamics Corporation, has contracted to provide a 24 hour a day "electronic stenographer" to work with an advanced electronic computer created by Remington Rand Univac, a Division of Sperry Rand Corporation. The computer is designated the LARC (Livermore Automatic Research Computer). The "stenographer" will be a CHARACTRON computer readout, being able to display and record on film split-second "thoughts" of the LARC computer at the rate of 15,000 characters per second, amounting to 180,000 words a minute—50 per cent faster than any computer readout previously built by the company.

TV HELPS THE WELDER In watching structural spotwelding on the underside of large aluminum panels of the KC-135 jet tanker-transport skins, a closed-circuit television has replaced the human eye at Ryan Aeronautical Company, San Diego, Calif. A small General Precision Laboratory TV camera stares untiringly at the condition of both top and bottom welds with electronic accuracy and clarity and transmits a magnified report via coaxial cable to a 17" monitor screen at the side of the welder.

A FIRST IN GEORGIA The nation's first state-sponsored educational closed-circuit television system will be installed this summer by the Radio Corporation of America for the Georgia Department of Education in The Conley Hills Elementary School, Fulton County. The RCA educational TV system will serve primarily as a "laboratory" installation for Georgia educators who are studying the practicability of statewide teaching-by-television.

## — GENERAL —

STOCK TICKER NOW SERVES ALL 48 STATES With the addition of Wyoming in June, New York Stock Exchange quotations began reaching ticker subscribers in all 48 states for the first time. This 20,000 mile ticker network flashes quotations from the New York Stock Exchange to 2564 stock tickers in 457 cities and towns in the United States, Canada and Cuba.

AERIAL COLOR PHOTOS REVEAL MINERALS Aerial color photography is now being used to make high-altitude portraits of mountainous and jungle regions in South America according to Hycon Aerial Surveys, Inc. Bird's eye pictures of earth structure in remote mountainous regions are giving geologists direct clues to mineral deposits which would have taken years to find on foot. Map-makers are also aided in the tedious task of mapping the earth's surface accurately in various regions of the United States as well as South America.

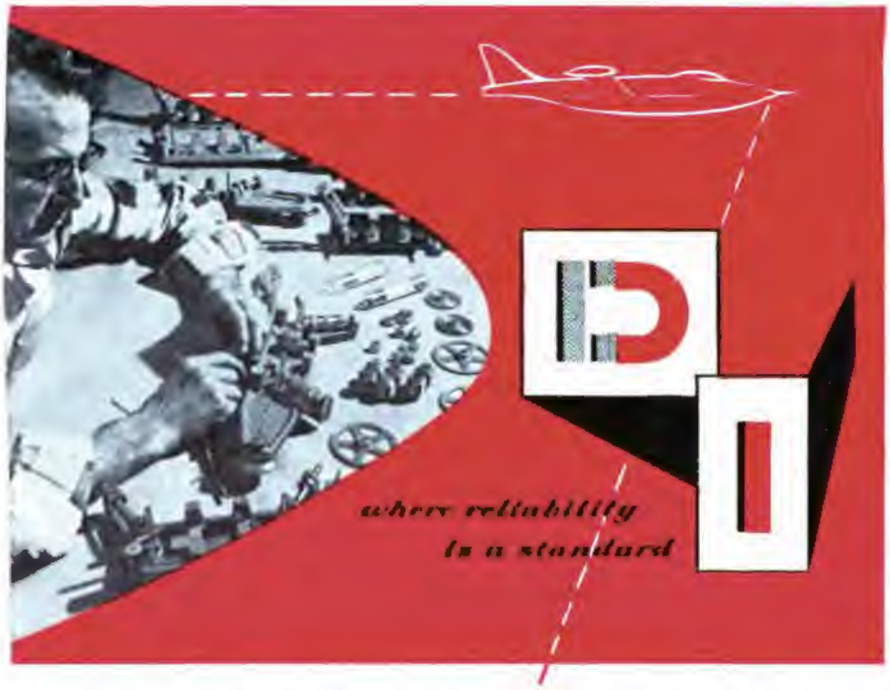
TV TRAINS IN ENGLAND After two years of experimenting, the British Railways have arrived with the first journey of a permanently installed TV train. Programs were transmitted to the train-turned-TV-studio through a 10 h.p. diesel generator in an adjoining car which generated 6 KW A.C. (250 volts) for all sound and vision. The train must be traveling at about 60 m.p.h. for a true TV picture on wheels.

SORTING MAIL AUTOMATICALLY An electronic mail sorting system is under development by the Canadian Post Office in Ottawa. Operators in special reading stations convert the address into a special code suitable for electronic handling, mark the code on the envelope with a special keyboard, and the remaining operations are completed automatically by high-speed electronic sorting equipment.

SLIDE RULE FOR SIGHTLESS STUDENT A uniquely designed slide rule has been presented as a gift for a blind engineering student by Keuffel & Esser Company, New Jersey instrument manufacturer. This unusual instrument employs tactile symbols in the form of raised brads systematically arranged and hammered into a 20-inch regular log duplex decitrig slide rule. It enables the user to handle the more complicated mathematics needed in electrical engineering.

THE MARKET AND NAMES FOR ELECTRONIC BRAINS According to National Securities and Research Corporation, the potential market for electronic computers is well over $5 billion and may prove to be closer to $10 billion, per annum. Foreign companies join the electronic brains industry listing with such names as: "Bark" and "Besk," Sweden; "G-1," "G-3" and "Informatik," Germany; "Mark II" and "Mark III," Japan; "Gamma," France; "Ural," Russia; "Leo," "Pegasus" and "Mercury," Britain; "Petra" and "Zebra," Holland.

WESCON The 1957 Western Electronic Show and Convention will be held in the San Francisco Cow Palace August 20-23, and will include 765 exhibit booths, 225 technical papers at 48 sessions. Maj. Gen. Bernard A. Schriever, Commanding General of the Air Force Ballistic Missile Division of the Air Research and Development Command, will be the principal speaker at the all-industry luncheon on August 23.



## LETTERS to the Editor

DEAR SIR:

In regard to the article on "Value Engineering" which appeared in the June issue of SIGNAL, we recently received the following letter from the Renegotiation Board (addressed to RAdm. R. L. Swart, USN, Vice Chief of Naval Material), which expresses its policy on the treatment of value engineering incentive earnings. It is our opinion that the policy will result in equitable treatment if the contractor properly documents his value engineering earnings to the Renegotiation Board.

Sincerely yours,
J. M. WATERS
*Director of Value Engineering*
*Bureau of Ships*
*Department of the Navy*

DEAR ADMIRAL SWART:

. . . The Board is pleased to be informed of this important development in your procurement techniques and of its modus operandi. While I think it is obvious that the Board cannot commit itself in advance to the specific treatment to be given in any individual case (since in overall renegotiation many factors prescribed by the renegotiation statute must be considered), we nevertheless recommend the specific action suggested below.

We suggest that the Navy ask its contractors having contracts of this type to inform us of that fact in renegotiation proceedings, and to be prepared to describe and document their value engineering accomplishments thereunder. This will enable us to explore the matter fully in each individual case, obtaining from the Navy pertinent facts and opinions through the performance reporting procedures already established between our agencies.

Having developed the facts in each case, all due consideration will be given thereto under the statutory factors in the determination of the case. As you know, the factors in the law are quite comprehensive and enable the Board to give suitable recognition to any achievements of this type on the part of defense contractors.

Sincerely yours,
THOMAS COGGESHALL
*Chairman*
*The Renegotiation Board*

DEAR SIR:

We are all very pleased with the generous play you gave our story on "The Trend of Facsimile in Military Communications" in the July issue of SIGNAL. Thank you for giving us the opportunity to present it.

Sincerely yours,
A. G. COOLEY
*Exec. Vice Pres.*
*Times Facsimile Corp.*

# RELIABILITY ASSURANCE

The operating reliability of White Alice, largest tropo scatter system yet conceived, is of the utmost importance. REL, which developed and manufactured all scatter radio equipment for White Alice, has also devised the easily movable test bay *(left)*.

This bay permits system level settings to be made, measures system frequency response, and enables noise loading tests which measure system intermodulation of two or more stations. It also makes possible precise measurement of carrier frequency while the transmitter is in service. The incorporated monitor converter *(above)* provides a loop between a station's spare transmitter and spare receiver for all of the above tests.

In addition, any panel from transmitter exciters or receivers can be instantly inserted in REL's unique test bench, pictured in a previous advertisement, for complete measurement and testing.

The skills and experience which achieved these solutions are also available for your specialized radio problem.

REL

Radio Engineering Laboratories·Inc.
**36-40 37th St · Long Island City 1, N Y**
STillwell 6-2100 · Teletype: NY 4-2816
Canadian representative: AHEARN & SOPER CO · 384 BANK ST · OTTAWA

# AFCEA Group Members

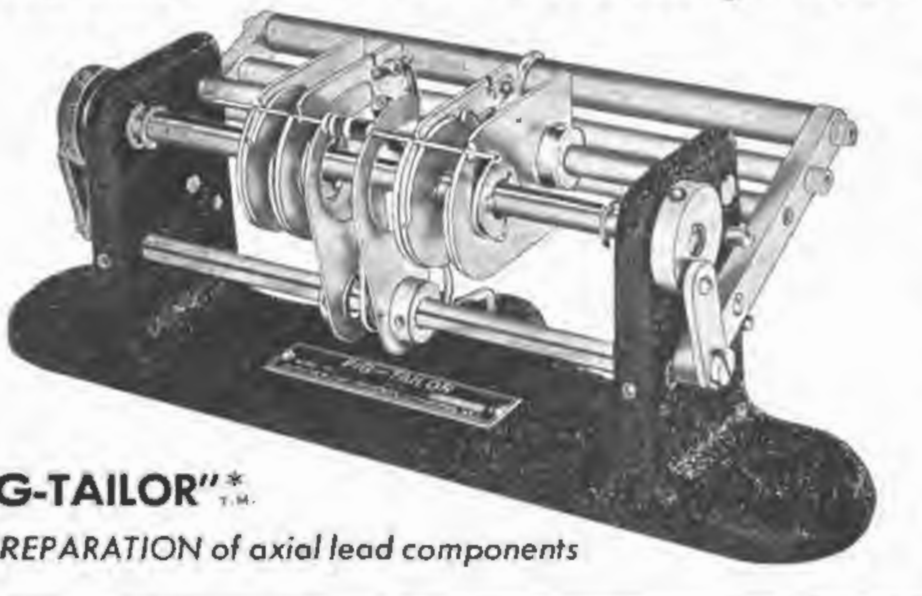
## Communications—Electronics—Photography

*Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By thi membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several o its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufactu ing, procurement, and operation.*

Admiral Corp.  
Aircraft Radio Corp.  
Allied Control Co., Inc.  
Allied Radio Corp.  
American Cable & Radio Corp.  
American Electronic Laboratories, Inc.  
American Institute of Electrical Engineers  
American Machine & Foundry Co.  
American Radio Relay League  
American Telephone & Telegraph Co.  
American Telephone & Telegraph Co., Long Lines Dept.  
Ampex Corp.  
Amphenol Electronics Corp.  
Anaconda Wire & Cable Co.  
A. R. F. Products, Inc.  
Arnold Engineering Co.  
Atlas Precision Products Co.  
Automatic Electric Co.  
Automatic Electric Sales Corp.  
Automatic Telephone & Electric Co., Ltd.  
Barker & Williamson, Inc.  
Barry Controls, Inc.  
Bell & Gossett Co.  
Bell Telephone Company of Pa.  
Bell Telephone Laboratories, Inc.  
Bendix Radio Division, Bendix Aviation Corp.  
Blackburn Electronic Corp.  
Bliley Electric Co.  
Bomac Laboratories, Inc.  
British Thomson-Houston Co., Ltd.  
Bruno-New York Industries Corp.  
Burroughs Corp.  
California Water & Telephone Co.  
Cambridge Thermionic Corp.  
Capitol Radio Engineering Institute, Inc.  
Carolina Telephone & Telegraph Co.  
Central Technical Institute  
Chesapeake & Potomac Tel. Co.  
Cincinnati & Suburban Bell Tel. Co.  
Collins Radio Co.  
Columbia Broadcasting System, Inc.  
Compagnie Francaise Thomson-Houston  
Contraves Italiana  
Convair, Division of General Dynamics Corp.  
Cook Electric Co.  
Copperweld Steel Co.  
Cornell-Dubilier Electric Corp.  
Craig Systems, Inc.  
Crosley Division-Avco Mfg. Corp.  
Dana, P. A., Inc.  
Designers for Industry, Inc.  
DeVry Technical Institute  
Diamond State Telephone Co.  
Dictaphone Corp.  
DuKane Corp.  
DuMont, Allen B., Laboratories, Inc.  
Eastman Kodak Co.  
Electronic Associates, Inc.  
Electronic Communications, Inc.  
Elgin Metalformers Corp.  
Fairchild Camera & Instrument Corp.  
Farnsworth Electronics Co.  
Federal Telecommunication Laboratories  
Federal Telephone & Radio Co.  
General Aniline & Film Corp.  
General Cable Corp.  
General Communications Co.  
General Electric Co.  
General Telephone Corp.  
Gilfillan Bros., Co.  
Globe Wireless, Ltd.  
Gray Manufacturing Co.  
Hallamore Electronics Co.  
Haller, Raymond and Brown, Inc.  
Hallicrafters Co., The  
Haloid Co.  
Hazeltine Electronics Division, Hazeltine Corp.  
Heinemann Electric Co.  
Hercules Motor Corp.  
Hitemp Wires, Inc.  
Hoffman Laboratories, Inc.  
Hogan Laboratories, Inc.  
Hoover Electronics Co.  
Hopkins Engineering Co.  
Hughes Aircraft Co.  
Hycon Eastern, Inc.  
Illinois Bell Telephone Co.  
Indiana Bell Telephone Co.  
Indiana Steel & Wire Co.  
Institute of Radio Engineers  
International Business Machines  
International Resistance Co.  
International Telephone & Telegraph Corp.  
Jacobsen Manufacturing Co.  
Jansky & Bailey, Inc.  
Kellogg Switchboard & Supply Co.  
Kin Tel  
Kleinschmidt Laboratories, Inc.  
Koiled Kords, Inc.  
Lansdale Tube Co., Division of Philco Corp.  
Leich Sales Corp.  
Lenkurt Electric Co.  
Lenz Electric Manufacturing Co.  
Lewyt Manufacturing Corp.  
Librascope, Inc.  
Loral Electronics Corp.  
Machlett Laboratories, Inc.  
Magnavox Co.  
Maida Development Co.  
Mallory, P. R., & Co., Inc.  
Materiel Telephonique Co.  
Michigan Bell Telephone Co.  
Montgomery Co., The  
Motorola, Inc.  
Mountain States Telephone & Telegraph Co.  
Mullard Ltd.  
Muter Co.  
Mycalex Corporation of America  
National Co., Inc.  
Nelson Technical Enterprises  
Nems-Clarke, Inc.  
New England Tel. & Tel. Co.  
New Jersey Bell Telephone Co.  
New York Telephone Co.  
North Electric Co.  
Northwestern Bell Telephone Co.  
Oak Manufacturing Co.  
Ohio Bell Telephone Co.  
O'Keefe & Merritt Co.  
Otis Elevator Co., Electronic Division  
Pacific Mercury Television Mfg. Corp.  
Pacific Telephone & Telegraph Co.  
Packard-Bell Co.  
Page Communications Engineers, Inc.  
Phelps Dodge Copper Products Corp.  
Philco Corp.  
Photographic Society of America  
Plessey Co., Ltd.  
Prodelin Inc.  
Production Research Corp.  
Radiart Corp.  
Radio Condenser Co.  
Radio Corporation of America  
Radio Corporation of America, Defense Electronic Products  
RCA Great Britain, Ltd.  
Radio Engineering Laboratories, Inc.  
Ramo-Wooldridge Corp.  
Raytheon Manufacturing Co.  
Red Bank Division, Bendix Aviation Corp.  
Reeves Instrument Corp.  
Remington Rand, Division of Sperry Rand Corp.  
Remler Co., Ltd.  
Rocke International Corp.  
Saxonburg Ceramics  
Society of Motion Picture & Television Engineers  
Sonotone Corp.  
SoundScriber Corp.  
Southern Bell Telephone & Telegraph Co.  
Southern New England Telephone Co.  
Southwestern Bell Telephone Co.  
Sperry Gyroscope Co., Division of Sperry Rand Corp.  
Sprague Electric Co.  
Stackpole Carbon Co.  
Standard Telephone & Cables, Ltd.  
Stanford Research Institute  
Stelma, Inc.  
Stewart-Warner Corp.  
Stromberg-Carlson Co., Division of General Dynamics Corp.  
Surprenant Mfg. Co.  
Sylvania Electric Products, Inc.  
Technical Materiel Corp., The  
Tele-Dynamics, Inc.  
Telephonics Corp.  
Teletype Corp.  
Tensolite Insulated Wire Co., Inc.  
Texas Instruments, Inc.  
Times Facsimile Corp.  
T.M.C. (Canada) Ltd.  
Trad Electronics Corp.  
Transitron Electronic Corp.  
Triad Transformer Corp.  
Tung-Sol Electric, Inc.  
United Telephone Co.  
United Transformer Co.  
Waterman Products Co., Inc.  
Webster-Chicago Corp., Government Division  
West Coast Telephone Co.  
Western Electric Co., Inc.  
Western Union Telegraph Co.  
Westinghouse Electric Corp.  
Weston Electrical Instrument Corp.  
Wheelock Signals, Inc.  
Wickes Engineering & Construction Co.  
Wilcox Electric Co., Inc.  
Willard Storage Battery Div., Electric Storage Battery Co.  
Wisconsin Telephone Co.  
Wollensak Optical Co.  
Zenith Radio Corp.

# PROVEN-on the assembly line!

**PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"**



**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*

# "PIG-TAILORING"

***. . . a revolutionary new mechanical process for higher roduction at lower costs. Fastest PREPARATION and ASSEMBLY f Resistors, Capacitors, Diodes and all other axial lead omponents for TERMINAL BOARDS, PRINTED CIRCUITS and IINIATURIZED ASSEMBLIES.***

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
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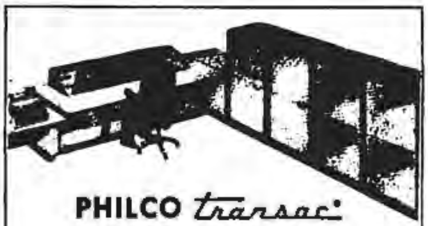

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# Chapter News

***Atlanta***—President elect Lt. Col. Donald L. Adams (left) and Charles M. Eberhart, retiring president of the chapter, greet Lt. Col. John V. Fill, Chief of the Electronics Branch, Army Ballistic Missile Agency, who was guest speaker at the May meeting.

### *Atlanta*

Lt. Col. John V. Fill, Chief of the Electronics Branch of the Army Ballistic Missile Agency, Huntsville, Alabama, spoke on "The Army Missile Program," at the chapter's May meeting.

During the business session, new officers were elected as follows: president —Lt. Col. Donald L. Adams, Third Army Signal Section, Fort McPherson; vice presidents — Arthur E. Arnold, Western Union Telegraph Company; Robert J. Smith, Atlanta General Depot and Elmo F. Stewart, Georgia Institute of Technology.

### *Augusta—Fort Gordon*

Col. David P. Gibbs, new commander of the U. S. Army Signal Training Center, was introduced to the chapter at its June 20th meeting by Col. Braxton E. Small, chapter president.

Principal speaker of the evening was 1st Lt. Richard M. Dumont, program director of the U. S. Army's Southeastern Signal School's television branch. His topic was "Commercial Television."

### *Gulf Coast*

At the July business meeting, President Ancil Arseneau reported on the events of the national convention at which he had represented the chapter, and plans were made for increasing membership and providing interesting programs during the coming year.

Roy L. Hipple was appointed to fill the vacancy in the position of chapter treasurer.

The chapter also reviewed its experience in stimulating interest in electronics among local high school students during the past year and various recommendations were made to implement this program in the next school term.

### *Hawaii*

Feature of a recent meeting was a boat tour of Pearl Harbor arranged by the Navy members of the chapter. Special guests at the luncheon which followed at the Commissioned Officers' Mess were introduced by Col. Glenn Meader, chapter president, as follows: Brig. Gen. Herbert L. Scofield, Commanding General, USA Base Command, and Brig. Gen. Don Graul, Commander of the 1808 AACS Wing.

At the annual elections, Col. Wayne L. O'Hern, USAF, was chosen to head the chapter during the coming year. The other new officers are: vice presidents—Capt. Frank A. Dingfelder, USN; Julian Lamboley, USARPAC; secretary — CWO Joseph B. Milligan, USAF; treasurer — Mary Evans, NavComSta; National Council member—Louis Robello, Hawaiian Telephone Company.

### *Kansas City*

About ninety members and gue journeyed from Kansas City to Fo Leavenworth, there to be joined b about fifteen officers, for the Apr meeting. The host, as well as th speaker of the evening, was Lt. C John Clapper of the Command a General Staff College.

Upon arrival, the group witnessed a display of television and electronic equipment currently in use by the Signal Corps.

Following dinner at the Officers' Club, Colonel Clapper gave a brief resume of the history and purpose of the Command and General Staff College. He then spoke on the subject of "Signal Communications in Atomic Warfare."

Special guests of the chapter were Col. John R. Howland, regional vice president, and Lt. Col. Colwill of the Australian Communication Corps.

At its May 23rd meeting, new officers and directors were elected for the coming year. Lt. Col. G. D. Meserve, USAF (Ret.), former president of the Montgomery (Ala.) Chapter, was chosen to head the chapter. Vice presidents are: D. E. Busse, Wilcox Electric Co.; Lt. Col. E. N. Jenkins, SigC, Fort Leavenworth; J. T. Naylor, United Telephone Co.; secretary-treasurer—M. H. Tyrell Southwestern Bell Telephone Co.

Board of directors: Cornelius Ashley, Southwestern Bell Telephone Co.; Lt. Col. Z. W. Barnes, Richards-Gebaur AFB; C. L. Buell, Western Union Telegraph Co.; R. E. Conrath and A. J. Esrey of American Telephone and Telegraph Co.; J. G. Kreamer, United Telephone Co.; W. G. Rider, Rider-Philpott Studio; J. T. Wallingford, Central Technical Institute; W. R. Wheeler, AT&T Co., and J. V. Wilcox, Wilcox

***London***—British Telecommunications Research, Ltd., was host to the chapter for its April meeting. Above, chapter members witness a demonstration of telegraph distortion measurement and a regenerative repeater during a tour of the company's facilities.

ectric Co.

Speaker of the evening was Col. John Bestic, Chief of the Communications- ectronics Division of the Strategic Air mmand, Omaha, Nebraska, whose bject was "The Strategic Air Com- nd and Communications-Electronics." lonel Bestic illustrated his talk with tual slides outlining some of the nctions of SAC and stressed the im- rtance of communications and elec- nics in this arm of national defense.

### *ndon*

British Telecommunications Research, d., was host to the chapter for a din- r-meeting and tour of its facilities on ril 26th. Arrangements for the event re made by Automatic Telephone & ectric Co., Ltd., group member of the CEA, and Sir Archibald Gill, Direc- r and General Manager of BTR.

Of particular interest in the tour and monstrations were the pilot regulator d amplifier, negative impedance, tele- aph storage on magnetic drum, tele- aph distortion measurement and re- nerative repeater.

Following dinner, Mr. F. P. Morrell, SC. M.I.E.E., presented a short talk the activities of British Telecommu- ications Research, Ltd.

The chapter's annual meeting was eld on May 28th at the Columbia lub, and new officers were elected as llows: president — Lt. Col. John T. yler, USAF; vice presidents — Capt. I. Williams, Jr., USN; Col. J. A. ihal, USAF; Cdr. C. G. Mayer, RCA reat Britain, Ltd.; Maj. C. L. Bachtel, SA; associate vice presidents — Mi- hael Clark, The Plessey Co., Ltd.; J. Eades, Automatic Telephone & lectric Co., Ltd.; T. E. Goldup, Mul- ard, Ltd.; Sir Reginald Payne-Gall- vey; treasurer — Maj. Fred E. Stant, USAF; associate treasurer—P. D. Can- ning, The Plessey Co., Ltd.; secretary —Capt. H. W. Gipple, USAF; associate secretary—L. T. Hinton, Standard Telephone & Cables, Ltd.

Capt. Edward Metzger, chapter president, gave a detailed report on the annual convention which he had attended in Washington in May. At the conclusion of the meeting, he was given a standing vote of thanks for his leadership during the past year.

### *New York*

Members of the chapter, their ladies and guests enjoyed a most successful meeting at Governor's Island on June 12. Held at the Officers' Club, the evening included cocktails, a buffet supper and dancing. This was the last chapter meeting until September and no business was transacted.

Among the 225 in attendance was Rear Adm. Frederick R. Furth, new National President of the AFCEA.

### *Philadelphia*

Professor Francis Davis, Professor of Physics and Meteorology at Drexel Institute, was guest speaker at the chapter's April meeting and discussed "Meteorological Measurements." Professor Davis is well known in the Philadelphia area for his broadcasts and telecasts of the weather over WFIL and WFIL-TV.

The meeting was held in the Skyview Terrace Dining Room at the International Airport, and was preceded by a social hour and dinner.

### *Philippine*

Col. Orville Laird, Director of Communications, Hq. Thirteenth Air Force, was elected president of the chapter at its June 15th meeting.

The other new officers are: vice president—Cdr. George Partis, NAVCOMMFACPHIL; treasurer — Jay Howe, 2720th Maintenance Group; secretary —Robert C. Young, Radio Electronics Hqs., Inc.

### *Pittsburgh*

The chapter's annual dinner party was held at Buffalo Inn, South Park, on June 6th. The entertainment featured a special program of 3-dimensional music by Earl LaFean, chapter member.

Recently elected officers were introduced as follows: president — George H. Aderhold, Saxonburg Ceramics Co.; vice presidents — H. S. Brown, Mine Safety Appliance Co.; Maj. John T. Dabinett, Carnegie Institute of Technology; H. Lundberg, Shields Rubber Co.; R. C. Ridley, Copperweld Steel Co.; J. I. Seitz, Union Switch & Signal; W. H. Yates, Western Union Telegraph Co.; H. D. Choate, Bell Telephone Co. of Pa.; secretary—Harry W. Shepard, Jr., Stanwix Autopark; treasurer — F. K. Wunderlich, Pennsylvania Railroad Co.; member executive committee — Harold W. Mitchell (retiring president), Bell Telephone Co. of Pa.

Board of Directors: E. W. Breisch, Union Switch & Signal; John Wesner, Carnegie Institute of Technology; A. M. Crawford, Pennsylvania Railroad Co.; F. E. Leib, Copperweld Steel Co.; S. E. Phillips, Bell Telephone Co. of Pa.; E. J. Staubitz, consulting engineer; S. C. Stoehr, Jr., Bell Telephone Co. of Pa., and R. W. Hill, Hamburg Brothers, Inc.

### *Rome-Utica*

Officers elected at the April meeting were officially installed on June 19th at a dinner-meeting at the Officers' Club, Griffiss Air Force Base. Robert A. Rodriguez, outgoing chapter president and organizer of the chapter, was the installing officer.

Program feature of the evening was a film, "The WAC of Shangri-La Fame," which was of particular interest since it depicts the true jungle crash and adventure of Rome's own Mrs. Margaret J. Atkinson of Rome Air Development Center. Also shown was a short film on the crash rescue radio equipment which is being developed by the Air Research and Development Command to speed up locating crashed aircraft.

***Tokyo***—Program for the chapter's May 3rd meeting was sponsored by the Air Force, with "The Role of Communications and Electro in the Air Force" as the theme. Pictured at the head table, left to right, are: Capt. Robert H. Weeks, COMNAVFE, chapter direct Col. Charles J. Harrison, FEAF, chapter director; Brig. Gen. Cecil P. Lessig, Commander, 41st Air Division, keynote speaker; Chapter Pr James T. Ramsey, Philco Corp.; Col. Aubrey R. Morley, Sig Sec., Hq. AFFE, vice pres., and Col. Thew J. Ice, Hq. FEC, program chairm

***Rome-Utica***—New officers installed at the June meeting, left to right: Albert D. Reisenberg, treasurer; William L. Roberts, 3rd vice president; Murray Socolof, 1st vice president; Allan A. Kunze, president; Robert A. Rodriguez, outgoing president and installing officer; Charles A. Strom, Jr., 2nd vice president; Darrell S. Kirby, secretary.

## *Scott-St. Louis*

A dinner-dance on June 7th at Augustine's Restaurant in Belleville, Ill. recessed chapter activities for the summer months.

During the business session, Col. C W. Gordon, chapter president, reported on the events of the national convention, and plans were made for the opening meeting in September.

Program feature was "Hemo, the Magnificent," the second color film in the Bell System's series of science films.

## *Southern Connecticut*

KIP Electronics Corporation, Stamford, furnished the program for the June 13th meeting, with George W. Baker, president, and John N. Higgins, sales manager, as the speakers.

The discussion and demonstration explained how a new tube type comes into existence, tracing the progress from the original presentation of the problem through to the successful achievement — a new tube. KIP Electronics provides a unique service to government and industry in that special purpose tubes may be provided to solve tube function problems where no existing tube will do the job.

During the business session, Edward A. Chmielewski of SoundScriber Corporation was named to the post of chapter treasurer to fill the vacancy created by the transfer of Bernard Rosenberg to Philadelphia.

## *Tinker-Oklahoma City*

Dr. James G. Harlow, Executive Vice President of the Frontiers of Science Foundation of Oklahoma, addressed the chapter's June 28th dinner-meeting at the Tinker Air Force Base Officers' Club. His authoritative presentation, "The Citizen of the New Frontiers" was considered outstanding by the chapter audience. Dr. Harlow was introduced by Professor Ansel P. Challenner of the University of Oklahoma

Dr. Harlow is a Fellow of the Oklahoma Academy of Science. During World War II, he served in the Navy and received a special commendation for his work in organizing and admin-ering one of the Navy's advanced chnical schools for officers. He holds e rank of Commander in the U. S. *aval* Reserve. Now on the staff of the aiversity of Chicago, his current aching and research interest lies in e fields of science, education, higher lucation and administrative theory. *uring* 1957 he is on leave from the niversity to act as Executive Vice resident of the Frontiers of Science oundation of Oklahoma.

**okyo**

The importance of Communications id Electronics in the Air Force was rcibly pointed out by Air Force-host iest speaker, Brig. Gen. Cecil P. Lesg, Commander of the 41st Air Divion, Japan, at the May 3rd chapter incheon. Held at the Rocker-4 Club ι Tokyo, the meeting was sponsored y the Air Force in the Far East and eatured displays of Air Weather Serve, AC/W, AACS and Airborne Electonics.

General Lessig paid high tribute to ll AFCEA members and guests for heir splendid effort in the field of elecronics, and pointed out that without he aid of electronics *no defense would e possible.* He explained that, with he increase in speed of aircraft, elecronics and electronics people must ear a larger share of the responsibilty for providing effective weapon sysems.

The General went on to draw a comparison between the 1941 aircraft-electronics system and the present and future systems look. He stated that with new speeds and altitudes possible there is a vital need for more reliability and effectiveness in electronic systems. He also stressed the fact that clumsiness of hand and slowness of mind must be overcome in dealing with these new speeds. In the old days, he said, we had minutes to hours to play with but now we must think in terms of seconds, and possibly micro-seconds, if we are going to cope with speeds ranging from mach 2 to 10.

General Lessig concluded his talk by encouraging greater effort be expended on new techniques and developments through research and development. He said "push everything and every effort to make improvements possible."

At the conclusion of the meeting, members and guests were invited to tour several Tokyo electronics-optics establishments.

**Washington**

Chapter president L. Harris Robinson, Motorola, Inc., reports that the monthly luncheons will be resumed at the Willard Hotel in October. Monthly luncheons will run through to include June 1958. John Gilbarte, Admiral Corp., has been selected as program chairman.

# ITEMS OF INTEREST

## From Government, Industry and the Services

### Sun Rays To Power Satellite Instruments

Instruments within an earth satellite will be able to draw their required electrical power from the sun. During recent experimentation, engineers from the U.S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., proved that solar batteries may provide an ideal power source.

Army scientists attached glass-protected solar cell clusters to the skin of an Aerobee-Hi rocket launched by the Navy at White Sands Proving Ground, New Mexico. Approximating satellite conditions, the rocket was fired to an altitude of 190 miles. The batteries, of tiny silicon wafers, functioned with only slight electrical output variance.

Until the rocket's radio re-entered dense atmosphere and ceased functioning, telemetered data indicated that the cells had provided continuous power during the flight.

As visualized by scientists, the solar cells attached to the skin of the earth satellite would supply instrument power for approximately the 60 minutes the vehicle would circle the earth in the sun. They also could charge small nickel-cadmium batteries to provide electricity during the remaining 40 minutes the satellite travels in the earth's shadow.

Further tests are to be conducted during some of the early satellite launchings.

### New Amplifier Uses Ferrites

Research physicists at Bell Telephone Laboratories have successfully operated a new solid-state microwave amplifier using a ferrite material as the active element.

Functioning at room temperature, this ferro-magnetic development is expected to have a much lower noise level than conventional microwave amplifiers. The device should prove valuable in correcting weak microwave signals in radio astronomy, microwave relaying and radar fields.

Although the amplifier has certain superficial similarities to the solid-state spin oscillator, both must be supplied power from an oscillator operating at a higher frequency than the signal to be amplified.

It appears that ferromagnetic amplifiers can be designed for operation in practically any portion of the microwave spectrum. Preliminary results indicate that the band width is adequate for many applications. Thus, although still in the experimental stage, the discovery may lead the way to an entirely new group of ferrite microwave devices.

### Life Can Exist On Mars

First results of an eight-month-old Air Force research project show that life can exist on Mars. Living specimens were cultivated under conditions approximating planet environmental extremes and not only survived but flourished.

The living organisms, bacteria which thrive on nitrogen, were placed in soil samples collected from the more desolate regions of the U. S.

Conducted at the Air Force School of Aviation Medicine near San Antonio, the tests included duplicating temperatures which range from 70 degrees Fahrenheit to 95 degrees below zero. The air on Mars is nearly all inert nitrogen—probably less than one per cent is oxygen. Pressure is the same as that found in the stratosphere and the water supply is less than the content of the earth's dryest deserts.

A certain number of the bacteria survived paralleled conditions and were able to reproduce in a moisture content of only two-fifths of one per cent.

### Safety Measure For Jets

The Sperry Gyroscope Company, Great Neck, N. Y., has developed an electronic method for monitoring jet engines, both in flight and on the ground. The simple device will make safer jet travel and greater military mission reliability possible.

Weighing 15 pounds, the new equipment "routinely" picks out and measures selected vibrations within the recesses of jet power plants.

A warning of impending trouble is given when unusual vibrations—caused by inbalance of rotating parts—are present and when normal engine vibration limits are being exceeded.

Compact, permanently-installed airborne units will enable airline and military flight crews to precisely monitor the performance of jet engines in flight, thus assuring increased safety. They will also be able to spot quickly imminent disturbance that otherwise might require the attention of a team of ground maintenance technicians.

The Air Force, which makes wide use of the company's analyzing equipment with piston engine aircraft, has scheduled preliminary tests for the new "jet system." The Navy also plans tests, and airline executives are negotiating for its installation in turbo-prop and turbo-jet aircraft on order.

### "Solion" Rivals Vacuum Tube

The Naval Ordnance Laboratory recently reported the development of a device that may replace the vacuum tube and even the transistor in performing some functions in electronic circuits.

Nicknamed the "solion," the electrochemical unit depends upon the movement of ions in a solution rather than in a gas or vacuum.

Application of the device might conceivably range from guidance of aircraft to use in burglar and fire alarm systems.

### G. E. Announces Fusion Research

The General Electric Research Laboratory has launched a scientific search aimed at developing safe and inexpensive power from the fundamental process of the hydrogen bomb.

According to Dr. Guy Suits, G.E. vice president and director of research, a "substantial research program" to study the fusion process has been underway at Schenectady, N. Y., for more than a year.

"Fusion technology, as now conceived, employs the most basic technical skills of the electrical industry, and it is inevitable that the industry will contribute heavily to this important development," Dr. Suits said.

Thus far, research on fusion has been more productive of "hope than power" but eventually a reluctant nature must be made to yield a controlled thermonuclear reaction for energy generation, he added.

"My own view," Dr. Suits stated.

s that five additional years of re- arch will be required to make pos- ble a realistic appraisal of the fu- on process; in ten years we may be t the point of technical feasibility; *ilot-plant* production of fusion power ill not begin for twenty years and *ompetitive* power production lies eyond that."

During this period of discovery nd development, the production of ower by fission, which is technically easible today, will rapidly become ompetitive with older energy sources, e predicted, adding that experience ccumulated in producing atomic ower by fission will be invaluable hen fusion becomes practical.

## WESCON Field Trips

A number of field trips have been cheduled for the ninth annual West- rn Electronic Show and Convention n San Francisco, August 20-23. VESCON will offer the expected 0,000 registrants a choice of organ- zed visits to research laboratories, nanufacturing plants, military instal- ations and other points of profes- ional interest to electronics engineers.

Included in the itinerary are tours of two military defense facilities—a U.S. Army NIKE missile installation and the U. S. Naval Radiological Defense Laboratory at Hunter's Point, San Francisco.

A group, limited to 150 U.S. citizens, will observe progress on the first nuclear-powered guided missile submarine, the *U.S.S. Halibut.*

## Army Develops New Mask

A protective mask, which will guard the American soldier against chemical, biological, and radiological agents, has been developed by the Army Chemical Corps. Designed to give complete protection against the inhalation of war gases, germ warfare agents and airborne radioactive fallout particles, the mask does not safeguard against direct radiation.

A major feature is the elimination of the protruding canister used currently. Pads of a new lightweight, pliable gas-aerosol filter material are enclosed within cavities molded into the rubber face piece.

In addition, lower breathing resistance, superior vision, better speech transmission and greater comfort are among the advantages of the design.

While the new mask still must undergo rigorous tests before it can be adopted as standard, the principl incorporated are believed sound.

The mask was produced with th assistance of the John T. Ryan M morial Laboratory of the Mine Safet Appliances Company, of Pittsburg Pennsylvania, under a research co tract with the Army Chemical Corp

## X-17 Research Rocket

An Air Force research rocket, th Lockheed X-17, has reached the high est speed ever achieved by any i strumented missile. On a number flights the rocket attained the reco speed as it flew into the ionospher

The biggest and the most powerf U.S. missile using all solid prope lants, the three-stage X-17 is designe to aid in overcoming the re-entr problem. Steps are necessary to pr vent long range missiles, which wi travel out of the earth's atmosphe in a high arc to their destinatio from burning like meteors when the return to the heavy air close to th earth.

Built by Lockheed's Missile Sy tems Division in Van Nuys, Calif the 40-foot tall rocket has been fire repeatedly from the long range mi sile test center at Patrick Air Forc Base, Florida. Various materials an shapes were subjected to missile-lik re-entry conditions.

## "Automatic Navigator" Developed By Navy

Ten years of research have pr duced an "automatic navigator which supplies continuous informa tion to pilots. Designed to me modern, high-speed flight requir ments, the new instrument is base on the air-ground radar Doppler sy tem and was developed by the Nav and Ryan Aeronautical Co., Sa Diego, Cal.

The 200-pound device, designate APN-67, gathers data instantaneousl and transmits it as visual display screening out irrelevant plane motion Data supplied includes latitude, lon gitude, ground speed, desired an actual ground track, ground mile traveled and course error.

## Mixed-Unit Aircraft Engine

The British recently released new concerning their first mixed-unit ai craft engine. The combined jet an rocket engines were used in the ini tial flight of the Saunders-Roe S.R 53.

The mixed-unit aircraft overcome the previous problem of fall-off i

## ITEMS OF INTEREST

thrust of pure jets at high altitude. Entirely independent of the atmosphere for oxygen to support combustion of a hydro-carbon fuel, the new engine is called the "Spectre." It carries highly concentrated hydrogen peroxide which, through a catalytic process, is transformed into heavily oxygenated, super-heated steam. When mixed with atomized engine fuel and ignited, the steam produces a powerful thrust movement.

Rocket-powered aircraft such as the S.R. 53, are able to climb to operational levels, now in the stratosphere, in a shorter time than previously possible. During the course of the climb, when the altitude begins to rob the jet of its thrust, that of the rocket is increasing. A high rate of climb is maintained up to extreme operational altitudes.

### Chemically Made "Mirrors"

Chemically formed "radio mirrors" may insure normal continuance when solar activity interrupts communications. According to Joseph Kaplan, chairman of the United States program for the International Geophysical Year, the "mirrors" will bounce radio waves toward the earth when operations are suspended.

One such "mirror," formed when the Air Force seeded the atmosphere 60 miles up with 10 pounds of nitric acid, bounced radio signals back as intense as the normal ionized layer.

Mr. Kaplan said chemical injections of the upper atmosphere can play a significant role in bettering communications during solar disturbances and are well within the bounds of practicality.

### High Altitude Suit Proves Successful

A full pressure high altitude suit, which will afford pilots protection in the stratosphere, has been successfully flight tested by the Navy.

Commander Jack Morrisey, in a turbojet F80 Crusader, demonstrated that pilots will be able to fly a supersonic craft in the stratosphere without risk of lowered cabin pressure. At high altitudes exposure to the thin atmosphere would boil a man's blood in seconds.

The new suit, made of nylon and rubber, also retains life saving pressure in the event a man bails out at stratospheric altitudes. In addition, it will keep the pilot afloat and free from exposure in cold water.

Although the suits contain their own communication, oxygen and ventilation systems, they have more mobility, better visibility, comfort and protective features than previous models of high altitude equipment.

### Antarctic Bases Seek "Ham" Contacts

With Naval Reserve training and electronic units particularly in mind, seven Navy Antarctic bases have made a request for more U.S. amateur radio contacts.

"Ham" radio represents the only direct touch with families and friends available to the 318 Navy men and scientists in the Antarctic.

Amateur radio, according to the Commander of Naval Units in Antarctica, has proven an excellent morale factor and a network would be desirable as a reliable relay for personal messages.

NOTE: Presently, National Headquarters of AFCEA is receiving call letters from "ham" operators who are members of the Association. The purpose of this is to build up within AFCEA an International "Ham" Network. (Note June issue, page 21.) Send us your card. We are working on a plan.

## Names in the [illegible]ws

**Harold Silverstein,** [illegible]ial A[illegible]sistant to the Chief Sign[illegible]cer, [illegible] been awarded the Secr[illegible] of [illegible] Army's Research and S[illegible] Fell[illegible]ship. He will attend [illegible]ingto[illegible] American University a[illegible]gage[illegible] a project on the man[illegible]ent [illegible] use of Electronic Dat[illegible]ocess[illegible] Systems for logistical [illegible]usine[illegible] type applications within [illegible]Army[illegible]

**Major General E. [illegible]r G[illegible]land,** one of the ranki[illegible]mmu[illegible] cations-electronics offi[illegible] in [illegible] United States Air Force[illegible]red [illegible] 31. Prior to his retirem[illegible]Gen[illegible] Garland served as Chie[illegible]nal [illegible]cer, SHAPE.

**Captain Robert F. [illegible]ert** [illegible]cently received the Army[illegible]men[illegible]tion Ribbon with metal p[illegible]t a[illegible] letter of commendation f[illegible]Gen[illegible] Sun Yup Paik, ROK Ar[illegible]Chief [illegible] Staff. The recognition was[illegible]resul[illegible] his work as Signal maintenance [illegible] visor to the ROK Army Signal D[illegible]pot at Pusan, Korea.

**Brigadier General Wesley T. Guest,** Signal Officer, U.S. Army, Europe, has been assigned to the Sacramento Signal Depot in California. Originally appointed to the Office of the Chief Signal Officer in Washington, General Guest will proceed to California from his current European post and assume his new duties in September.

**Frank A. Cowan,** whose inventions contributed greatly to telephony, died June 21 in New York after a brief illness. He was 59. Responsible for the development of varistor type modulators and demodulators, his inventions also include a telegraph transmission measuring set. Mr. Cowan was Assistant Director of Operations of the American Telephone and Telegraph Co., Long Line Department.

**Brigadier General Alfred R. Maxwell,** USAF-Ret., has been named vice president of Hallamore Electronics Co., division of The Siegler Corporation, Anaheim, California. He will direct East Coast operations for the Hallamore division in Washington.

**Colonel Bernard M. Wootton,** Deputy Director of Communications-Electronics, U.S. Air Force, was recently nominated for the rank of brigadier general. He is a vice president of the Washington Chapter of the AFCEA.

U.S. Navy Photo

The Variable Angle Launcher, one of NOTS' test facilities, is considered the largest "blow-gun" in the world. Experimental missiles are blown into the water through a 300-foot long launching tube.

# NAVAL ORDNANCE TEST STATION DESIGNS, DEVELOPS, TESTS ADVANCED WEAPONS

Serving the needs of the fleet and other service branches for superior weapons is the mission of the Navy's largest ordnance research and development center, the U. S. Naval Ordnance Test Station (NOTS) at China Lake and Pasadena, California.

Established in 1943 by the Bureau of Ordnance, NOTS is the "home" of weapons such as the 2.75" MIGHTY MOUSE air-to-air rocket and the recently unveiled SIDEWINDER guided missile. These weapons are products of an effective military-civilian team at NOTS which originates and carries out weapon ideas; designing, developing, and testing guided missiles, rockets, torpedoes, armament-control systems, and other ordnance items until they are completed and ready for mass production.

Many specialized facilities enable the Station to pursue this broad program. Among these are highly instrumented test ranges, transonic and supersonic test tracks, facilities for the development and pilot production of solid and liquid propellants, a naval air unit equipped with planes of many types, a multimillion-dollar research and development laboratory, and other installations.

The main facility of NOTS encompasses over 1,200 square miles of the Mojave Desert 155 miles north of Los Angeles, while underwater ordnance activities are centered at Pasadena, with water test ranges located at Morris Dam, Long Beach, and San Clemente Island. About 4,800 scientists, engineers, and other civilians, and 1,200 military personnel at NOTS installations are constantly striving to develop better weapons for our nation's defense.

This is one of a series of ads on the technical activities of the Department of Defense.

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# NEW PRODUCTS FROM INDUSTRY

## Instant Radar Maps

Combining the accuracies of radar, the convenience and utility of photography and the speed of electronics, Hycon Mfg. Co., of Pasadena, Calif., recently developed a revolutionary device which presents a photograph of the ground beneath an aircraft, as seen by its radar, thus allowing unprecedented navigational accuracy.

Working equally well day or night, in clear weather or above clouds, the "radar strip recorder" requires neither operator nor dependence upon ground equipment.

This automatic device with its associated fast film processor, is adaptable to practically all types of airborne radar. In addition, the device is useful as a ground recorder of radar or telemeter information relayed from flying radar sets. In such cases, the strip recorder simplifies the task of ground controllers and observers in monitoring the flight path of a missile or drone aircraft.

Using only one liquid bath, the unique developing process functions at a high temperature to obtain the speed of only 10 seconds for development. The strip is then viewed directly on a translucent lighted screen measuring about 9" x 11". Since the process is continuous, the pilot and navigator see a slowly moving portion of a long strip of film which is automatically wound up on a roller in the machine.

High precision optics and advanced electronic techniques provide for manual adjustment to wind drift and automatic correction of distortions due to high altitude.

## Type PR-200 Preamplifier

For use with their telemetering receivers, Nems-Clarke, Inc., 919 Jesup-Blair Dr., Silver Spring, Md., has announced their PR-200 Preamplifier. Completely new in design, it is both weatherproof and pressurized so as to permit location at the antenna without encountering moisture problems.

With this new unit employed, line losses as high as 6 db will not decrease the sensitivity of the receiving system by more than a few tenths of a db. The pass band has a uniform response of 3 db over a frequency range of 215-245 megacycles.

This Preamplifier has a self-contained power supply which is controlled from a 1¾" power control panel, designed for mounting in the relay rack with other equipment.

Similar units are available having a uniform response within 3 db over a frequency range of 225-260 megacycles.

## Robot Meteorological Station

The Société Télécommande et de Télémécanique, of Boulogne-sur-Seine, France, has recently installed in the polar region of Antarctica their all-automatic weather forecasting station. Claimed to function for months either in polar or in tropical regions, it will eliminate the previous necessity for supporting operating personnel there.

Powered by batteries, the robot station can emit information at all hours and over a range of 936 miles. It indicates the direction and velocity of winds (up to 144 mph), temperatures from -113° to 140°F., barometric pressure and other desired atmospheric information.

The registering instruments are linked to an electromagnetic "brain" which codes data received, passes it on to the broadcasting unit and stops the broadcast when transmission is completed. The "brain" is directed by a pendulum clock, the system's nerve center.

After sending out its call sign 14 times, the station flashes its bulletin 3 times at dictation speed. Two transmitters of different frequency allow the "brain" to select one for day and the other for night.

## Pushbutton Tube Analyzer

A pushbutton vacuum-tube analyzer, said to permit measurements under almost any operating conditions, has been developed at the Laboratory for Electronics, Inc., Boston, Mass.

Featuring a true trans-conductance measurement to an accuracy of 3%, the model 725 electron tube analyzer is said to permit simultaneous measurement of all variables on separate meters. In addition, conductance to 30,000 micromhos can be measured.

Plate and screen voltages from 0-300 volts are available, and grid and suppressor voltages range from plus to minus 150 volts. It is claimed that as low as 1 microamp can be measured.

Other capabilities include end-of-life test, short test, gas test and electrode leakage resistance tests.

## Voice for Electronic Brain

A Voice Data Link System, which converts automatic commands of computing machines into verbal messages from a library of pre-recorded words, has been announced by the Electronics Div. of Fairchild Controls Corp., Robbins Lane, Syosset, Long Island, N. Y.

A wide variety of important uses includes air traffic control, airborne warning, remote voice communication, multi-lingual communications and information directory for transportation terminals.

Teamed with an air defense electronic data system such as SAGE, the Voice Data Link provides automatic guidance control of aircraft using existing communications facilities. As the "brain" computes best course and altitude for an intercept, the Data Link transforms the information into a verbal message which is transmitted to the aircraft by a standard voice channel transmitter.

As a multi-lingual communicator at international airports or with NATO commands, stored vocabularies in many languages are used.

Any number of message formats and message lengths can be had by proper programming of the system. The Voice Data Link also provides for simultaneous transmission of more than one message over individual audio channels.

## Radar Indicator Recorder

A new Beattie Radar Indicator Recorder designed for airborne fire control systems was recently announced by Beattie-Coleman Inc., 1000 North Olive St., Anaheim, Calif.

This new camera records range and code lights as well as radar reading. Two synchronized counters are provided; one records optically while the other is visible to the operator. In addition, a sweep second hand watch is optically recorded. Binocular viewers of the radar screen contain a filter for minimum eye strain. Moreover, viewing and picture taking is permitted simultaneously.

Holding 100 ft. of 70mm perforated film which is automatically advanced by an electrical drive mechanism, the camera allows exposures either at regular predetermined intervals or at random.

Designed to fit the confines of a cockpit, the new recorder features compactness and dependability.

### lew Patent: A. A. Kiriloff

Now available from Alexander A. iriloff, of London Terrace House, 05 West 23rd St., New York 11, . Y., is a new device for deflecting rom electronic apparatus the disrbances from atmospheric and other *atics.*

Using emanation of radio-active aterials in its process, this device as been granted patent # 2794118, A. A. Kiriloff *et al,*" recently reeased by the Atomic Energy Comission.

### ew Directional Antenna

Ainslie Corp. of 312 Quincy Ave., uincy, Mass., is offering a newly eveloped microwave antenna for the 00-500 mc band, with a dipole exiter.

Gain of the new antenna is 23 db r better at 500 mc, with minimum ide lobes and cross polarization of 0 db or better.

Having a rugged, lightweight, alluminum mesh construction, the unit s fully weatherized and corrosive resistant and is now available in both a 12 ft. diameter Model CF-121M and a 14 ft. diameter Model CF-141M.

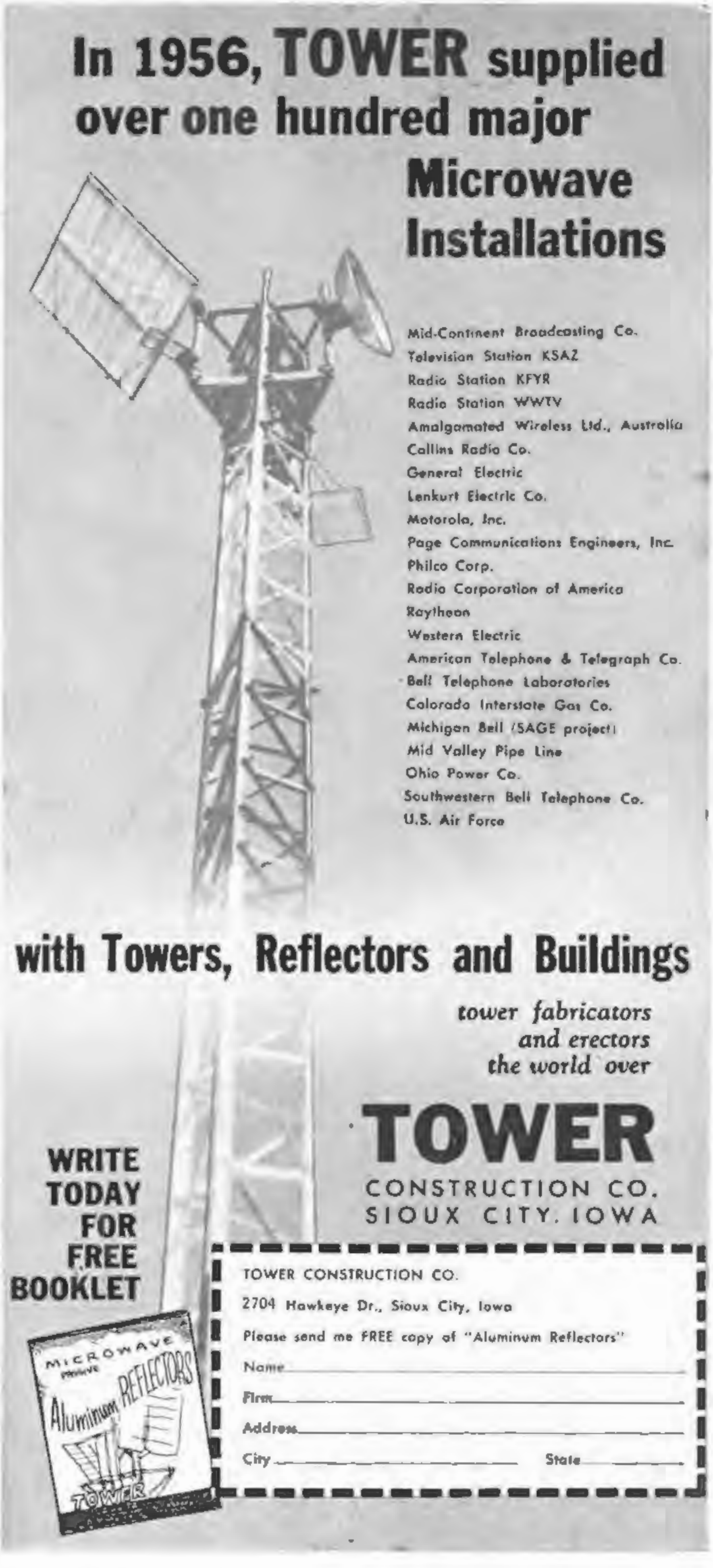
### No *Transistors In New Miniaturized Terminal*

A new miniaturized carrier-telephone terminal, claimed to be a "real break-through" in engineering progress, has been developed by Radio Engineering Products Limited, 1080 University St., Montreal, Canada.

Compared to equipment now in use, the new unit is less than 1/10 the cubic content and ¼ the weight, requires 1/7 as much power and uses only 10 electron tubes, all of a single type. It is further said that transistorized designs are 2.4 as large and more than twice as heavy. Shock-mounted in its carrying case, the complete terminal measures $15\frac{3}{16}$ x $9\frac{7}{8}$ x $9\frac{11}{16}$ inches and weighs 67 lbs. All controls, connections, fuses and tubes are accessible from the front panel.

The terminal provides 4 toll-grade carrier-derived telephone circuits, a voice-frequency order-wire circuit and frequency space for up to 20 carrier-telegraph circuits. Also included are ringing converters, complete test and line-up facilities, automatic transmission regulator and attendant's telephone set.

Operating distances up to 40 miles without intermediate repeaters are possible over standard loaded spiral-4 field cable. From 115 or 230 volts, 45 to 66 cycles, operation requires only 43 watts.



## NEW PRODUCTS

### "Solar Clock"

A new portable clock which will operate for one month on a day's equivalent of sun or incandescent light, has been announced by General Time Corp., New York. It will be available next Fall from the company's Seth Thomas division.

If exposed periodically to light, the "solar clock" will run indefinitely and is said to be capable of operating for more than a year on stored energy.

The device contains a series of cells that generate voltage when exposed to light. The voltage charges another cell which, in turn, operates the clock.

### "Talking" Alarm Device

An alarm system using both radio and magnetic tape to inform proper sources of either fire or burglary emergencies, is now available from Radialarm, Inc., of Toledo, Ohio.

When the system is activated, a radio transmitter broadcasts a prerecorded magnetic tape giving information as to source of broadcast, location and fire bo ceivers are in fire d police headquarters. T repeated 3 times.

### Copyflo Continuo

The Haloid Co., Roch pioneers in xerography, oped a unique, low-cost automatic enlarging and of engineering drawings of their new "XeroX Co 24-inch" continuous printer.

Enlarging 35mm microfilm image to a width of 24", the machine prints the drawings on a continuous roll of paper at 20 ft. a minute. No ink is used and the clean, fast electrostatic process requires neither water nor liquid chemicals.

Either positive or negative microfilm may be used, but not inter-mixed. Roll microfilm in either 16mm or 35mm size may also be used with an auxiliary attachment, a change which can be made in 10 minutes.

### Cordless Switchboard

Designed to provide large savings in time and space for small concerns having 100 or fewer employees, a new cordless switchboard has been developed by the Bell Telephone Labs., of American Telephone & Telegraph Co.

In contrast to comparable equipment which ordinarily fills a room about 12 feet square, this new unit has switching equipment contained in 2 soundproof cabinets measuring 2¼ x 2½ x 5¼ feet.

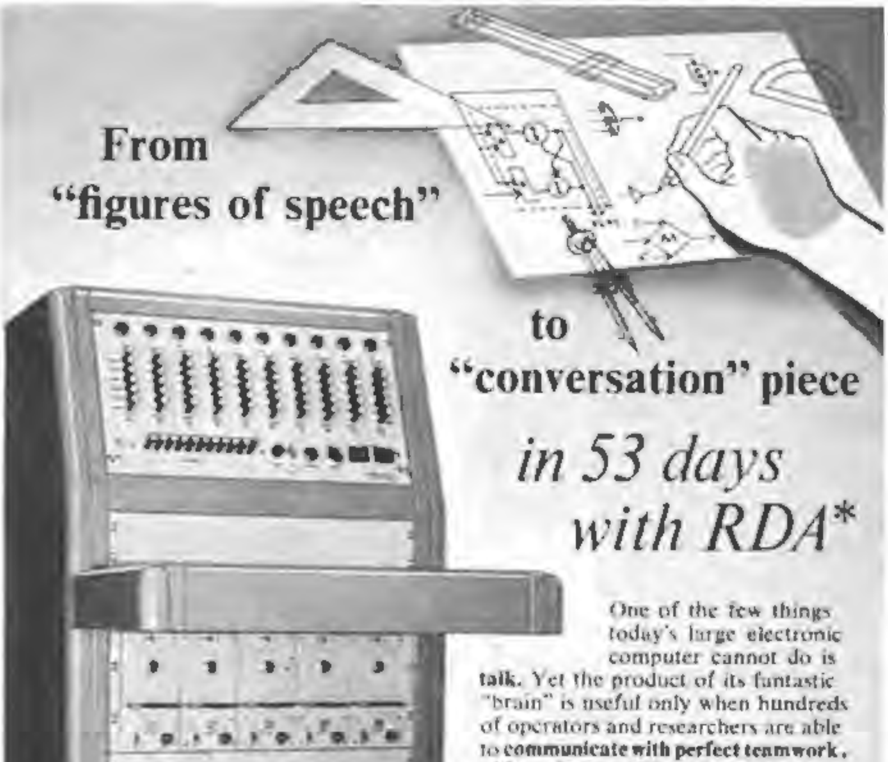
### Tiny Timing Tube

Raytheon Manufacturing Co., of Waltham 54, Mass., has developed a new tube the size of a cigarette filter tip that will indicate how long an electronic device has been operating, and thereby prevent costly breakdown of expensive equipment since parts can be replaced before they reach the danger point.

Maximum use of the new tube is expected in equipment requiring super-reliability such as radar, aircraft and computers. Other devices in which the timer can be used include motor bearings, heater elements, burglar alarm systems and transmitter tubes.

Completely self-sealed and impervious to surrounding conditions, the timer can operate immersed in liquid and functions equally well in hot or cold temperatures.

Measuring 1" x ⅜" and weighing less than 1/6 ounce, the tube is simple to install and much cheaper than mechanical timing devices.



***ATTER PROPAGATION: THEORY AND PRACTICE, by Ira Kamen and George Doundoulakis. Howard W. Sams & Co., Inc., Indianapolis 5, Indiana. 197 pages, $3.00.***

Of considerable value to those who ish to familiarize themselves with e work in the field of long range mmunications, this book was degned for the technicians who will erform the important roles of inalling, operating and maintaining e many scatter propagation sysms eventually to network the earth.

The theory is presented in simple nderstandable language. Formulas re outlined to give the technician omplete guide lines on how these ormulas are applied to scatter propaation engineering practice. It is oped that the text will lucidly expose e principal problems and the present tate of the art.

Data in the text has been carefully ollated from the authors' experiences s design engineers and from their onversations with engineering assoiates and others, all of whom are redited throughout the work.

***NTRODUCTION TO UHF CIRCUITS AND COMPONENTS, by Milton S. Kiver. C. Van Nostrand Co., Inc., New York. 408 pages, $7.50.***

For those interested in UHF and ts use in amateur or in commercial pplications, this book presents an xceptionally clear treatment of UHF rinciples and their application to reeivers, convertors and all other quipment.

The purpose of the text is to point ut the underlying equality of all adio, whatever the frequency. Conepts of UHF circuits are presented as logical outgrowths of more familiar low-frequency equipment. Discussion of the operation of every component first begins with the simplest statement of how the electrons or waves act and then progresses to a full account of the actual apparatus.

Presentation is geared toward easy comprehension, but the reader is also referred to excellent theoretical treatises for intensive study.

Supplemented by hundreds of specially prepared photographs and diagrams, Mr. Kiver has prepared a valuable coverage of actual operating principles of every element in present UHF equipment.

***ANALOG COMPUTERS: THEIR INDUSTRIAL APPLICATIONS. Proceedings of a Symposium, April 1956, Sponsored and Published by Midwest Research Institute, 425 Volker Blvd., Kansas City 10, Mo. 210 pages, 8½" x 11", $5.00.***

Compiled from the Proceedings of MRI's 1956 Symposium for Management, this publication contains 13 technical papers plus a transcript of the round-table discussion which, collectively, present a valuable survey and status report on the analog computing field.

Covering the role of the analog computer in both solving and refining technical and non-technical problems, the book includes applications in the design and operation of engineering systems, in flood routing and other hydraulic problems, in economic programming and in industrial control problems.

With the purchase of this publication, a copy of each of the following articles by the MRI staff may be had at no additional charge: 192 — "A Look Back, and Ahead, at Automatic Processing;" 188 — "How Management Looks at Industrial Research;" 180 — "How Operations Research Aids Management;" 168 — "MRI's Analog Computing Facility for Industry."

***TRANSISTOR CIRCUIT ENGINEERING, Ed. by Richard F. Shea. John Wiley & Sons, Inc., New York. 468 pages, $12.00.***

The first book in the field of transistor research to supply quantitative design information, this work was prepared to combine a proper mixture of basic transistor theory with examples of its proper application in typical circuits.

Detailing up-to-date information on the development of new devices which have opened new fields of utilization, the text provides instruction for actual circuit designing and developing of useable circuits in all potential fields of application.

Lucid directions are given for building successful audio amplifiers, radio frequency amplifiers, etc., using currently available transistors. Moreover, the book shows how to combine these elements into radio receivers, TV sets, and high fidelity audio systems. Mathematical treatment is limited to that necessary for clarity.

Written by members of the General Electric Co. staff, the text is expected to assume a place of authority in the field of transistor research.

***STORAGE AND PRESERVATION OF FILM. Eastman Kodak Co., Rochester 4, N. Y., 50¢. (Reviewed by Frank Smith, Photo Ed.)***

Motion picture workers who are concerned with the use, storage and preservation of motion picture film will doubtless be pleased to know that a new, illustrated 80-page data book is available to them.

Covering all phases in the care and storage of processed and unprocessed motion picture films, the data book has been planned to meet the needs of film processing laboratories, motion picture studios, theaters, TV stations, libraries, schools, and archives.

A section of the book discusses the structure and composition of motion picture film, identification of nitrate and safety films, the effects of temperature and humidity on film and other factors which govern the stability and permanence of film base and the photographic image. Also explained are principles of proper storage for raw film, the design and operation of storage rooms and care of film in the field before and after exposure.

***THE TRANSPORTATION CORPS: OPERATIONS OVERSEAS, by Joseph Bykofsky and Harold Larson. Office of the Chief of Military History, Dept. of the Army, Washington, D. C. 671 pages, $6.50.***

With this volume, "U. S. Army in W. W. II," the Army completes its trilogy covering the mammoth task of Army transportation involved in prosecuting global warfare.

Recounting deficiencies as well as accomplishments, the authors point up the numerous problems which severely hampered transportation operations such as adverse climate, a paucity of trained personnel, extensive use of untrained combat troops and the lag of oversea commands in developing organizations that could give centralized and integrated direction to Army transportation activities.

While the several crises described picture the seriousness of such deficiencies, the work clearly indicates that the shortcomings discussed should serve to accent rather than detract from the achievements of the U. S. Army's overseas transportation operations.

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# Breaking Production Bottlenecks

## with Automatic Sweep

Sweep Drive operating a G-R Unit Oscillator whose output is held constant by the Type 1263-A Regulating Power Supply.

### Type 1750-A Sweep Drive . . . $460

**Speed Range:** adjustable 0.5–5 cps, reciprocating motion

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Used in combination with G-R's popular line of Unit Oscillators, the Sweep Drive makes available sweep generators for the frequency ranges: 500 kc-to-50 Mc, 50 Mc-to-250 Mc, 65 Mc-to-500 Mc, 250 Mc-to-920 Mc, and 900 Mc-to-2000 Mc. The Drive can be coupled to either the oscillator's slow-motion drive for sweeping over small ranges or coupled directly to the main shaft to take advantage of the extremely wide frequency ranges offered by G-R Unit Oscillators.

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*Spencer-Kennedy* wide-band amplifiers for community TV distribution systems required tedious and time-consuming checks at many points to insure acceptable gain and response uniformity. Standard test procedure called for checks at 15 different frequencies, and if any adjustments were made, it was usually necessary to repeat the entire set of measurements. Test time was about an hour per unit and would often cause severe production bottlenecks.

Engineers at SKL successfully broke the bottleneck with the G-R Type 1750-A Sweep Drive. The response characteristic, now displayed on an oscilloscope, is instantly obtained over the entire band from 54 to 216 Mc. Adjustment effects are observed easily and immediately. Average testing time is now cut by 50 percent with no loss in accuracy — the bottleneck is eliminated with a considerable saving in production costs.

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Communications—Electronics—Photography

September 1957

# SIGNAL

Transarctic Communications

See page 7

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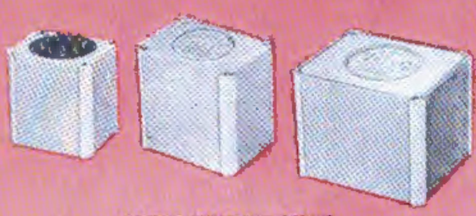

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# DREAMS WITH A PURPOSE

> *"Leave the beaten track occasionally and dive into the woods. You will be certain to find something you have never seen before."*
>
> ALEXANDER GRAHAM BELL

THERE have always been dreams and high hopes in the communications business. And always, for something over eighty years, there has been continuous and determined research to help make those dreams come true.

For before there was a telephone there was a telephone laboratory.

First it was just two men, Bell and Watson, in an attic workshop. Then the idea grew, as the need grew, and the practical values of research became nore and more apparent.

Today there are more than 10,000 eople at Bell Telephone Laboratories, of whom over 3000 are trained scientists and engineers.

Their work covers many fields and goes exploring and developing in many directions. But everything is directed to one goal. It is the betterment of communications service and the finding of ways to provide this better service at the lowest cost to the customer.

The great assets of the Bell Laboratories are the judgment and knowledge that have been gained from years of experience, combined with the enthusiasm of minds versed in the newest scientific knowledge.

There is also the encouragement of initiative through a careful balance of pure research and developmental work. The scientist is given a freedom that is rare in industrial work.

Some of the great achievements of the Bell Laboratories have come in recent years.

The Transistor is a Bell Telephone Laboratories invention. So is the Solar Battery. So, too, are the switching machines that have brought about Direct Distance Dialing. And, again, there was the development of those wonderful amplifiers for the underseas telephone cables.

It all adds up to a great deal of progress. But there is much more to come. All that has been done is but the beginning.

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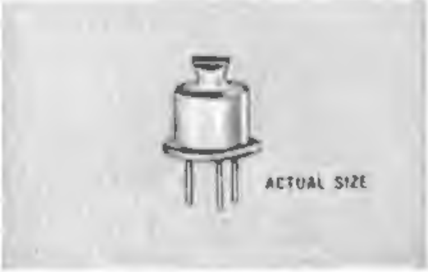

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*Managing Editor*
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Photo News
FRANK SMITH

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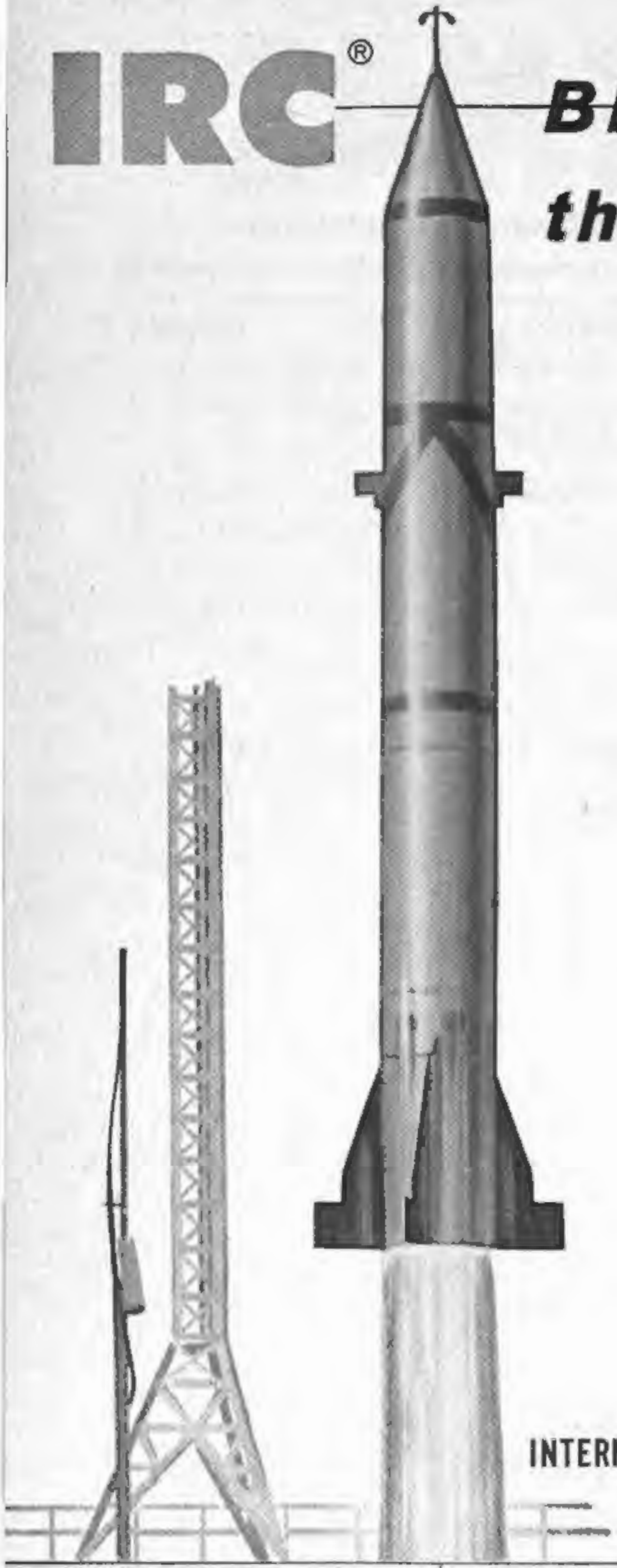

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# The President's Page

Frederick R. Furth

In my first message, I wish to express my profound appreciation for he honor which you have conferred upon me as President of AFCEA or the year May 1957-May 1958. I am fully aware of the importance ind responsibilities of this office and the obligations that such an honor lemands on behalf of the Officers, Executive Committee, the Board of irectors and the Chapter Officers. There are but few positions which re as meaningful as that of the Presidency of the Armed Forces ommunications and Electronics Association.

AFCEA is truly an association of dedicated individuals who comrise the civilian-military team concept. In our work in the communiations and electronics field we must be continuously alert to the probem of balancing the heavy requirement for a strong military posture gainst the needs of a viable, expanding national economy. I mention his for it is imperative that we discuss such an issue as well as other najor problems at our chapter meetings and, at the same time, follow losely the timely articles published in SIGNAL Magazine. By so loing, we keep ourselves abreast of events which affect our national rowth and security. It seems to me that this is one way we can ctively stimulate progressive interest in our chapter activities. In rder to further stimulate chapter interest, Captain Wilfred B. oulett, USN, Ret., has been named executive vice-president. His luties, among others, will be that of maintaining close contact between ational Headquarters, our chapters and group members.

Finally, I would like to call upon our chapter presidents and group nembers to assist in building up membership in AFCEA. Last year ur membership showed a steady increase. This was due in no small ay to the issuance of an improved monthly magazine instead of a i-monthly publication. I am sure there are many individuals who ould like to know more about the Armed Forces Communications nd Electronics Association and who would be interested in joining if hey were extended an invitation.

## NEW WEAPON, NEW CONCEPT

An important new weapon for a new U. S. Army concept is now being delivered in quantity by Martin-Orlando. This is LACROSSE, a field artillery guided missile, developed to implement the combat concept of the Pentomic Army...a "fighting" Army consisting of self-sufficient highly mobile battle groups. LACROSSE will provide these battle groups with the shockpower of extraordinary speed, mobility and accuracy in heavy armament support of their operations. LACROSSE is the first generation of an entirely new kind of general purpose weapon. All of its components, consisting of the missile mounted on a standard Army truck and a guidance system, can be airlifted to advance areas. The missile is fired in the general direction of the target—without target data at the launching site. Its pinpoint accuracy is controlled by a forward observer. The Martin Company, with more than 10 years of design, production and operational experience in guided missiles, today stands as a leader in this important field.

**MARTIN**
BALTIMORE DENVER ORLANDO

# the WHITE ALICE story

***by William E. Burke***

**Vice President**

**Defense Projects Division**

**Western Electric Company**

STATION BY STATION THE LINKS IN vast new communications system re being forged in Alaska. Known y the Air Force code name as White Alice," this system will conect remote key locations to major efense and population centers. Built rimarily for defense communicaions purposes under a contract with he Western Electric Company, White Alice will undertake an adlitional civic duty, providing telephone and telegraph circuits for pubic use over a rugged land that has often been described as America's ast frontier.

It utilizes those seven league boots of modern communication, microwaves and over-the-horizon tropospheric scatter radio systems to provide reliable transmission.

By late summer, 13 stations were in service furnishing about 1,000 route miles of circuits. By Spring of next year, the presently planned system of 33 stations covering over 3,000 route miles will be completed.

This remarkable long-haul communications network has its origin in the problems of the geography of Alaska itself. A look at a map will show that the territory lies in the direct path of air routes over the top of the world—a logical direction from which hostile air attacks could be launched against the United States.

Defense installations have multiplied in Alaska in recent years. Radar stations, Air Forces bases, Army and Navy installations and most recently the Distant Early Warning Line have been established, taking advantage of Alaska's position as an outpost of the Nation from which her first defense against an attack could be mounted.

### *Study of Needs*

As this defense complex grew, the need for a modern, reliable communications network within the territory to support military operations became imperative. The requirements dictated that these facilities not only interconnect military establishments in Alaska, but tie them into the continental communications network as well.

Prior to the advent of the White Alice System, Alaska not only faced communication problems typical to an undeveloped and sparsely settled frontier, but it also had to contend with mountainous topography, extreme weather conditions and the variable radio propagation conditions of the Arctic and subarctic. The long distance wire network connecting the main populated areas of Fairbanks and Anchorage is operated by the Alaska Communication System (Signal Corps) under most difficult conditions. High frequency radio circuits operated by the Air Force, Civil Aeronautics Authority and ACS to remote areas have limited channel capacity and are subject to poor propagation conditions.

The growing requirements for improved service prompted the Air Force, in 1954, to request the American Telephone and Telegraph Company to undertake a comprehensive study of communication needs. This work was undertaken by the Long Lines Department.

The task was to provide a plan for an integrated communication system of a large number of channels equal in quality and reliability to Bell System long-haul circuits and designed first to provide essential defense needs for the Air Force and, secondly, to serve the requirements of all other government agencies where advantageous. These included military installations, air traffic and weather networks operated by the CAA and civilian services furnished by Alaska Communication System (Signal Corps).

Together, the weather and the topography ruled out conventional telephone and telegraph networks of cable and extensive microwave systems. Construction costs would be excessive and access for maintenance impossible.

This study showed that standard Bell System TD-2 Microwave systems operating in the 4,000 megacycle band with repeater spacings of about 30 miles could be used in built-up areas adjacent to main roads when line of sight could be achieved,

**A completed station in the White Alice communications system on the Kenai Peninsula interconnecting two tropospheric scatter paths and one microwave radio relay path.**

and the unattended repeater stations would be accessible for year round maintenance. Thus, the section near Anchorage from Wasilla through Anchorage and extending down the Kenai Peninsula to Homer involved 8 links and 178 route miles of these microwave facilities and was easily solved.

The remaining links of over-water and over-mountain hops of considerable distance dictated the use of the newest technique of radio communication, Forward Propagation Tropospheric Scatter. This UHF system operating in the 700-900 megacycle band employs high power transmitters and very large parabolic antennas to span up to 170 miles between stations. Thus stations could be located for the most part near points of circuit usage and minimize the number of stations to be built. Further, both microwave and tropospheric scatter systems can, by proper engineering of paths, provide freedom from the high intensity electrical disturbances and radio blackouts that have traditionally rendered Arctic radio communications useless for long periods.

### *Over-the-Horizon Technique*

The system now authorized and resulting from these recommendations consists of 33 stations covering about 3,000 route miles of which 23 links use the over-the-horizon technique. Locations of stations were determined by considering the terminal point of the circuits to be provided, the location of users, and a study of available topographic maps. Either one KW or ten KW transmitters built by Radio Engineering Laboratories, Inc., feed 30 foot circular parabolic or 60 foot rectangular parabolic antennas, depending on the path loss. Up to 132 voice channels are derived on either the TD-2 or scatter links using Western Electric Type K and L frequency division multi-channel terminal equipment. Telegraph channels are obtained by adding Western Electric 42A1 voice frequency carrier telegraph terminals to the voice channels. In total there are 170,000 telephone channel miles and 50,000 telegraph channel miles furnished by the system.

Authorization to proceed with the design and construction of the system was given to the Western Electric Company's Defense Projects Division in January 1955. The system requirements included not only the basic electronic facilities but buildings, fuel oil storage, water supplies, and in many instances, dormitories, access roads and some airstrips. In addition, varying requirements for entrance facilities required placing of substantial amounts of cable and the use of short distance radio links to connect users to the system.

Many defense installations to be served were not located for ease of access. Further, the charact of the scatter system requiring or negative angle takeoff and structed horizon for propagation, tated that most sites had to be lo on mountains or high ground. T latter requirements increased tre dously the construction costs an gistics problems. Site loca weather and terrain (and even a bears) joined to create difficult struction conditions.

Construction responsibility of buildings and related facilities f of the sites was placed on the U States Army Corps of Engineers. the remaining 23 sites this was cluded in the Western Electric tract which subcontracted this wo a number of firms, with Morri and Knudson having a majority the work.

### *Tests and Construction*

Western Electric's job of des engineering, construction supervi and test started with basic dev ment supervision from the Bell T phone Laboratories. The project te was organized from personnel tained from many companies of Bell System, each individual a speci ist in some phase of the work.

Before construction could sta field survey teams explored t ground. They found that the b maps showed mountains sometimes much as ten miles out of place a errors in elevation of as much 1,000 feet. They also checked the co struction possibilities of the tentati locations. Even then, the statio could not be built until radio prop gation tests verified calculations an showed that satisfactory transmissio was possible.

Transmission path testing require the temporary installation of te transmitters and receivers, and th erection of antenna towers up to 20 feet tall. Often 14 tons of equipmen were moved to mountain tops by air lift in planes and Air Force helicop ters. Hazardous landings were mad on treacherous stretches of snow in planes equipped with skis. At time the crews had to put much of th equipment on their backs and hike

After test gear was set up, a vigil of several weeks of propagation recording began. The crews had to continuously operate their sensitive measuring equipment while snow, driven on the Arctic winds, lashed their canvas shelters. Storms twice blew down and destroyed the well-anchored test antennas.

When construction work began, the airplane, often called the covered

(*Continued on page 10*)

# NEW "RADAR RULER"

## gives military surveyors an electronic seven league sextant

## PORTABLE RADAR STATIONS MEASURE AND DOUBLE CHECK 50 MILE READINGS IN SECONDS

For the *first time*, surveyors are freed from short-sighted optical equipment. Unlike old-fashioned surveying tools, the "radar ruler" pierces through fog, darkness or dense foliage, electronically pacing off distances of 1 to 50 miles, precise to within a few meters!

This new general-purpose surveying instrument was developed by Motorola's Military Electronics Laboratory for the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. The entire operation can be handled easily and quickly by unskilled personnel.

This self-calibrating system uses two identical portable radar stations which bounce a signal back and forth thousands of times each second. High-speed computers automatically provide the data necessary to measure off the distance.

Here is just one more example of the equipment now being developed by Motorola for many varied military applications.

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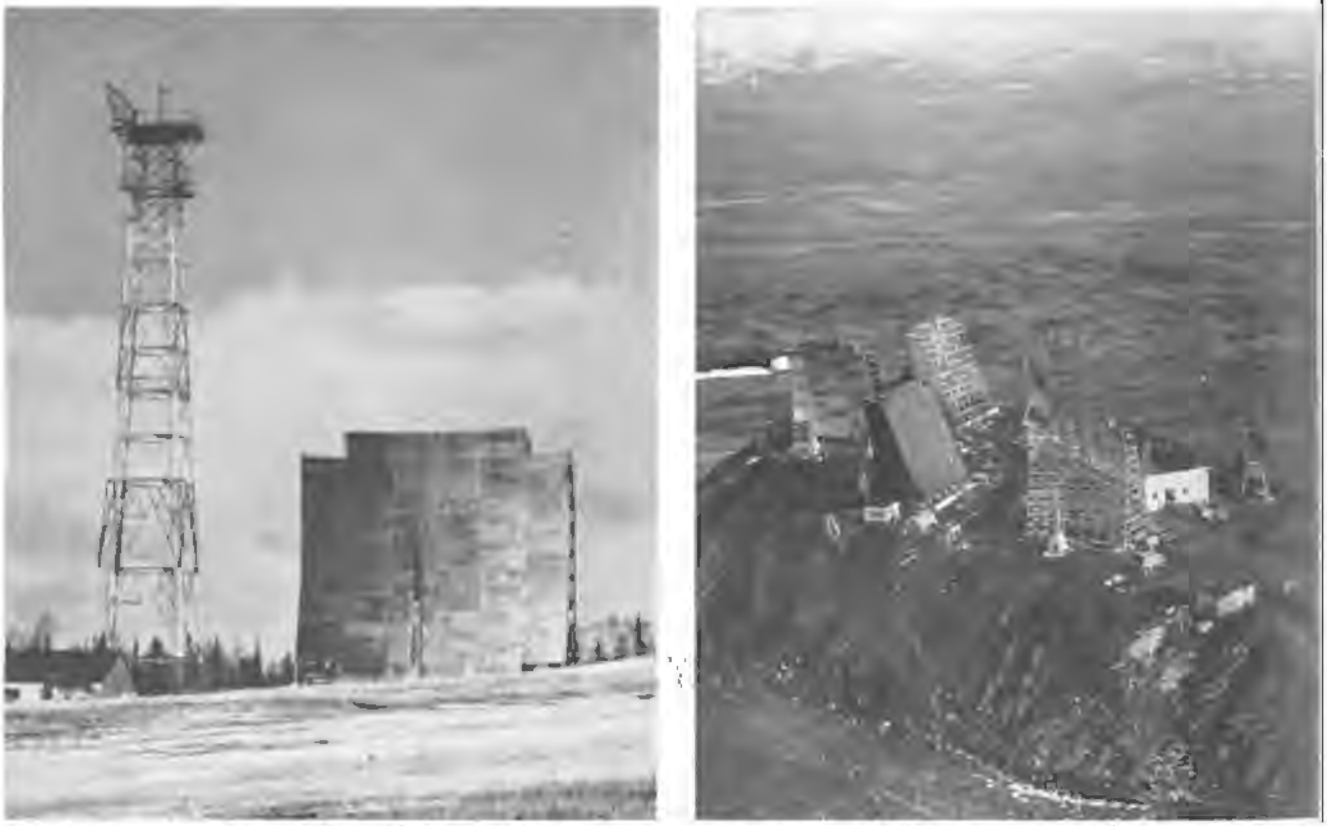

**Completed station (above left) in Matanuska Valley area interconnecting tropospheric scatter path and microwave radi path. Scatter station (above right) interconnects three paths with two antennas for each path. Two paths require 60 ft. rectangular parabolic antennas, and one uses a 30 ft. circular parabolic antenna.**

wagon of the Arctic, became the work horse of White Alice. Charter craft, piloted by the famed bush pilots and Air Force planes with their seasoned crews delivered men, equipment, and materials to remote wilderness locations. Frequently weather and landing conditions were unknown until the pilot was within a few miles of his destination.

Sea and land transportation were used when possible. However, the Bering Sea is usually open to shipping only about five months each year. The White Alice station at Cape Lisburne on the Arctic Ocean is icebound ten months a year! Even during open periods, storms and fog peril shipping operations. At every point in the Bering Sea area, except one, cargo was lightered ashore. Often the barges were lashed to Caterpillar Tractors while being unloaded to prevent their being wrecked by rough seas. In all, a total of over 70,000 tons of material and supplies have been delivered to White Alice sites in Alaska.

The construction work has involved building airstrips and many miles of steep, twisting mountain roads; blasting and chiseling mountain tops to accommodate the buildings and massive steel antennas; building fuel and water systems. At some locations it was necessary to build temporary heated enclosures around entire buildings to keep layers of ice from coating the framework.

### *Behind the Link*

No story about White Alice would be complete without a tribute to the people who have made the project possible—Bell System people drawn from all levels of responsibilty and experience, Air Force and Corps of Engineer people, and the many fine Alaskan craftsmen who contributed so much to the construction phase of the job.

Many of these people have been separated from homes and families for long periods of time. Many have undergone severe hardships and hazardous conditions. They have worked long hours under unfavorable circumstances. In doing so they have done more than a day's work and have taken in their stride many formidable tasks which lesser men would have shirked.

White Alice also has taken the combined management and technical skills of the Bell System Companies, the manufacturing and supply facilities of the Western Electric Company and the research and development abilities of the Bell Telephone Laboratories. Hundreds of companies large and small (more than 800 electronics firms alone) cooperated by furnishing equipment and materials on tight schedules which often meant disrupting other production schedules.

As important as White Alice is to Alaskan and American defense, its successful completion is also marking a tremendous new accomplishment in the art of communications. Until White Alice was undertaken, beyond-horizon radio was considered in the experimental stage. Its only previous use was over a trial route in Newfoundland. White Alice circuits now in service have proven the ability of this technique to provide communications circuits of the highest quality and have established beyond-horizon radio for future service of bettering communications among men of good will.

As the Honorable Anton Anderson, the Mayor of Anchorage, Alaska, said at the service cutover for the first White Alice links in November of last year, "This system has been properly named. To me it is Alice in Wonderland." And as Alice said to the Gryphon in Lewis Carroll's famous book, " 'I could tell you my adventures, beginning from this morning,' said Alice a little timidly, 'but it's no use going back to yesterday because I was a different person then'."

And so it is with Alaska; it is and will be a different person today and tomorrow with its growth potential improved by modern communication facilities.

# Golden Era

## photography - electronics

N THE WAY OUT TO THE COAST A le back, we flew at about 20,000 through some of the clearest ther I have ever seen. As we ap- ached the Mississippi, the pilot ounced over the p.a. system that would cross the river just north St. Louis. And so I moved over rer the window to get a better k at one of the most beautiful hts you can see from the air—the ning of the Mississippi and Mis- ri rivers.

The visibility was so good that day t I could see a sharp separation tween the waters of the two rivers ven after they had joined together—he Big Muddy was running along he west bank, and the clear waters f the Mississippi were running long the other. But as you looked outh, they gradually blended together and moved on toward the ulf.

There you have two mighty rivers n their own right, joining together o form the longest river system in he world. And there you also have n analogy for everyone reading this rticle. I am speaking about a gradual out accelerating trend which will roduce, in a few short years, the olden Era of Photography to paral- el the Golden Era of Electronics, just s certainly as those two rivers will ontinue to join together.

This trend involves electronics on the one hand and photography on he other, and for the next few moments I should like to make a few observations about these two large and increasingly related fields which will draw ever more closely together in the years ahead.

Because the entire economy has been growing so steadily since the end of the war, with the Gross National Product running today at the rate of probably $420 or $425 billion annually, the trends in various individual industries cannot help but be obscured somewhat by our economic progress as a whole. After all, when a football team is piling up seven or eight touchdowns, with everybody taking turns carrying the ball, it's pretty difficult to single out any one man. Nevertheless, one man usually begins to stand out above the rest. Perhaps he's a little faster, a trifle more intuitive, or more resourceful, and you remember him more than anyone else.

It seems to me that is the case in industry today, except for the fact that there are two standout performers, rather than one . . . electronics *and* photography.

Let's look at electronics a little more closely, so that we can have a better basis for seeing just how closely these two fields will draw together in the future. I don't know of any more logical place to start than at the beginning, but the problem is finding the beginning. You might say electronics began when Marconi developed the wireless, or when Lee De Forest invented the vacuum tube. Or you might move ahead a few years to the 1920's when radio broadcasting was developed. However, it seems to me that electronics, in the sense that we regard it today, really emerged from World War II, when for the first time we began to see the enormous future ahead of us.

The radio manufacturing and broadcasting industries rose to a volume of several hundred million dollars by the time we entered the war, and that's not peanuts in anybody's book. But when you get right down to it, they represent only a single phase of the industry as we know it today. They were the forerunners of an industry which leap-frogged across the equivalent of 25 or 30 years of technical progress during the five war years, and which has grown in 15 years from an annual volume of half a billion to $12 billion, and from employment of some 70,000 to more than ten times that number today.

This unprecedented growth—and I want to underscore that word "unprecedented"—makes electronics today the fastest growing of all the major industries. No other single industry can match it. The enormous variety of electronic products available at this very moment, and the day-after-day introduction of new ideas and new concepts makes one fact abundantly clear—the progress has been tremendous, but we have only scratched the surface. There are so many fruitful possibilities in this amazing field that one of the most difficult decisions for any company to make these days is deciding which direction to take next—and you have an infinite variety of directions from which to choose.

### *Two Areas of Electronics*

There are really two general areas of electronics. One is composed of the products which are essentially electronic from start to finish—the products which would not exist at all without the electron tube—TV, radio, the electronic brains, and so on. The other area is the application of electronics to something which has been done before mechanically or electrically, but not electronically. It is a case of using electronics to control something, or to compute or to memorize, and so on. This is the field with the largest potential—because it embraces every product area—military, commercial, industrial, and

**by**

**Don G. Mitchell**

CHAIRMAN OF THE BOARD AND PRESIDENT

SYLVANIA ELECTRIC PRODUCTS, INC.

consumer. In the military field, for example, the passive defense system for the new B-58 supersonic bomber is not comprised of armament in the usual sense. It is a shield of electronics which surrounds the plane and stands ready to repel any missiles which might be directed against it. In industry, electronic controls on production and materials handling equipment are becoming increasingly commonplace. On the administrative side of the business, electronic data processing is taking the drudgery out of inventory control, ordering and billing, marketing research, and many other tasks where the paperwork sometimes becomes so monumental that the *end* is all too frequently completely obscured by the *means*.

The magnitude of this area of the electronic industry is in the billions. Defense electronics is at the level of some $3 billion a year and will continue at a high level for years to come. Commercial and industrial electronics are a billion-dollar business today, or more than twice the entire industry in 1940. And yet this field is only in its infancy. Within five or six years, volume should have increased by $500 or $600 million or more, and be up around $2 billion by 1965 or even sooner.

It is extremely difficult for the average person to visualize commercial and industrial electronics because he is not aware of any direct contact with it. And yet his long-distance call goes over microwave links, or his power company may compute his light bill and tens of thousands of other bills in a matter of minutes instead of hours and days; and in more and more banks, the accounts are computed electronically, and any errors which might crop up were probably made by a human being, and not an electronic machine.

### *Systematic Application*

Yes, electronics has become the heart of national defense, and it is moving gradually into industrial processes and commercial applications—but the market with a potential that absolutely defies even a wild guesstimate is the consumer market. Some product lines can be charged with reasonable accuracy on the basis of population trends, continued growth in standard of living, and so on. But the technological factor in consumer electronics is so predominant as far as the future is concerned, that the traditional long-term market projections are really only the barest of minimums.

As the electronic device and the electronic component move toward broader and broader consumer application, there will be one pitfall which must be scrupulously avoided. And that comes under the heading of "over-engineering." It happened in major appliances, as many of you will recall. When relays and controls were first applied to washing machines, for example, there were plenty of headaches for the consumer and for the serviceman, and I honestly think that this resulted from trying to do too many things at once. The refrigerator escaped that period, because the engineers approached that venerable device more conservatively, and first developed a hermetic-sealed motor, and then automatic de-icers, and all the rest, but they didn't pile on everything at once.

The point is this: If electronics is applied systematically and logically, to automobiles, to home-heating and air conditioning, to home lighting, *and* to photography, the public will find itself with another invaluable aid to modern living. But so-called "packing" with electronic gadgets, and doing something by electronics that doesn't need electronics any more than good Scotch needs ginger-ale, will only provide a first-class nightmare for everybody. The engineers call this being "gadget-happy," but all too frequently they are the same boys who keep loading gadgets on a consumer product until you have to take in a young engineer as a boarder in order to keep the thing running.

### *Unlimited Potentials*

If there ever was a field where electronics has a logical and unlimited potential, that field is photography. The drawing together of these two major industries can be traced back to that phenomenon we know as "light," and the use of light to produce images. Light, of course, has been the very heart of photography since its beginnings, but using a stream of electrons to pick up the reflection of an image and then to reproduce that image on a screen miles away was accomplished on a practical basis for the first time only a short time before World War II. These were the early versions of television and radar, and from the day those achievements were recorded, it has been inevitable that electronics and photography would find increasingly common grounds and draw steadily closer together.

As we look back at the television of the late 1930's and at the early work done by the French on the predecessor to radar, we know now that these were among the major scientific break-throughs of all time. For years the electron had performed the masterful job of turning sound into an electrical impulse and back into sound. But with television and radar, the electron jumped out of this narrow confinement and joined photography in a realm which contributes more to the welfare of mankind than any of man's five senses—the sense of sight.

Here was the harnessing of light in a new form to bring information, amusement, and education to millions of people—more rapidly and more directly than ever before. However, I certainly do not feel that television is the achievement to end all achievements. Many of the technical accomplishments of television have been in a basic sense, photographic achievements. Or to put it another way, television and photography are so inter-related that where one stops and the other begins cannot be pinpointed. What we really seem to have is a complete blending of two different techniques and two different arts, and each can learn a great deal from the other.

Here is a case in point. The other night my wife and I went to the movies, and I must confess that it had been many weeks since the last time. I had become so accustomed to television pictures and television techniques that I was almost startled by what I saw on the screen. First, it gave the impression of being three-dimensional, although I realize this was an illusion, but the photography had a quality that no television program has been able to accomplish, and that quality was amazing flexibility. I recall saying to myself, "If television had this flexibility, and if motion pictures had television's immediacy and speed, what a combination we would have." Some day, I am sure, and perhaps it will be sooner than we think, these two techniques will merge completely, each drawing from the inherent advantages of the other. And that to me exemplifies what electronics and photography can contribute to each other.

There is a situation in television, however, which I cannot resist commenting upon briefly. You and I have seen an amateur armed with the best camera money can buy and have watched him take just about the worst photographs we have ever seen. By the same token, television as a technical phenomenon is all too frequently far superior to the programs it transmits. That presents a major challenge to those of us in photography and electronics, because I strongly feel that one of the basic sponsibility of a manufacturer is ot only to assure high product qualy but also to do everything he posbly can to make his product serve s fullest purpose.

So that we can review some of ese possibilities more fully, let's rst take a look at some of the chievements of the photographic inustry. Right at the outset, you will *ote that* the post-war achievements f the photographic industry have *ara*lleled very closely the developnents in entertainment electronics, vhich again suggests their natural ffinity. The emergence of television s a mass medium since 1947 and 948 was accompanied by the emerence of amateur photography as we now it today. The factors which timulated and fostered both of these levelopments have their similarities—he steady growth in population, more leisure time and increased interest in recreation and travel, steadily rising incomes, and superimposed upon all the others, the continued strength of the economy.

### *Sales Soar*

The consumption of electric power is always an extremely significant barometer, especially when it doubles in the short space of 10 years to the point where it now exceeds 500 billion kilowatt hours. While this was going on, another "doubling" was taking place—the dollar volume of camera and projector sales, and the consumption of film and flashbulbs.

Let's tie that down to a few specific instances. Cameras are now selling at the rate of some 6 million units a year, and the lion's share of that market represents, of course, the amateur. Colored film consumption has grown to the point where nearly 30% of the 2 billion film exposures made by amateurs last year were in color. That figure was only 7% in 1950.

Just the other day we learned that photoflash bulb production in 1956 totalled nearly 625 million units—which was more than 13 times the output of 10 years ago. You dealers know the reason: Amateurs consumed only 10% of the bulbs in 1946, but today they represent 95% of the market. For all of us in the photographic business, that adds up to a bright picture, if you will excuse the pun.

Just as in the case of the electronics industry, however, those output and sales figures may be impressive, but they are only the beginning. Here is an example: The 2 billion pictures taken by amateurs last year averaged out to about 57 pictures per household—or about five rolls of film pe household per year, using the typica 12-exposure roll. Think of the ac ditional volume that could be rea ized solely by encouraging eac household to take one more roll o pictures each year. I only wish ever sales opportunity were as poter tially fruitful as that.

For the past few moments we hav been scanning the production an sales side of the picture, but hov about the technical side—or are w still in the horse and buggy phas that prevailed for so many years be fore the war, when a camera was camera and film was film, and tha was that. The photographic industr has no need for concern on tha score. During the past several year more technological progress has bee made in photography than in th previous two or three decades. Paus for a moment and consider some o the items we accept as a matter o course today—American-made hig quality cameras that are at leas equal to foreign-made camera color-coded cameras that eliminat the mysteries of lens stops and shu ter speeds, all-purpose midget flash bulbs, faster films, low-cost camer kits, easy-to-operate range finder and exposure meters and many other

On the other hand, I sincerely fe that many of these impressive item will be effectively obsoleted withi the space of a very few years. Th research and engineering now unde way throughout the industry is a tacking every major problem and i aggressively seeking to attain ever major goal—especially the solutio to such long-established problems a reducing the size of photographi equipment without sacrificing pi ture quality or increasing the cost the equipment, or providing greate simplicity of operation through pra tical and workable automatic device which combine accuracy with d pendability.

The first of these research goals—reductions in equipment size—mear that within the next decade sooner, we will have smaller an more portable still and motion pictu cameras, and portable projectors an viewing equipment. Lighting equi ment will be more compact, too, wi still smaller flashbulbs, magazir flashguns, and electronic flash uni suitable for an amateur.

The second of these major goa brings electronics into the picture—the achievement of photograph equipment that will be easy to ope ate because of practical and worl

(*Continued on page* 14)

able automatic devices. Not too far from now, the fully automatic camera will become commonplace, and the amateur photographer, who today clings to the box camera because of the seeming complexity of more precise photographic equipment, can cast aside his final apprehensions. The focusing and exposure timing problems will be automatically solved within the camera. And there will be a greater latitude of exposures in films for acceptable pictures.

### *Progress and Probabilities*

As many of you know, one of the most promising areas of electronics is the field of semiconductor devices, such as the tiny transistor which is finding increasing application in the amplifying and switching of electrical impulses in many kinds of electronic equipment. Developments in this field may be translated into important benefits to the photographic industry. As you know, all amateur photography today is based on silver, due to its effectiveness in film developing. It is entirely possible that in the future growth of the solid state physics field a completely new basic photographic process may be achieved for capturing an image.

This may seem more than a little "blue-sky" today, but the camera of the 1960's will use electronics to adjust the lens, cock the shutter, and wind the film. And the flashgun will be equipped with a clip or drum similar to those used on automatic guns.

There will be another kind of progress. Many of the devices now used by professionals and advanced amateurs, will go increasingly into general use, as a direct result of simplification and cost reduction. I am thinking about ultra-high shutter speeds and fast films, and variable focal-length lenses, which have achieved such spectacular success in professional photography. And don't forget infra-red and ultra-violet photography, a technique which has barely been touched by the amateur.

Carrying electronics more deeply into photography, one of these days you will be able to take motion pictures on magnetic tape and play them back through your television receiver, which by that time will be flat-wall TV, available in every room in the home. Three-dimensional projection seems to be on the horizon, and electronics again may provide the solution.

These have been only some random possibilities—or perhaps I should say "strong probabilities"—and we could add perhaps a dozen or more without too much time and effort. However, when you combine all of the possibilities I have mentioned, and then make due allowance for the many others that have not occurred to us. I am sure you will agree with me that our photographic industry is on the threshold of one of the greatest periods of growth and diversification that any industry has ever known.

No matter where you look, everything seems to be in the industry's favor. As if the normal population growth were not enough, together with our continually rising standard of living, there are two special situations which are worth mentioning. One is the bumper crop of World War II babies. These children, born between 1942 and 1945, will be in their upper 'teens by the 1960's and that is an age bracket that constitutes a major market for photographic products; witness the fact that teenagers in nearly 10,000 schools throughout the country are today active in photographic activities of some sort, including regular classes, camera clubs, and the like. This widespread interest will undoubtedly be six or seven times greater in five or six years, as the awareness of this constructive and productive activity continues to grow.

### *The Era Ahead*

Everywhere you look these days, new chapters are being written in the history of photography—but the bookshelves that have been reserved for the volumes of the future stretch almost to infinity. Not even the remotest semblance of a line can be drawn to indicate where photography might be in 1967 or 1977. And I would say that the only other industry with as great a potential and as great an unknown is electronics. Together, these two fields have an era ahead of them that is difficult to measure, from any standpoint—whether it be quantity or usefulness.

But you and I know that a *potential* means only one thing—it is possible of attainment, but there is no built-in guarantee. Everyone in the electronics and photographic industry, and the thousands of others who will be joining these industries in the future, have a golden era ahead . . . a golden era, to be sure, but also one in which the competition will be tough and imaginative and versatile. But the opportunities for success will be greater than ever—both for the organization and the individual.

# CTRONIC . . . production performance engineering

### By Lt. Gen. C. S. Irvine, USAF, Deputy Chief of Staff, Materiel

AT THE OUTSET OF THIS article, I want to repeat something I have said many times. There is a job to be done, and the best way to get it done is to understand our industry-military problem. The sooner we reach that understanding, the better chance we'll have of producing operationally effective electronic hardware.

We are not intent on acquiring a stockpile of military weapons and delivery systems, solely for the purpose of keeping people working and happy. Our defense efforts do not stem from a militant philosophy. The plain fact is that so long as aggressive Communism continues to build a mighty war-making potential, we have no alternative, except to stay ahead of them—in other words, to have whatever force it takes to deter their drive for power.

To emphasize the position we are in, and to support my insistence that our electronics people *must* do more than they have yet done, I want to give you a few comments about the Soviets. With this as a background, I next intend to describe our managerial approach to producing better hardware, faster. Finally, I shall underscore the requirements facing the electronics industry and its engineers in the months and years ahead.

You have read and heard a lot about how the Soviets have progressed in aircraft development and production, and there is ample evidence of the success they appear to be having with nuclear weapons. The question that may arise is—just how do they stand, time-wise, with regard to our own advancements.

Without going into specific intelligence reports, we can deduce that their lag is virtually non-existent. Scientifically, they are moving rapidly and *on their own.*

They have revealed a radar capability, which implies a tremendous advance in the state-of-the-art. Further, their technical advancement in the electronics and radiation fields was confirmed at the Geneva Conference. I saw some of their electronic gear during my visit last summer. I am convinced that their engineers are about as competent as our own people. They develop more than marginal reliability into their equipments.

They simplify as much as possible, and, so far as I could tell, their equipment is truly specialized. In regard to work with reliable, high performance tubes—there is good reason to believe they are up with us.

To further their own knowledge, and *to avoid wasting time by duplicative research and development,* they keep abreast of what is going on in the outside world by reading scientific reports and journals originally done in other languages. They have over 3000 people working in a large, government-run library which translates, files and abstracts the technical papers from all over the world; information available in the most recently published reports is distributed to their scientists within a matter of days if the topic warrants priority treatment.

I do not mean to paint a gloomy picture, but I do want to impress on you the facts as they appear to us. As I have said before, the Soviet *rate of progress* in almost all technological fields is currently greater than our own. We should all be gravely concerned about it. It is this concern that we need to instill in both technical and management people.

With these facts before us, we have no alternative but to extend the lead while we possess an *existing* degree of airpower superiority. This means that we must convert knowledge into military hardware *now.* It means, especially, that the electronic segment of our industry must translate its language and symbols into tangible black boxes for our aircraft, missiles and ground control equipment. In the military we must simplify and streamline our procedures and our specifications. Whenever possible, we must make civilian and military standards coincide.

Let me say right here, though, that we can't create these complicated devices without proper management. By that, I mean that electronic components are parts of subsystems, and their creation must proceed in a systematic guided fashion. In other words, interrelated elements must be integrated into a workable whole, else we'll wind up with a hodge-podge of over-weight, ill-fitted, unreliable gimmicks.

To give direction to design, development, and production efforts, the Air Force has set up the subsystem approach as a managerial tool. It is quite similar to the weapon system concept of procurement. A prime electronic contractor is selected to design, assemble, *prove out,* and deliver a complete subsystem which will be incorporated in an air vehicle or as part of the ground support network.

Let me make it clear, however, that this prime contractor is *not* arbitrarily selected. Rather, we make a comprehensive facilities survey, just as we do under the weapon system concept—studying the company's organizational and managerial structure, its current commitments that could interfere with work completion, its production potential, and most of all its design and engineering approach to the problem.

Further, once it has a contract, it does *not* have a concurrent authority to tool up and produce all parts and components. It is required to establish a well-planned, coordinated subcontract structure and to farm out the production of as much of the work as reasonably can be done by smaller specializing firms.

This subsystem approach offers three decided benefits: For one thing, It provides for more rapid development through the use of several engineering staffs, rather than one. Additionally, this means that the end item should stem from the creative thinking of a larger cross-section of electronics experts, insuring greater performance.

For another benefit, this approach leads to dispersal of Government business to more companies, making for a sounder industrial economy.

*Most* important, however, the subsystem approach fosters more and *better* coordination of design and production engineering efforts. This is an *absolute must* in this era of highly complex equipment and the critical shortage of engineers.

We are convinced that this managerial approach to building electronic subsystems is a sound one. It leads to a specialized, simplified, integrated product, arrived at by plan instead of by-guess-and-by-golly.

But notice: I said it *leads* to this product. *It does not make it.* The approach is a tool of management aimed at keeping design-development-production gears well oiled and running smoothly. In the final analysis, its effectiveness is only what our engineers and production men make it.

In the light of immediate and future air vehicle performance goals and their impact in terms of electronic equipment, engineers across the Nation have a grave responsibility. To emphasize this fact, let me remind you briefly of our current weapon systems inventory.

In our bomber fleet right now we are replacing the B-36 with the B-52 long-range bomber. We have the B-47, B-57, and B-66 tactical bombers in our active units. Immediately beyond these, the upcoming supersonic B-58 is showing greater promise as a possible follow-on for the B-47.

Additionally, our fighter and interceptor aircraft are reaching an advanced stage of modernization. These include the F-100 day fighter and fighter bomber, F-101 fighter bomber and fighter interceptor, the F-102 fighter interceptor, F-104 superiority fighter, F-105 fighter bomber and F-106 fighter interceptor—all in the supersonic class, and each one a specific complex design for a definite operational requirement.

In the missile field, we are pushing the Titan and Atlas ICBM's (Intercontinental Ballistic Missile), the Thor IRBM (Intermediate Range Ballistic Missile), the Snark air-breathing missiles and the Bomarc interceptor. While these are proceeding as rapidly as possible, considering the costs, complexity and state-of-art, we know it will be some little time before they can be introduced to replace part of the manned bombers. In the meantime, we are making extensive studies in regard to both chemically powered and nuclear powered aircraft for supersonic long-range bombers as follow-on for the B-52, and to be used in conjunction with the ICBM's and IRBM's.

Performance-wise, we have set our sights on speeds of over Mach 3 and altitudes of more than 15 miles for manned aircraft, for the immediate future. During the next ten years, we want to shoot for Mach 10 and altitudes far exceeding anything now possible with the current state-of-the-art. Also, we want to extend the range of specialized bombers to such a point that we can make a round trip flight between here and any spot on the globe without refueling.

In close conjunction with these delivery systems, we must have effective electronic devices *that are absolutely reliable*, and that exceed in performance anything that the Soviets have or will have. These, I know, are far-reaching requirements, impossible ten years ago and difficult today. But for tomorrow's deterrent force *they have got to be facts of life.* In over 35 years of military service, I have found that the only safe prophesy is that weapons and their method of employment will change, for progress itself is changed for the better.

But let's get down to cases—as far as you are concerned. In the first place, electronic subsystems are the heart and soul of ballistic and air breathing machines: timing, guidance, and aiming devices, navigational systems, sensing and lock-on equipment—the list is long. Except for the body and the propulsion system, these machines are in fact numerous electronic subsystems integrated into a workable whole.

### *An Electronic Complex*

The activating force of our total Air Defense structure is an electronic complex with a three-part sequence: ground detection of aircraft, ground-to-interceptor guidance, and interceptor-to-foe homing and fire control. Each of these three is dependent on the other, and total reliability of the whole system demands 100% reliability of each separate one.

Our retaliatory strength will be effected directly by the capability of electronic devices. It makes no difference how *potentially* damaging our bombers are, unless they break through the enemy's defense net and drop bombs accurately on assigned targets. We have a high standard to uphold.

Now—I'm not pretending to pass along this information as something new or startling. You are as well acquainted with these needs as I am. My purpose is to lay them out before you and to impress upon you—and upon the companies, laboratories, and research centers—the magnitude of the work to be done. The first task needing consideration involves creating certain critically needed tubes, especially those required by our electronics counter measures program, our advanced radar system, and our next stages of communication.

We are looking forward to the advanced oscillators and amplifiers such as the traveling wave tube and expect its availability in terms of years. We need it now. This tube, besides being voltage tuned, has the interesting characteristics of widely variable band width, the ability to transmit on several frequencies at one time, and a tuning range in the order of two to one.

Being an amplifier rather than an oscillator it can form the desired signals and frequencies at low level and then amplify them to the power we need. We anticipated their use as far back as 10 years ago. But the rub is this: While we have known the theory, we haven't gotten very far. And that's the job in front of you and your companies. It is essential that you get busy and convert your formulas and equations into hardware—something we can sink our testing teeth into.

With American know-how resting comfortably on its laurels, I am concerned because it is possible that European nations have the jump on us.

Of course, I realize that companies may have been reluctant to move into this field because they felt that the equipment the Air Force desires would not have a direct commercial application. I am certain that advanced amplifiers and oscillators will have wide commercial application and will appear on the foreign market, perhaps, before they do here.

It is only common sense to coordinate design efforts with materials engineers, tool designers, subsystem contractors and production engineers, toward the goal, not merely of nursemaiding one handmade product, but of laying the ground work for mass production. This effort should not be limited to an article which, when finished, performs reliably only within the confines of a laboratory. It should anticipate the adverse vibration and heat conditions in its operational environment.

Greater simplicity is needed. It has been said that equipment has been over-designed, and therefore over-priced, for the performance of military missions. It may be only that the complex laboratory standards we are trying to use are too high for Service operation. Perhaps we should approach commercial standards and simplicity for our military purposes. Military aircraft and engines tend to do the pioneering and developing for our commercial airlines and our private flyers.

In electronics, because of the much wider commercial market, it seems imperative to me that we should move forward in our development and production standards on a broad front which will meet both military and civilian requirements.

So far, *production* itself has not been a bottleneck. By that, I mean that we have usually had on hand the number of items required for assembly. Notice, though, I said *production of numbers* had not been a problem. But reliability and efficiency of operation have been problems—critically serious ones. And of especial importance insofar as the defense communications network is concerned, incompatibility of interrelated subsystems has resulted in serious deficiencies.

Administratively, we are conducting an intensive program to establish certain operating norms which should lead to reliability factors. Progress in this effort appears to be very satisfactory. But these reports are after-the-fact statements. The best way to cure these malfunctions is to engineer fool-proof mechanisms operating well below maximum outputs.

Unfortunately, specification ratings too often allow only a slim margin between normal conditions and extreme situations such as supply-voltage variation, load variation or even manufacturing variation. As a consequence, installed items, when subjected to take-off, cruise, and landing operations, too frequently malfunction.

The point I am making is that you must extend greater effort to ruggedize marginal components, or so alter the design that malfunctioning will not result in mission failure.

At the same time, we must endeavor to reduce the scope of the job and limit our specification requirements to the bare minimum. We must have hardware that will run even if it will not accomplish every job that the fertile minds of our military and civilian technicans can envision.

Additionally, I urge you to eliminate after-manufacture adjustments as much as possible. Present black boxes are essential to us because all too often our maintenance people are not engineers and therefore cannot set controls as accurately as you can in your laboratories.

Space does not permit me to itemize all the types of component weaknesses and shortcomings that have resulted in product failure. But, failure reports tell the sad story.

However, there are occasions when we must take a calculated risk, and we have with HF, VHF and UHF, with the bomb nav system, and with the fire control system. Here is the pattern of one sample item: 1948—development started; 1950—production contract let, with prototype scheduled for one year later; 1952—production delivery due, but dates not met; 1953—engineering changes further delay delivery; 1954—1955—tremendous technical difficulties, a terribly high failure rate, a sadly discouraged and highly vocal operational command; 1956—final satisfactory operation of the de-bugged unit.

In summary, the Air Force asked for too much, too soon. The company promised too much, perhaps with tongue in cheek. Obviously, looking back at this program, there was not enough management, by either the Air Force or company. This sample could be applied to any one of the major electronic systems which the Air Force has installed in its aircraft. We get there eventually, but it sure is a rocky road.

Another problem we have discussed at length is that of compatibility. This is primarily a design shortcoming, too often resulting from inadequate coordination between the different engineering staffs which are responsible for related components or companion subsystems. These range from frequency and voltage discrepancies, inadequate power availability, and data link code distortion; to errors such as inadequate space allotment for black boxes, mismatched connections, and too great a separation between related components within the air vehicle, or no provision for cooling.

If you think for a moment I am exaggerating these problems, talk with some of your technical representatives who have seen the difficulties we have encountered, and who have had to substitute make-do modifications for real engineering. Or go to the Air Proving Ground Command or one of our tactical units and just listen to the poor crew chief—he can't get his job done in a forty-hour week.

Now—I realize that my comments here have a negative tone to them. In fact, you may get the idea that the electronics picture is totally black. This is not the full truth. In my opinion, it is just a dull grey. Some of our companies have shown real initiative and individual effort. Their designs showed originality and offered material improvements in performance. Some of our Air Force procedures show signs of modernization. But world circumstances and the urgent need of our aircraft, missiles, and communications network do not allow me to indulge in my favorite pastime of commending people for work well done. I am forced to call for more and better effort than we have yet put forth.

### *Courses of Action*

In conclusion, then, let me repeat the obvious: *To an ever increasing degree, electronics will determine the true effectiveness of our military capability as a deterrent force.* We are so dependent on this field of endeavor that we can neither defend ourselves nor retaliate without its products. But the products have to be more efficient, more reliable, and far simpler from the maintenance point of view than anything yet offered. And they have to come faster than in the past.

Recently, you've read and heard that the Soviet Union is facing some serious difficulties within its industrial complex. You may have been told that they are producing at a slower rate than in the past. I do not intend to deny those reports, but I am afraid we would be going down the "dream-world" path if we interpreted those reports to mean that Soviet emphasis on military technology is letting up. In all likelihood, the simple truth is that they are facing scientific barriers and are concentrating their efforts on less publicized but highly important new devices.

Make no mistake about it. They have not retracted from their avowed intention of dominating the world. In face of probabilities where the Soviets are concerned, we have only three courses of action to follow: First, to produce the best, most efficient, most reliable end items our trained minds can create—and to produce them in sufficient quantity to assure our continued air power superiority. Second, to upgrade the training and motivation of our scientists, our design engineers, and our production engineers to higher and higher plateaus of achievement. And third, to stimulate and activate the hearts and minds of our young men and women to fully participate in the geometric upswing of our electronic future.

# a TRIBUTE to a LEADER

A new destroyer escort, *USS HOOPER* (DE-1026) was launched August 1, 1957 at Bethlehem Steel Pacific Coast Shipyard, San Francisco. The new destroyer escort was christened by Miss Elizabeth L. Hooper of Washington, D. C., daughter of the late Rear Admiral Stanford C. Hooper, USN, Navy Communications pioneer for whom the ship is named. It is designed for anti-submarine search and attack warfare, scouting and convoy duty and will be fitted out by January 24, 1958.

The late Rear Admiral Hooper graduated from the U.S. Naval Academy in 1905. He is often referred to as having been "the father of Naval Communications." His Naval career ashore and afloat was most distinguished. He occupied many important positions and received a number of civilian awards in the field of communications and numerous commendations. In recognition of his outstanding military service, he was presented the Navy Cross.

Following seven years at sea and an instructorship at the Naval Academy, in 1912 Rear Admiral Hooper was appointed Fleet Radio Officer, a post that he himself had suggested as necessary for the proper administration of the new method of communication.

In the period 1915 to 1928, he was the guiding spirit in developing Naval Radio from little more than a toy to the essential communications medium it had become by the latter date. In the first few years he pushed through to completion the world-wide chain of land stations, furnishing the first communication between the Navy ashore and the Fleet at sea. In 1925 he went to sea as U.S. Fleet Radio Officer on a cruise to Australia and carried out the Navy's pioneer tests of what were then very high frequency waves. The reports made at that time had a tremendous influence on the development of this field by the Navy and all other radio interests.

Many new features appeared as standard in Naval radio equipment during this development period, largely through Rear Admiral Hooper's influence and under his personal direction. Perhaps the most outstanding was the radio direction finder. It was due to Rear Admiral Hooper's leadership and drive that Naval Research Laboratory became an activity.

From 1928 to 1934 he served as Director of Naval Communications, during which time in 1930 he was appointed a member of the President's Radio Board.

For many years, Rear Admiral Hooper served as a member of the Interdepartment Radio Advisory Committee; as delegate, or technical assistant, to practically all international radio conferences; as Navy liaison with Congressional Committees on Communication matters, and as Chairman of the radio group representing the Government departments, marine and aviation interests in all radio matters, particularly international. It was his original recommendation which resulted in the formation of the Radio Corporation of America, thus creating an all-American world-wide communications company to free the United States from dependence on foreign controlled radio communications.

From 1939 until 1942, he served as Director, Radio Division, Navy Department, and in 1942, was made Technical Assistant to the Vice Chief of Naval Operations, Navy Department. In 1945 Admiral Hooper began his retirement and it was in this year that he was selected as a winner of the Elliot Cresson Gold Medal, awarded by Franklin Institute, "in consideration of his pioneering leadership and practical utilization of discovery in the field of radio for the U.S. Navy."

Besides his many military decorations, Admiral Hooper received the Medal of Honor of the Institute of Radio Engineers, "for the orderly planning and systematic organization of radio communication in the government service and the concomitant and resulting advances in the development of radio equipment and procedure." Also, the Marconi Memorial Medal of Merit of the Veteran Wireless Operators Association was awarded to him, "for outstanding contributions to the radio art, particularly in building up the wireless communication system of the United States Navy from the status of an engineering experiment to a major military arm for control, detection, and communication."

The Armed Forces and Communications Electronics Association is proud to have had Admiral Hooper as one of its members. We are pleased that one of our Nation's Naval destroyers will bear his name—for this is indeed a deserving tribute to a leader and pioneer who devoted his life to a Naval career and a better America through communications.

# . . . By Jove!

ASW* is a Navy need in protecting our nation's supply lines . . . as guardian of our coast line . . . if the time ever comes when an underwater aggressor wants to pose his threat. Like Jove, god of the skies, the Navy's *Anti-Submarine Warfare techniques will be poised to seek and sink that threat . . . with a complete electronic search, track and kill package especially designed for the aircraft and the mission. ➢ ➢ For economical and operational efficiency, the LMEE "Tri-A" (Advanced Airborne ASW*) system will fill a true Jove-like function . . . in seeking the aggressor . . . and as a thunderbolt in destroying it. ➢ ➢ This is only one of many LMEE advancements in sonobuoys, displays and search systems. Along with the development and production sections in Utica, its Advanced Electronics Center at Ithaca, New York, is making important contributions to passive systems studies. Coordination between LMEE engineers and Naval research scientists can wipe out tactical advantages the submarine has traditionally enjoyed. Write Department D.

LMEE

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A DEPARTMENT IN THE DEFENSE ELECTRONIC DIVISION

# SIGNAL·GRAM

## — GOVERNMENT —

ATOMIC CLOCK FOR ARMY The National Company, Inc., Malden, Massachusetts, announced it has received a $609,525 contract from the Army to produce experimental military atomic clocks, called atomichrons. The company said the clocks generate their own power and are so accurate that they can be used as standards, besides being designed for use in a disaster where no reference to standards would be possible. By utilizing frequency control, the instrument corrects continuously the signal of a crystal oscillator that drives the clock. The compact and rugged atomichrons can withstand great shocks, acceleration and wide temperature ranges.

"PANATRACK" A device for simulating the actual flight path of a space vehicle has been developed by engineer Edward J. Madden, Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Virginia. Called "Panatrack," the device projects a moving view of the terrain over which the vehicle "flies," showing the area as it would be seen by an observer in a space ship or satellite. The apparatus consists essentially of a projector inside a globe.

DEPARTMENT OF DEFENSE SUMMARIZES STRENGTH OF ARMED FORCES On June 30, 1957, the total combined strength of the Armed Forces was 2,794,411. This represents an increase of 4,581 from May 31, 1957. Breakdown figures—Army, 997,916; Navy, 676,532; Marine Corps, 200,893 and Air Force, 919,070.

NAVY TO USE "ELECTRONIC BRAIN" TO STUDY VANGUARD FLIGHT A specially-designed electronic brain, known as the Automatic Recording and Reduction Facility (ARRF), will be installed and placed in operation at the Air Force Missile Test Center near Cocoa Beach, Florida, by early fall. The ARRF automatically processes flight information from each of the three-stage VANGUARD test vehicles and satellite launching vehicles, and final data can be provided in less than 72 hours after a firing. This is a joint development of Radiation, Inc., Melbourne, Florida, and the U.S. Naval Research Laboratory, Washington, D. C.

WAGES AND PRICES The final score of the effects of world-wide increases in labor costs has not yet been written. According to figures compiled by the United States Department of Labor, hourly wages in the United States have increased about 42% since 1950 and consumer prices about 20%. Figures showing increases in hourly wages and consumer prices in other countries are: Canada—52% and 18%; Great Britain—55% and 42%; West Germany—52% and 15%; France—90% and 38%; netherlands—48% and 32%.

FCC MEETING ON PAY-TV The Federal Communications Commission will take up the subscription-TV question at a special meeting on September 17. Thus, they will resume the pay-TV question which was reviewed in August before the agency recessed.

CONTRACTS: ARMY: Collins Radio Co., investigation of theory and application of scatter circuits in tactical systems and developing tropospheric scatter system, $426,079; Melpar, Inc., technical assistance for Army aircraft electronics systems and equipment tests and studies, $753,089; Times Facsimile Corp., engineering test model, polaroid facsimile system, $50,000; Fairchild Aircraft, research and development for manufacture of high speed surveillance drones, $12,000,000; Willys Motors, Inc., further work on Mechanical Mule, $6,783,424; Philco Corp., radio relay units and associated parts, $10,000,000. NAVY: Hazeltine Corp., ship instruments, $5,443,337 and decoding equipment, $1,180,283; Packard-Bell Electronics Corp., radar test equipment, $300,000 and production of IFF (Identification, Friend or Foe) equipment, $1,000,000; Ryan Aeronautical Co., automatic navigators, $348,016; Federal Telecommunications Labs., development of transmitting equipment and amplifier, $99,600. AIR FORCE: American Bosch Arma Corp., facilities and support of ballistic missiles, $1,922,290; Kollsman Instrument, azimuth computer, $2,651,127; Otis Elevator, bombing and navigational radar trainers, spares, data and equipment, $2,230,547; Westinghouse Electric Corp., production of 3600 magnetron tubes, $1,400,000; Texas Instruments, Inc., photographic mapping radar system, $1,394,318; General Electric Co., fire control system, $16,000,000.

## — INDUSTRY —

SMALL "BRAIN" A high-speed digital computer, "Leprechaun," has been built at Bell Telephone Labs. Leprechaun is about the size of a home TV set and requires less power to operate—only 9,000 electrical components. It can take its instructions immediately from its memory no matter where the instruction may be stored. The machine can store 1,024 "words" in its memory—each "word" consisting of 18 binary digits. Developed under an Air Force contract, the new computer is to be used for programming and logical-design research on digital computers for military real-time control applications.

RCA CLOSED-CIRCUIT TV SYSTEM GUARDS GATE Television has joined the guard force at the Esso Standard Oil Company's refinery research laboratories in Baton Rouge, Louisiana. Two RCA "TV Eye" cameras are installed at a turnstile gate, which bars the entrance to the grounds. The closed-circuit installation enables Esso guards to control the gate in an office hundreds of feet away where they can see and confirm the credentials of employees seeking entry. One camera shows a clear view of the person and the second camera televises the employee's identification badge.

AUTOMATIC TELEPHONE DIALING James Kilburg, the inventor of "Dialaphone," an alphabetical index that automatically dials up to 890 pre-picked telephone numbers, has signed a contract in San Mateo, California for manufacturing of the device with Western Electric Company for Bell Telephone System, and also with Automatic Electric Company for independent telephone companies. The self-contained unit connected alongside the telephone, is operated by turning a hand crank to locate a name on the alphabetical listing, then the starter key is pressed to complete the call automatically. The dialaphone will be available from local telephone companies on a subscription basis only.

"READING" DOCUMENTS ELECTRONICALLY Solartron Electronic Group, Ltd., of Thames Ditton, Surrey, has devised an electronic "reader" aimed at making information from documents instantly available to computers without resort to human middlemen. The electronic reading automatic (ERA) scans the document at the rate of 300 characters a second and feeds information directly into a computer by means of electrical impulses. Solartron and Rheem Manufacturing Co. of New York have formed a jointly-owned company called Rheem-Solartron, Ltd. to do research and development work on the ERA and other electronic devices.

## — GENERAL —

NORTH AND SOUTH POLE "HAMS" Two American scientists, Dr. Charles R. Bentley and Maurice J. Davidson, who are engaged in research for the IGY, have succeeded in communicating with each other between the North and South Polar regions. The scientists, both of whom are from Columbia University, reported reception on the "Ham" radio band "clear as a bell," although the distance between their stations is more than 11,200 miles. It is believed to be one of only two such direct conversations from the Arctic to the Antarctic.

"RETMA" NOW "EIA" Radio-Electronics-Television Manufacturers Association (RETMA) has changed its name to Electronic Industries Association (EIA). The organization felt that EIA more simply and adequately describes the present character and growth potential of "our expanding industry." Other changes—the set division will be known as the consumer products division, and the tube division will be expanded into a tube and semiconductor division.

NATIONAL ELECTRONICS CONFERENCE More than 10,000 persons are expected to attend the 1957 National Electronics Conference at the Sherman Hotel in Chicago, October 7-9. A total of 96 technical papers, six tutorial talks and three luncheon addresses will be presented during this 13th annual conference. A record 245 commerical exhibits will be on display with most of the nation's leading electronics manufacturing and research laboratories represented. The event is sponsored by the American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers and Northwestern and Illinois Universities.

ATOM FAIR The 1957 Trade Fair of the Atomic Industry is scheduled for October 28 through 31 at the Coliseum in New York City. The sponsor, the Atomic Industrial Forum, has offered to send AFCEA members Complimentary Atom Fair tickets on request. Ticket requests should be made on business letterhead, and addressed to: Atom Fair, 3 East 54th Street, New York 22, New York.

# BIZMAC

## electronic brain joins the Army

**by A. L. Malcarney, Executive Vice President, Defense Electronic Products, RCA**

WHEN NEWSPAPER COLUMNIST H. I. Phillips heard recently about some of the fancy feats the new Bizmac electronic "brain" was performing for the Army, he remarked: "This sort of thing can do away with the human head except for purposes of photography and shaving."

That, of course, is more than a mild exaggeration. Still the Army is finding out that RCA's Bizmac electronic data processing system can do some impressive things. At the Ordnance Tank-Automotive Command (OTAC) headquarters in Detroit, where it keeps track of the Army's spare parts all over the globe, Bizmac can:

- Complete in forty-eight hours an inventory procedure that once took up to three months.
- Process by computer in one hour as much work as 400 girls with hand calculating machines could turn out in the same time.
- Store on a single 10½-inch reel of magnetic tape as much information as was previously held in ten file shelves.
- Reduce by 85 per cent, over the next year, OTAC's visible records which are now on some 10,000,000 file cards, punched cards, metal plates and hand-written sheets.
- Record information on magnetic tape and read from tape at 1,700 words per second—a rate at which it could finish Tolstoy's "War And Peace" in about five minutes.

Bizmac is the latest and largest of a whole array of electronic data processing systems that are working an office revolution in industry, in commerce and in Government including the Armed Forces. The Army Signal Corps, Ordnance Corps and other services have shown great interest and ingenuity in adapting these systems to their own special requirements in logistics, financial and personnel management, record-keeping, and research and development. The Services have found, as Major General W. Preston Corderman, Commanding General, Fort Monmouth, N. J. Signal School and Laboratories, expressed it, that "with the tremendous capacity of electronic computers to process, to store, to memorize and to display information, untold amounts of space, of money and numbers of people can well be saved."

### *Bizmac Controls Inventory*

At OTAC headquarters, a four-story, block-long, brown brick building in the southwestern section of Detroit, the Bizmac system is used for inventory control. The Command is responsible for the development, design, manufacture, storage, supply and maintenance of nearly everything needed to put a global Army on wheels and tracks, and keep it supplied with spare parts. Some idea of the vast scope of the job may be gleaned from the fact that a typical tank requires about 6,000 separate maintenance items, and a typical transport vehicle requires 4,000.

Altogether, OTAC supports about a million pieces of tank and automotive equipment. It supplies spare parts for 145 different basic vehicles and over 1,200 different models. Its inventory includes more than 170,000 separate items, ranging from nuts and bolts to complete engines and transmissions. These spare parts are stored at twelve major depots in the United States and abroad, each depot serving the Army camps, posts and stations in its immediate geographical area.

### *What's In the "Brain?"*

The depots feed information on their supply transactions into the Bizmac system daily. This information comes in over telephone lines and is received in the form of punched cards. It is then transferred to magnetic tape, Bizmac's basic storage medium, and stored in one of 182 tape stations. Each station can be connected to other units in the Bizmac system at the push of a button. The magnetic tape is run through one of the three sorters which do the electronic equivalent of "paper shuffling"—putting data in the proper sequence. Then the tape is processed through the computer which automatically updates the files and singles out items for the attention of the supply manager. When the computer finds a depot short of an item, it passes this information on to an electro-mechanical printer which prints re-order forms at the rate of 600 lines a minute. If one particular fact is needed quickly, an interrogation unit can search the system's 100,000,000 facts and find the answer within three minutes.

The uniqueness of Bizmac lies in the fact that it can handle more work than other systems because of its ability to do several operations simultaneously, and control and coordinate them from a central point. It can perform a file search at the same time it is posting information to an account and printing out the results of a previous computation. All these operations can be controlled remotely from a room, known as system central, which is similar to a telephone exchange.

Bizmac is designed to handle three main functions:

*Keeping Inventory of Spare Parts.* It maintains up-to-the-minute information about what supplies are on hand at each of the twelve accountable depots, how much is needed, what has been ordered and in what quantity, and how much material is in transit. By checking on supplies daily, Bizmac will permit an eventual reduction in inventories. This cut is expected to result in substantial savings on warehouse expenses, carrying charges, and loss through obsolescence. Major General Nelson M. Lynde, Jr., Command General of OTAC, estimates that the savings will amount to "many millions of dollars," and that Bizmac will pay for its initial cost of $4.1 million, many times over every single year.

*Cataloging Spare Parts.* Bizmac will make it possible to get spare-parts catalogs out to the varions depots even before a new vehicle rolls off the assembly line. It will publish up-to-date catalogs within a few days after changes are made, instead of having a lag of several months as previously. Mechanization of cataloging will also aid OTAC in the change over to the Defense Department's new stock numbering system, designed to eliminate duplication among the three Armed Services.

*Forecasting Supply Requirements.* Bizmac is now keeping track of how fast the various parts are moving at each depot and predicting how many parts will be required in the months ahead. In the future, it will forecast how many parts have to be on hand or on order throughout the entire depot system to keep supplies flowing in orderly fashion from the production line to all users. On the basis of these forecasts, slow-moving items can be prevented from ever getting into the system to pile up as surpluses. Periodically, Bizmac will forecast the spare-parts needs for advance budget planning, and prepare financial analyses of inventory for the supply manager.

### *Favorable Results*

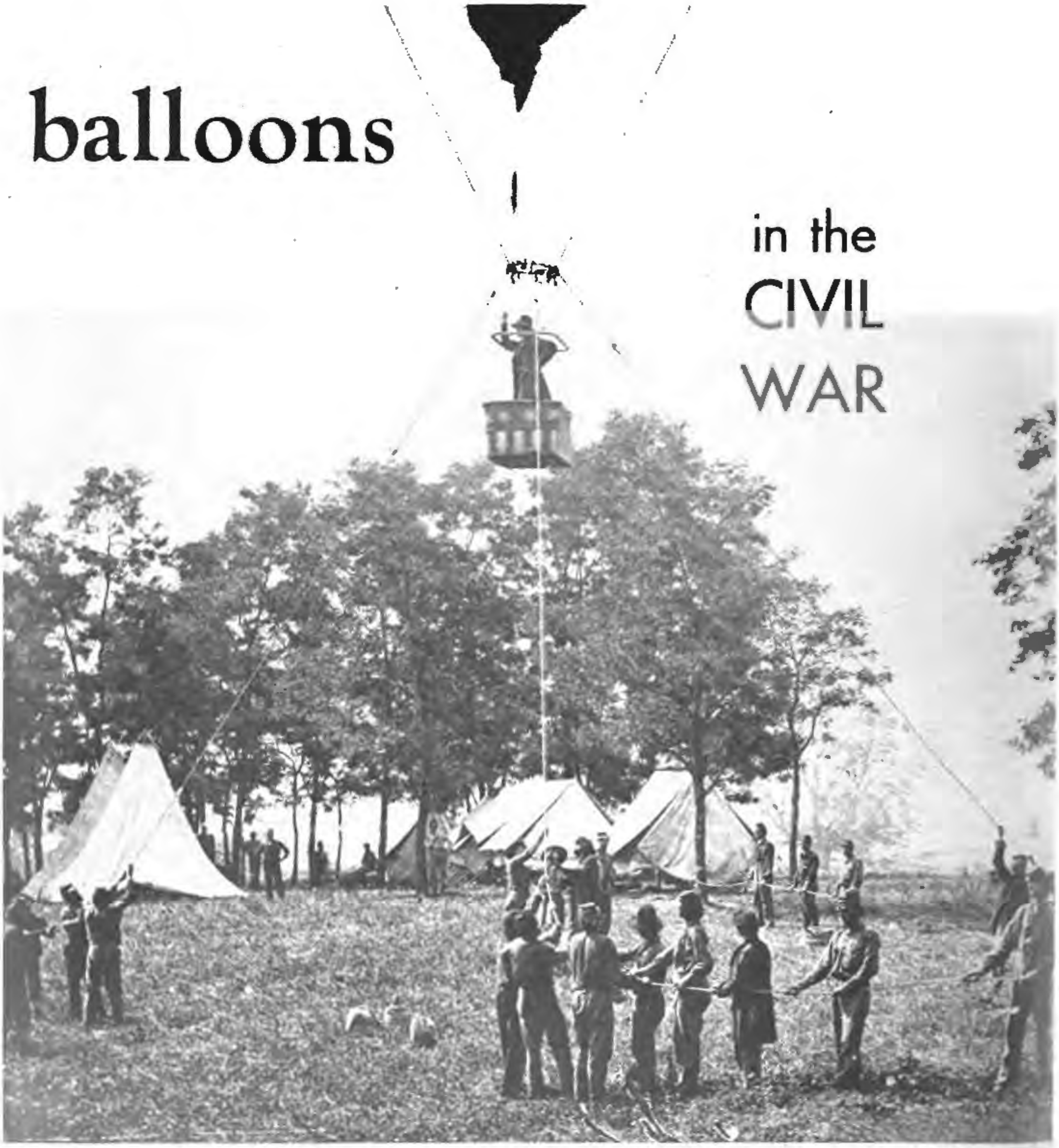
The Bizmac installation in Detroit includes some 220 units of nineteen different but fully integrated types of equipment. However, the system itself is highly flexible, operating on the "building block" principle so that a business organization can use as many or as few units as it needs to do its job. Several Bizmac systems are now on order with RCA, but the one at OTAC is the first to go into full operation.

General Lynde summed up the results to date in this way:

"From what we have seen of the Bizmac system in operation so far," he said, "we feel that it can contribute importantly to our job in two ways. First, it can streamline our operations and help the system to be more responsive to the Army's demands. Second, it can save the taxpayers substantial sums of money."

Watching the computer console of RCA's Bizmac electronic data processing system are (left to right) Dr. Elmer W. Engstrom, RCA's Senior Executive Vice President; Maj. Gen. Nelson M. Lynde, Jr., Commanding General of the Army Ordnance Tank-Automotive Command, and Arthur L. Malcarney, Executive Vice President of RCA's Defense Electronic Products.

# balloons in the CIVIL WAR



by

**H. V. CANAN**
**Colonel USA, Ret.**

THE INTRODUCTION OF BALLOONS as a practical tool for war opened a new third dimension for military intelligence. Military students having foreseen their value, it was only natural that European armies had not overlooked their possibilities as elevated platforms for military observations. In the United States, the staff of the American army in mid-nineteenth century was preoccupied with Indian fighting and had little time for new military inventions. But, at the outbreak of the Civil War, professional balloonists were quick to rectify this oversight.

On April 18, 1861, less than one week after the fall of Fort Sumter, Thaddeus Sobieski C. Lowe, one of the better known aeronauts in the United States, brought the military potentialities of the balloon to the Nation's attention in a most spectacular manner. In what was to be a preview of a contemplated trans atlantic flight, he started on a free flight from Cincinnati, Ohio. Nine hours later he landed in Unionville, S. C., a distance of four hundred miles by air. His triumphant reception cooled considerably when abolitionist newspapers were found in the basket of his balloon. After considerable difficulty and two arrests, Lowe was able to establish his scientific status and was allowed to return North with his balloon.

About the same time James Allen, the first professional balloonist to volunteer his services to the Union, appeared in Washington with two balloons, but his appointment as a military balloonist did not materialize for several months.

Using city gas to inflate his balloon, Allen made his first ascension June 6th, 1861. An attempt three days later was short-lived because the supply of gas, obtained this time from a portable generator, was insufficient.

Official military observers of these early demonstrations recognized that balloons could be useful only if trained soldiers were permanently detailed to operate them.

Following Allen's demonstrations, Major General McDowell, in command of the Union troops in Virginia, asked for a balloon to reconnoiter during his advance on Manassas. Allen was given this assignment. His efforts were coupled with bad luck which was to plague balloon operation during the formative period of the balloon corps. One of Allen's balloons burst during its inflation, and the second tangled with some telegraph poles en route to Falls Church, Virginia, and was damaged. It was not Allen who failed; it was his equipment, and this ended Allen as an independent civilian volunteer balloonist. During the next year when Lowe re-entered the picture and headed the balloon corps, Allen was appointed a military aeronaut and eventually became chief of the balloon service.

**← Professor T.S.C. Lowe, who was instrumental in bringing to the Nation's attention the military potentialities of the balloon, prepares to observe the Battle of Fair Oaks, Virginia in 1862.**

The Corps of Topographical Engineers had been given the responsibility for developing balloons for military purposes. They requested bids from several aeronauts and in June 1861 a contract was awarded to John Wise. Wise, an able balloonist, was directed to construct a military balloon for $300. His arrival in Washington in July coincided with Allen's difficulties across the Potomac.

### *Failure At Bull Run*

When Allen failed General McDowell, Wise, having been appointed a military balloonist, was ordered to move forward to Bull Run with his balloon. Difficulties in obtaining gas delayed his departure until the day of McDowell's defeat on June 21, 1861. The working similarity between balloon observers and the Signal Corps, in transmitting findings to ground forces, prompted Major A. J. Myer, the Chief Signal Officer, to request and obtain permission to accompany the balloon forward. By noon of the 21st, a caravan of men was only halfway when sounds of battle warned them to move faster if the balloon was to play any part in the engagement. Against the wishes of Wise, Myer had the inflated balloon tied to an escort wagon so that it could be moved forward at a trot. In this rough treatment it caught on some trees and the fabric was punctured. If the movement forward had continued, the balloon probably would have fallen into the hands of the Confederates. However, if the balloon had been present during the battle, it undoubtedly would have had considerable effect since the Union forces were almost without eyes while the Confederates were served with signal and observation stations.

Three days later when the balloon was repaired, Confederate reconnaissance detachments and artillery were observed near Arlington and within five miles of the Capitol. When the balloon was moved forward to be more useful, its mooring ropes were cut on telegraph wires, freeing it so that it floated toward the Confederate lines. Fortunately for the Union Army, it was shot down by their own rifle fire. McDowell's command had enough of balloons since their contribution was nil.

These two balloonists who had failed were supposed to be among the best in the country. Wise retired to his home and later entered the infantry where he served until he died.

While Allen and Wise were having their difficulties in achieving recognition, aeronaut Lowe arrived in Washington. Although he came late, he had good political backing. Consequently, he was received at the White House and a small sum of money was allocated by the War Department for two demonstration ascents. The first, in June 1861, carried Lowe and a telegraph operator five hundred feet into the air. From this distance the following message was sent directly to the White House:

Balloon Enterprise
June 18, 1861

To the President of
the United States.
Sir:

> This point of observation covers an area nearly 50 miles in diameter. The city, with its girdle of encampments, presents a superb scene. I have the pleasure in sending you this first dispatch ever telegraphed from an aerial station, and in acknowledging indebtedness for your encouragement for the opportunity of demonstrating the availability of the science of aeronautics in the military service of the country.
>
> T. S. C. LOWE

Similar messages were sent to other War Department officials. Here was a man who understood human nature and advertising.

A second demonstration, witnessed by the President, was held on the grounds of the White House. Several ascents were made at that time with Government officials and general officers. The newspapers praised the demonstrations and Professor Joseph Henry of the Smithsonian Institution sent the Secretary of War a detailed report of the public showing and his approval of the military use of balloons.

Immediately following the demonstrations, McDowell, who was ignorant of the enemy in his front and being in need of a balloon for his command in Virginia, requested that Lowe report to him. Lowe made a successful ascent and drew a map for

**Professor Lowe's military balloon near Gaines' Mill, Virginia.**

the Union Army command.

The commander of the Union armies, General Scott, had been unreceptive to the use of balloons. Lowe was received only through the personal intervention of the President, who escorted him to Scott. Because of this introduction, Lowe was hired in August as a military aeronaut. Although he was the last to be recognized officially, he rose to the top in balloon development and became well-known and well-liked by McClellan and the Topographical Engineers. He worked closely with Professor Joseph Henry of the Smithsonian Institution, whose approval of all plans and methods Lowe carefully sought before acting. His tactics gained for him the confidence and respect of the higher officials.

By the end of 1861, balloon operations were on a firm basis. Lowe had constructed six ballons which were operated by hired balloonists. Twelve horse-drawn field hydrogen gas generators, of the sulphuric acid-iron filing process, had been built. Each was capable of filling the largest balloon in three hours. A converted coal barge was added to the balloon service and from its deck balloons could be inflated and ascents made.

During the Fall and Winter of 1861, the balloons made frequent ascents and kept the Union Army fully informed of what the Confederates were doing in its front. The balloons never were better than during this static military situation. Military commanders took great personal interest in them, and Lowe personally was so much in demand for observation that he had difficulty in staying away long enough to make the new balloons which had been ordered.

Human nature changes but little, and even senior officers are fascinated by the new. One fine spring day a corps commander could not resist the call of the wide blue yonder and he ascended alone. At about 900 ft. elevation, the anchor rope gave way and the general floated off to the whims of the breeze. But, he had learned his lessons well. As he floated over the Confederate lines he made detailed reconnaissance. Then releasing ballast and rising higher he found a favorable current which brought him back safely within the Union lines. Thus were the Confederates deprived of a balloon and a corps commander as a prisoner of war.

As the balloon corps took shape, balloons were assigned to divisions, but operations remained under the technical supervision of Lowe and under the administrative control of the Topographical Engineers. As new balloons were delivered, additional operators were hired. They continued their good work and to them goes the credit for discovering, in the spring of 1862, that the Confederates had evacuated Manassas, thereby permitting McClellan to start his attack in the Richmond peninsula.

Once the movement of the Union army to the peninsula was decided upon and approved, events moved rapidly. A balloon was dispatched to Fortress Monroe and the report came that all was quiet there. Movement of troops started immediately. Lowe with his personnel and all of his equipment was ordered to Monroe. He moved with five balloons, ample horse-drawn field gas generators, and a train of about seven wagons carrying additional balloon and camp equipment.

Observation started as the army moved up the peninsula. The Army of the Potomac had been organized into corps and the normal assignment of balloons was to the corps. Lowe supplied his balloons with telegraph wire to facilitate direct communication with corps headquarters. In addition, he used signal flags with special codes or sent messages to the ground on rings sliding down the anchor ropes.

Although Lowe and his men ascended nearly every day, they did not discover Jackson's movement on the right flank of the Union line, a major factor in McClellan's retirement from the peninsula.

The success of the Union balloons impressed the Confederates. They made several attempts of their own, but lacked the necessary materials and operators. Their use of the balloon was never widespread.

### ***Balloonists Adept at Reconnaissance***

By 1863, balloonists had become adept at observing and reading signs. Under favorable terrain conditions, direct observation could often distinguish infantry units, cavalry scouts, outposts, artillery batteries, emplaced guns, field fortifications, and encampments. Smoke was a valuable source of information, whether it came from cannon or small arms, from camp fires, or from the destruction of bases and supplies. Density and color of the smoke was important in determining its source. When the distance was too great to permit direct observation of camps, smoke from camp fires could mark the size and position of the enemy. Camp fires almost invariably revealed the presence of the enemy and sometimes their number. Strength of a moving column was easy to estimate by determining the time it took to pass a fixed point, or if it was stationary or in position, by comparing its length and density with that of friendly troops whose numbers were known. To assure greater accuracy in identification, maps and field glasses were carried by observers and compass bearings were used to identify objects.

### Attractive Targets

To obtain the best observation, positions near the front were desirable. This made balloons a favorable target for artillery. The enemy artillery could not resist the challenge of the sitting bird. Although some damage was done at times to the rigging, none of the balloons were hit in the envelope or basket, nor were any brought down by hostile artillery fire. The points of ascension always attracted casual visitors, and several generals were nearly hit by artillery fire when near balloons. Because they attracted fire, the presence of balloons was none too welcome by the troops and the balloonists were frequently asked to move their equipment away. In some instances Lowe found it desirable to construct shelter for his ground crews although only one member of his organization was killed during unit operations.

The failure to assign soldiers or to place the balloon corps on a military status determined the defeat of the corps in the summer of 1863.

The following criticism, made by an officer at Lowe's trial balloon run on the White House lawn in 1861, proved well-founded: The absence of military status and a permanent organization of trained soldiers and ground crew, rendered balloon management highly impractical. Responsibility was shunted from branch to branch without arriving at any satisfactory solution. The regular work of each branch was increased by detailing men for duty with the balloon corps.

Not having been granted military status, the highly-paid civilian balloon corps personnel incurred resentment and distrust despite their aeronautic ability and service. Since their observations were not always accurate, suspicion of the value attributed to such service was felt to be justified.

Finally in March 1863, the Corps of Engineers was delegated the administrative control of balloons, but the reception was far from one of kindly acceptance. Lowe's salary was drastically reduced, and he greeted the insult with a prompt resignation. However, during the emergency of the Chancellorsville campaign, Lowe patriotically served the corps, but without pay. A precipitant decline was effectively staged with the rude treatment of Lowe. Gradually, other technicans were dismissed, equipment was allowed to deteriorate and remaining officers lost interest.

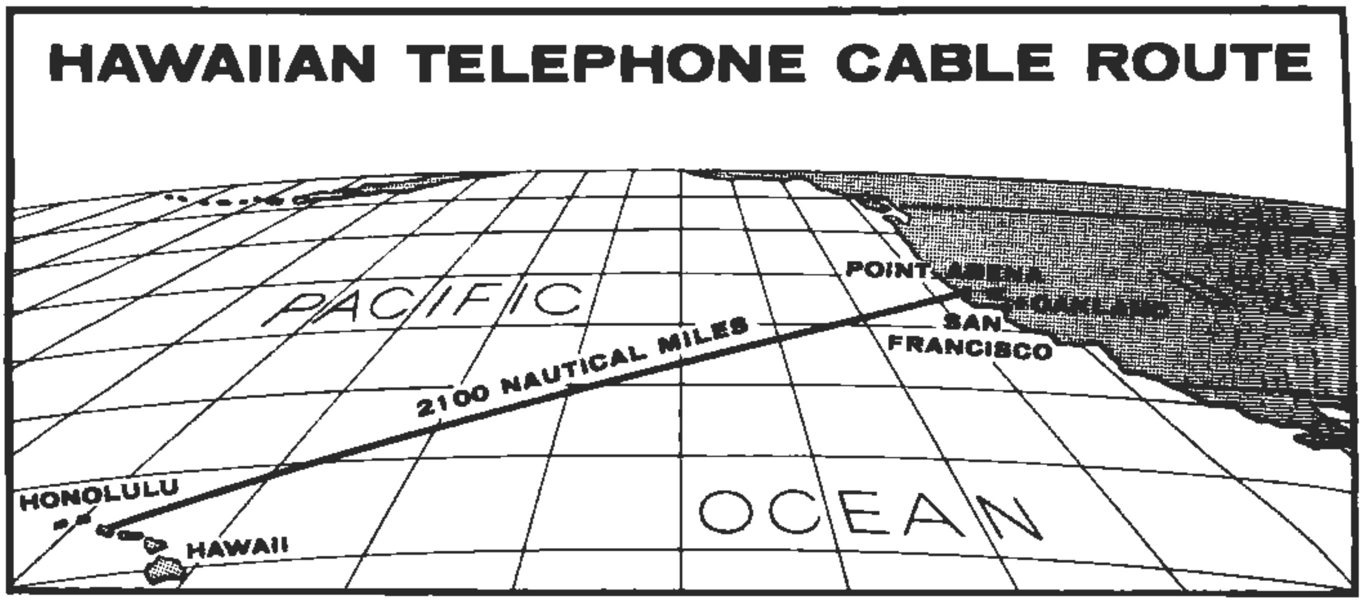
### A Strategic Decision

Finally, Hooker, following the battle of Fredericksburg, made a strategic decision which completely ignored the use of balloons as an intelligence instrument, bringing the corps to the brink of complete elimination.

Hooker, who had ultimately replaced McClellan as Commander of the Army of the Potomac, was making a strategic move up the river prior to the battle of Chancellorsville in 1863. Fearing that the Confederates would recognize his tactics, he decided not to risk the possibility of exposing his position by also moving the balloons. Although the balloon report on the movement of Confederate troops from Fredericksburg toward Chancellorsville had been of great value, the balloons were deprived of this last chance to prove their full potential. In June 1863, the balloons were transferred to the Signal Corps. Colonel Myer, Chief Signal Officer, requested but was denied both men and money for carrying on proper support and improvement. Failing to obtain this support, all balloons were subsequently ordered back to Washington and their use was completely discontinued.

Had the balloon corps continued, without doubt, its observations, which continually improved with experience, could have grown to become a highly valuable asset to the Union Army at Gettysburg, in the Wilderness, at Spottsylvania and with Grant at Richmond. Now stands the obviousness of that miscalculation wherein a most advantageous intelligence adjunct was allowed to pass out of existence at a time when its use implicitly promised to reach a peak of effectiveness.

**Inflation of the balloon "Intrepid" to reconnoiter the Battle of Fair Oaks, Virginia. The battle, which took place from May 31 to June 1, 1862, was fought in the area just east of Richmond.**



**SIGNAL Staff Report**

# THE THIRD LINK

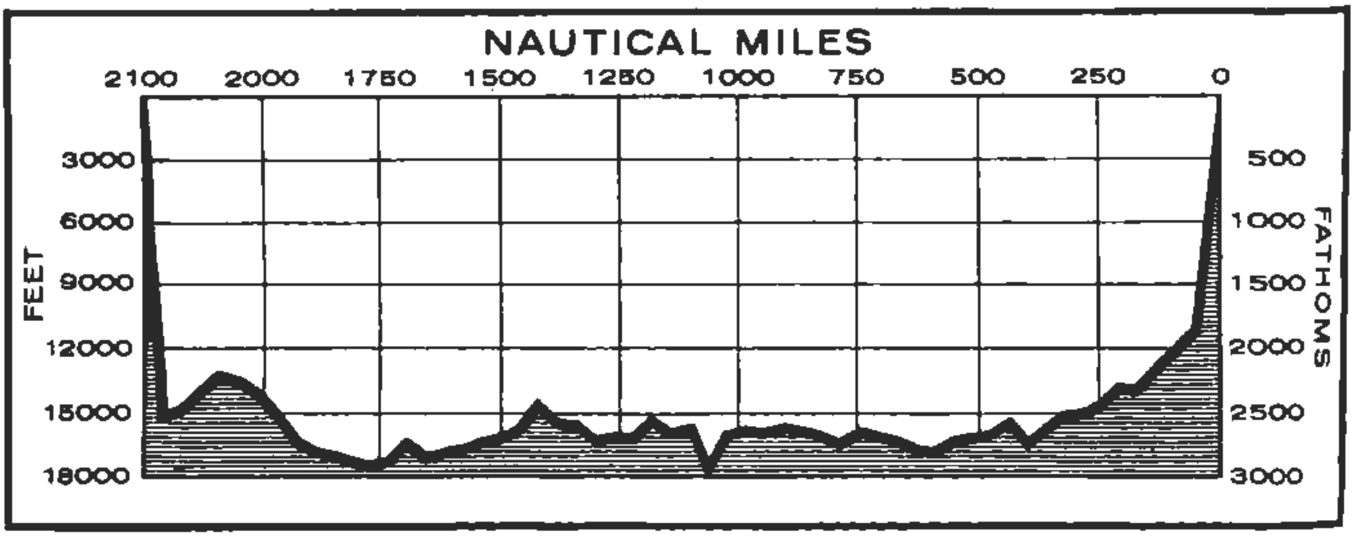
THE CABLESHIP MONARCH, GREY hulled veteran of scores of deep water ventures, sailed from San Pedro, California, July 12, 1957, on her biggest assignment—laying of the first undersea telephone cable link with Hawaii. This was to be the last phase of the multi-million dollar project which was started a year ago.

In September 1956, a survey was made to chart the topography of the ocean bottom between the California Coast and Hawaii, as little was known about the ocean bed beyond the continental shelf. It was necessary that the cable route avoid steep slopes, often subject to submarine landslides which could snap the cable, and to by-pass canyons where cables might be exposed to abrasion by ocean currents.

A depth recorder, which bounces sound waves off the ocean floor, was instrumental in the discovery of an unknown mountain beneath the sea, an 11,000-foot peak about the size of Mount Hood. The crew dubbed it "Mount Huddell" as a token to the ship used for the survey.

Other obstacles which had to be avoided were the Murray Fracture Zone, a trough four miles wide running 1200 miles east to west, and the "Moonless Mountains" which stretch 1000 miles north to south and rise two miles above the ocean floor.

Varying depths of the Pacific floor over which the cable is laid.



In April 1957, mainland shore sections were placed 10 miles seaward from Point Arena, California, amid *pounding* surf, swift cross-currents and treacherous undertow. After several ingenious but unsuccessful methods of beaching the cable ends were attempted, a helicopter finally picked up a towline from the beach and carried it above the surf to the work boat. *The line* was then hauled in by hand and later by tractor.

At the same time, 2,400 miles away at Hanauma Bay on the island of *Oahu*, Hawaii, charges of dynamite were exploded in off-shore reefs. Geyser-like shafts of water rose 100 feet in the air. The job involved trenching through razor-sharp coral to protect the twin shore sections of the cable. To make sure the trench was deep and smooth, skin-divers searched for jagged edges that might injure cable armoring. The shore ends extending two miles out to sea were floated to the beach from a shallow barge.

The cableship *Monarch*, playing the leading role in a multi-ship operation, began its task at Point Arena, site of the eastern terminus of the underwater twin cable system. According to the Long Lines Department of the American Telephone and Telegraph Company—Bell System unit in charge of the cable laying phase of the $37,000,000 project—the cableship picked up the end of a shore section placed there in April, spliced it to the cable in her tanks and headed for the Islands. Laying out 1,900 miles of cable at approximately six knots, *Monarch* steamed along on her south-westerly course.

By this fall, both of the 2,400 mile cables for the new Pacific voiceway will be completed. These cables will be capable of carrying 36 simultaneous conversations. Featuring the dialing of calls between the mainland and Hawaii, service is expected later this year. This will climax three years of planning and construction by Long Lines, the Hawaiian Telephone Company and Pacific Telephone and Telegraph Company, participants in the project.

Two other vessels will be engaged in the precisely timed, summer-long laying operations. They are the cable-laying *Ocean Layer*, and the cable supply ship, *Arthur M. Huddell*. Long Lines said there would be virtually no interruption in round-trip cable operations between the mainland and the Hawaiian Islands. Laying is to follow this sequence:

(1) From Point Arena westward, *Monarch* will lay the first 1,900 miles and buoy the cable end before proceeding to Honolulu.

(2) *Ocean Layer* will rendezous with *Monarch* at the buoy. She will take the cable end on board, make a splice and continue another 665 miles to the entrance of Hanauma Bay, on the island of Oahu. There, the east-west cable will be joined with one of the newly laid Hawaiian shore sections.

(3) Both cableships will then reload cable from the *Huddell* at Honolulu.

### *In Deep Water*

For the second cable (west to east), *Ocean Layer* will pick up the second Hawaiian shore section and lay some 800 miles eastward and buoy the end. *Monarch* will pick up the cable end and continue to Point Arena for the final mainland splice. The cables will lie as much as 25 miles apart on the ocean floor.

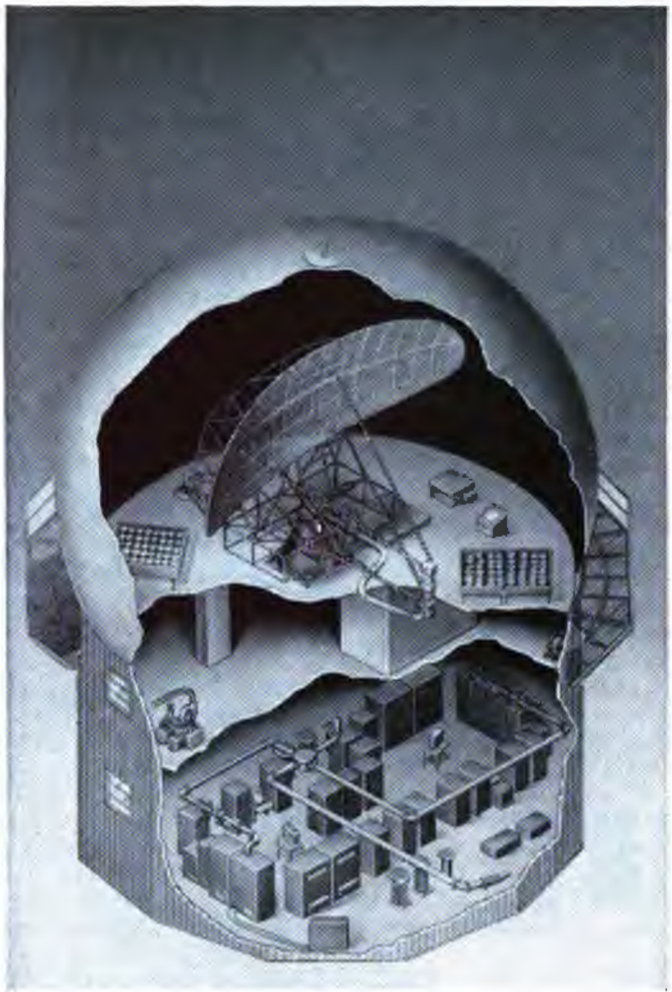
The Hawaiian cable system is similar in design and construction to the 2,250-mile Atlantic telephone cables extending between Newfoundland and Scotland, and the 900-mile Alaskan cables between Port Angeles, Washington and Ketchikan, Alaska —both were opened to service in 1956. The transatlantic cable system was the first deep-water voice link to cross an ocean.

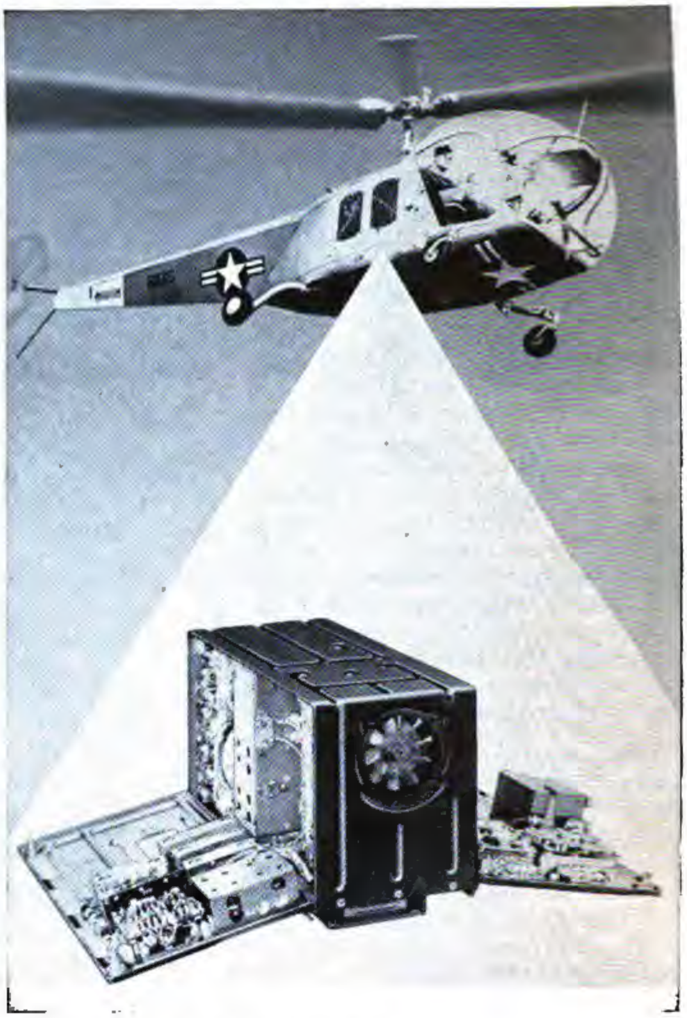
The Hawaiian cables will generally be in deeper water than either the Alaskan or Atlantic cables. At one point they will strike a depth of about three miles.

Cables are the coaxial type, especially designed to withstand the tremendous pressures of the ocean bottom. Sturdy, flexible repeaters are built into the cable about every 40 miles to boost the strength of signals when they reach the fading point along their deep-sea course. About 2,500 volts are required from each end to operate the cable system.

Long Lines pointed out that the compatibility between mainland and Hawaiian telephone facilities would enable an operator in Honolulu to dial direct to any telephone number in 6,500 communities on the mainland. In like manner, mainland operators in hundreds of cities can dial any subscriber on the island of Oahu, where 95% of Hawaii telephones are located. This will be the first of A. T. & T.'s ocean cable systems to be equipped for operator dialing.

The Hawaiian cables will substantially augment the 14 radio circuits presently operating between the mainland and Honolulu. When the cable system is placed in operation in the fall of 1957, it will also be used for teletypewriter service and for transmission of radio programs, but not for television transmissions. Wouldn't Queen Liliuokalani have enjoyed the opening of this important communication system?





# FROM LONG-RANGE SEARCH RADAR TO SUBMINIATURE COMMUNICATIONS SYSTEMS!

Creative engineering and precision manufacturing are our business. In the communications and related electronic fields, Bendix* provides unlimited know-how and facilities. From the mightiest to the smallest, from the simplest to the most complex, Bendix radar and communications equipment possess the winning combination of proven design, precision manufacture, top performance and dependability.

Long-range Search Radar (AN/FPS-20)—one of our many products—is shown above. Now in production for the U. S. Air Force, this advanced type radar system culminates four years' intensified research, design and development by the Air Research and Development Command and Bendix engineers. It now plays a vital role in our national defense. Its dual-channel equipment includes high-powered transmitters and ultra-sensitive receivers far more sensitive and powerful than any other now in use.

By way of contrast the accompanying illustration shows the Bendix subminiaturized AN/ARC-44 communications system. It, too, figures importantly in our national defense. Now being produced for the U. S. Signal Corps, these rugged and reliable units are installed in small liaison fixed-wing and rotary-wing aircraft such as the L-19 Cessna and H-13 Bell helicopter for directing ground troops and artillery fire.

**AN/URD-4 RADIO DIRECTION FINDER**

Highly versatile Bendix unit used for many land and shipboard purposes. Locating carrier-based aircraft lost beyond the range of shipboard radar and locating by triangulation unknown sources of radio signals are but a few of its uses.

*TRADEMARK

Bendix Radio Division
**BALTIMORE, MARYLAND**

Bendix
AVIATION CORPORATION

A 1957 AFCEA Convention Presentation.

# Vanguard Instrumentation System

*by Vernon J. Crouse, Group Engineer, Project Vanguard, The Martin Co.*

TODAY THE SCIENTIFIC WORLD STANDS on the threshold of man's greatest adventure into the mysteries of our world and our universe. I am, of course, referring to the International Geophysical Year (IGY), which started July 1 and extends through the end of 1958.

The IGY will be a world-wide endeavor to obtain more information about man's environment. One of the most dramatic contributions to the IGY will be the United States' attempt to place an instrumented satellite into an orbit about our earth. Fantastic as this idea seems at first, I can tell you with all confidence that it is about to become a reality.

### NRL Selects Martin

Shortly after the Presidential announcement on July 29, 1955, which officially started our satellite program, The Martin Company, Baltimore, was selected by the Naval Research Laboratory to design and build the satellite launching vehicle, Vanguard.

Almost everyone is now familiar with the configuration of the satellite launching vehicle (Figure 1) and the trajectory it will follow in order to place its satellite payload in orbit (Figure 2). It will require a giant three-stage rocket vehicle, weighing some 11 tons and standing as high as a seven-story building, to establish a 20-inch, 21.5-pound sphere in orbit.

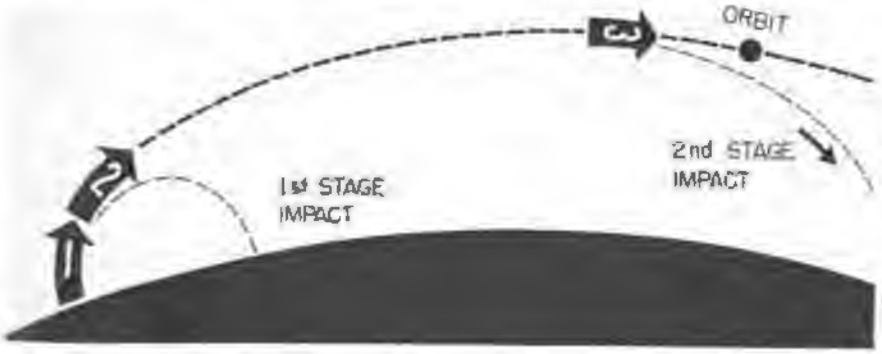
To maintain an orbit will require maximum performance from all the different components that go into the complex launching vehicle. Foremost among these components are the electronic and communications systems that are needed to determine the performance of the vehicle and to establish the correct flight trajectory.

I'd like to discuss the instrumentation system of the Vanguard vehicle: the necessity for such a system, how it works, and what it is expected to do.

Naturally, the satellite launching will not be attempted until a thorough and exhaustive flight test program has been completed. The test program is planned to evaluate clearly the performance of all the components, the complete systems, and the design of the over-all

A three-stage rocket assembly, some 72 feet long and with a total weight of about 11 tons, will be required to get the scientific satellite, weighing about 21 pounds, into its earth-circling orbit.

FIGURE 1



Functions of the three stages of the rocket launching assembly are shown in this sketch of the trajectory. The first stage starts the system on its flight, drops off some 40 miles and two minutes later, after its fuel is spent. The second stage then takes over, burning out at about 130 miles altitude, and coasting on to the desired orbital altitude of 300 miles. At this altitude, the third stage places the satellite in its orbit, at a velocity of about 18,000 miles per hour. Over-all elapsed time: about ten minutes from take-off!

FIGURE 2

vehicle. Only after complete information has been received and analyzed will a satellite launching be attempted. As a matter of fact, the actual satellite launch vehicles will carry only a minimum of instrumentation; the Vanguard's performance will have been established by the test vehicles.

To give you an idea of what the test instrumentation will tell us, the performance of the first and second stage engines must be thoroughly analyzed; separation of the stages must be checked and proven; igniting the second and third stage propulsion units at high altitudes has to be tested and proven. Above all, the control system must be exhaustively checked, because if the rocket vehicle does not place the satellite at precisely the proper altitude, speed and position, the entire mission will be a failure.

The mention of just these few problems should impress upon you the amount of instrumentation that will be carried aboard the test vehicles. Each test vehicle will be fired to achieve a definite primary test objective, and several secondary objectives (Figures 3 and 4). Each rocket will carry an instrumentation system capable of making 200 internal measurements as well as complete external instrumentation. Telemetering will transmit this data to the ground.

MEASUREMENTS BY CATEGORIES

| | | | |
|---|---|---|---|
| Pressures | 58 | Strains | 7 |
| Voltages | 34 | Flow Rates | 5 |
| Temperatures | 21 | Vibrations | 4 |
| Mechanical | 19 | Velocities | 4 |
| Accelerations | 9 | Attitudes | 2 |

MEASUREMENTS BY ENGINEERING ACTIVITY

| | | | |
|---|---|---|---|
| Aerodynamic | 57 | | |
| Propulsion | 49 | Structural | 11 |
| Controls | 25 | Instrumentation | 5 |
| Electronic | 13 | Electrical | 3 |

Figure 3 and 4

As many as four telemetering transmitters will be used in each test vehicle. In addition, optical coverage, radar and Doppler tracking techniques will be used to determine the trajectory and velocity. These are extremely important items in the success of the over-all missioo, and must be checked very accurately. The electronic components and systems used in tracking must perform at maximum capacity.

We depend on tracking data also for range safety purposes, and failure of the equipment could mean the loss of the entire mission. To this end, we have an obligation to ensure that commercially procured equipment is fully qualified in every way to produce peak performance.

What makes all our problems even tougher is that the environmental conditions to be experienced by the Vanguard are extremely rugged and in some cases unknown. The vehicle will accelerate to the fastest velocity ever attained by a man-made object—18,000 miles per hour. It will fly from the sea-level launching site to the vacuum of outer space, encountering wide changes of air pressure, temperature, and aerodynamic friction along the way. Little is known about conditions on the borderline of space; that is why we are launching a satellite in the first place.

The internal instrumentation system of the Vanguard test vehicles will change from one vehicle to another with regard to the number and type of measurements as the test program progresses. But the basic system will remain the same (Figure 5). It is probably very similar to the basic system used in most other rocket and missile test programs.

Transducers are used—where necessary — to transform the functions to be measured into suitable electrical signals. These signals are then used to modulate a telemetering transmitter, which transmits the data to a ground receiving station. Here the signal is decoded and recorded in analog form. Some of the data is displayed in real time and is monitored as the flight progresses.

Three types of telemetering systems will be used to transmit data: the PWM/FM, PPM/AM, and FM/FM systems (Figure 6). Each has its own particular merits. The PWM/FM and PPM/AM systems use data sampling methods, or time multiplexing of the various data channels.

The FM/FM system uses frequency multiplexing to provide continuous transmission on each channel. Some of the PPM/AM channels are further subcommutated to increase the total number of available data channels, accord-

(Continued on page 36)

BLOCK DIAGRAM OF INSTRUMENTATION SYSTEM

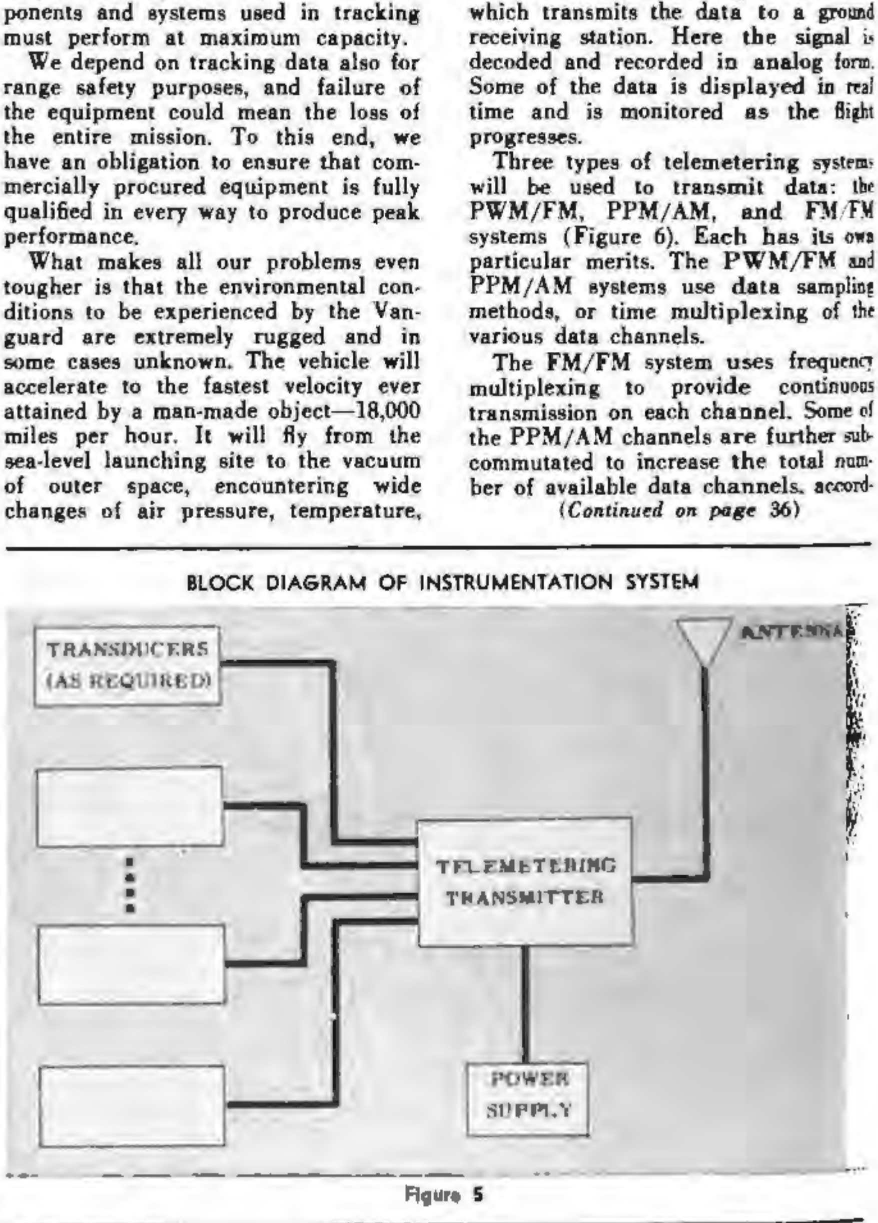
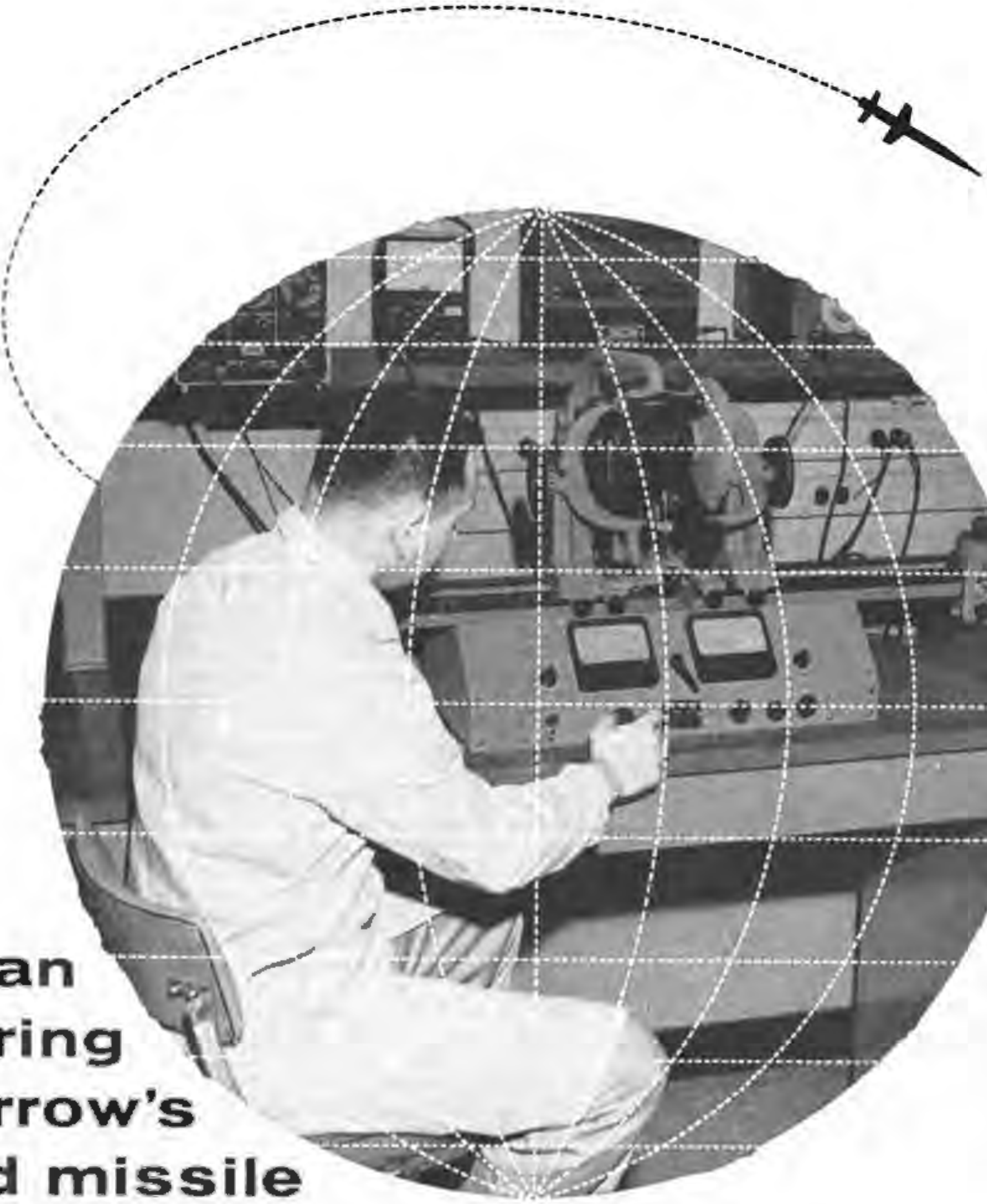


Figure 5

TYPES OF TELEMETERING SYSTEMS

| Designation | No. of Data Channels | Sampling Rate Per Channel |
|---|---|---|
| PWM/FM (Pulse-Width Modulation) | 43 | 20 Samples Per Second |
| PPM/AM (Pulse Position Modulation) | 15 | 312.5 Samples Per Second |
| FM/FM (Frequency Modulation) | 12 | Continuous |

Figure 6



# This man is steering tomorrow's guided missile

His uniform is a laboratory coat, his cockpit a dust-free room with carefully controlled temperature and humidity. He's a skilled General Mills gyro technician—as much a part of the defense of his country as the jet pilot. Results from his work, and from work in other R & D labs, assure us that tomorrow's guided missiles will be even more accurate than today's. ¶ At the Mechanical Division of General Mills, the gyro lab is part of a talented, well equipped guidance and navigation systems development group. The group also includes top men and facilities in infrared, microwaves, electronic and mechanical design, and overall systems engineering. We team these men and facilities with a complete precision production plant to handle systems, sub-systems and major assembly problems for the world's most exacting customers. Possibly you too can benefit from our capabilities.

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*Creative Research and Development • Precision Engineering and Production* ing to the needs of the particular vehicle. The arrangement is approximately six channels with subcommutation and nine continuous channels without.

The PPM/AM system was developed by the Naval Research Laboratory and has been used successfully for a number of years in the Martin Viking and the Aerobee programs. It has the advantage of being able to handle large quantities of data at low frequency response rates. The PWM/FM system has also been proven in rocket and missile work, and can handle slow response data. The FM/FM system is the standard RDB telemetering system, and is the prime range system at the Air Force Missile Testing Center, where the Vanguard vehicles will be launched. Its main function on the Vanguard program will be in handling high-frequency data inputs.

The telemetering systems indicate to a great extent the type of transducers or end instruments which will make the measurements we are seeking. In most cases, the telemetering system requires a signal input in the range of zero to five volts. Because of this, we are using potentiometric-type sensing elements wherever we can. Thermocouples, strain gauges, and inductance pickup are avoided whenever possible because they require added circuitry, black boxes, and the associated headaches that go with converting these signals to a usable voltage. In addition, signal converters take up too much valuable space and weight.

The Vanguard program has not been without its instrumentation problems. Past experience on the Viking rocket helped us to anticipate many of the difficulties we would encounter, but new problems peculiar to the Vanguard mission remained to be solved. Instruments have to perform under almost impossible environmental conditions. Temperature ranges from —300° to +1500°F will be encountered in many areas. Some instruments and equipment will be in contact with liquids and gases corrosive enough to etch or even destroy most metals. And all the components will have to contend with ever-present acceleration, shock and vibration.

Perhaps the toughest problem we faced was measuring the temperatures and pressures of the second-stage propellants: white fuming nitric acid and unsymmetrical dimethyl hydrazine. We felt that if we could develop a transducer that could maintain a sustained operation in the highly-corrosive nitric acid, this same instrument would be satisfactory for use in the other propellants of the Vanguard.

Handling white fuming nitric acid has been a serious problem in the past. It will vigorously attack most metals; titanium, aluminum, and stainless steel show the greatest resistance. Both the acid and the hydrazine are highly toxic, incidentally, and present an explosion and fire hazard to the ground crew.

It was apparent that no available transducer would be completely satisfactory for correct measurements in these media, so a special development program was initiated with the Rham Instrument Company of New York. The instrument has been built, tested, and evaluated. It employs a bourdon tube sensing element constructed of 316 stainless steel alloy with special fittings and weldments. It also has a stainless steel fail-safe case for protection, in case the tube fails. No isolation diaphragms or isolation media of any type are used in any of these instruments; direct measurements is the feature throughout.

Rham has also developed an instrument to measure pressure in the decomposition products of hydrogen peroxide, in temperatures up to 500°F.

The necessity of making internal temperature measurements has also presented us with special difficulties. The temperatures involved range from —300°F, the approximate boiling point of liquid oxygen, to +300°. Major consideration was centered around the use of thermistors, rather than thermocouples, since thermistors have an electrical resistance variable with temperature. Thermocouples require additional equipment to amplify their low-level signals to voltages compatible with the telemetering equipment; this presents a weight penalty and serious technical problems.

However, the thermistors used on the Martin Viking were known to have had some leakage under pressure, particularly in liquid oxygen systems. We realized that what was needed was a sealed thermistor temperature probe which could be assembled into a threaded boss, similar to the standard thermocouple probe. The resulting design encloses the thermistor in a thin aluminum capsule, which makes it adaptable for use in any of the media previously discussed.

Another challenge to our instrumentation requirements was the measurement of temperatures on the skin of the nose cone, which is subjected to severe aerodynamic heating. Again, the use of thermocouples was ruled out, for the reasons already mentioned. Similar measurements had been made on other rockets, possibly at lower skin temperatures, using the technique of cementing a wire grid to the inside surface of the skin. The wire grid or gauge has an electrical resistance that is a function of its temperature. This relationship is used to develop an electrical signal that is a measure of the temperature.

There were several obstacles to adapting this technique for the Vanguard vehicle. One was that the cements previously used had a maximum usable temperature of about 600 to 900°F, which is not adequate for some of the Vanguard measurements. Even at these temperatures, the cements tended to become brittle and flaky.

Also, all the known cementing processes required curing at an elevated temperature, and to do this without depositing an oxide coating on the skin material would have required a special oven capable of maintaining an atmosphere of inert gas. Finally, it was found that the Vanguard skin materials could not be held at this high curing temperature for the required length of time without being seriously warped.

To solve the problem, then, we developed gauges of platinum alloy wire grids fused to postage-stamp sized squares of metal approximately one mil thick. These foil squares are then spot-welded to the skin surface, eliminating the need for cementing and curing.

With the exception of some of the more unusual measurements I have discussed, the instrumentation system for the Vanguard vehicle is not unlike that found in any other missile or rocket program. Our goal has been to use conventional techniques and proven equipment wherever possible and to improve on their quality rather than jump into new methods and techniques where results would be somewhat doubtful. We believe that in some small way we have contributed to the state of the art in flight test instrumentation and in maintaining communications with a space vehicle.

We are only scratching the surface of space exploration, yet we are pushing to the limits of our existing equipment. Future satellites and space vehicles offer us all the greatest challenge of our lives. In any future venture, as in the present one, electronic and communication techniques will determine the success or the failure of the mission.

The time is drawing near; and when you stop and think of the time, money, energy, and facilities that are being put in a program of this magnitude, you might stop and ask — Why do we want an artificial satellite at all?

If you require specific justification for this endeavor, there are many particular results which are of immediate practical value. For example, expected data on the physical characteristics of the upper atmosphere, pressure temperature, and density will be required for future high speed, high altitude airplanes and missile designs. Triangulation measurements employing a satellite will permit more and exact determination of the size of the earth and of relative location of the land masses. In addition, more complete information on solar radiation, cosmic ray intensity, weather and magnetic phenomena undoubtedly will be of great value to the meteorologist.

However, all of the above data relate to the obtainment of short range objectives. The true significance of the project is that we have accepted the challenge to create something never before seen by man. Something to be used for the advancement of mankind by extending our knowledge of our environment. We have taken the first step in the exploration and conquest of outer space.

# SPLIT-SECOND MISSILE CONTROL AT 15,000 MILES PER HOUR

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# Rapid Fault Elimination In Complex Electronic Systems

*by John F. Scully, Special Projects Manager, Monroe Calculating Machine Co.*

*A 1957 AFCEA Convention Presentation*

★ ★ ★

THE PURPOSE OF THIS ARTICLE IS TO discuss some aspects of the maintenance problem which affect major electronic systems in industry and the military and some work that the Monroe Calculating Machine Company has been doing to reduce the burden of maintenance of such systems over the last few years.

The problem is essentially generated in modern times by the inherent complexity and size of the large systems which we need to perform modern day functions in warfare and industry. The very nature of the problems themselves requires that the systems be complex. Try as we will to minimize the number of elements in these systems, larger and larger systems are found necessary every day. Not only does the size increase in terms of number of elements, but also the complexity of the interrelationships of the elements. To comprehend in detail a modern computer with perhaps 15 or 20 thousand logical elements is an almost impossible task—impossible, that is, to all except those few who are very expert on that particular equipment — for example, the people who designed and built it. As the complexity increases, the need for keeping the equipment in operation increases even more drastically.

One result of this complexity is that sound maintenance programs and research and development efforts are badly hampered. Also, the operational reliability of these large equipments into which we put so much faith in modern warfare is considerably lowered over what we might expect of them because, while they may do an ideal job when they are working, they may often fail to work. Also, the training and establishment of necessary personnel, particularly in the military, to keep the equipment in operation, becomes very difficult because you approach the time where a man needs two years to learn how to trouble shoot the equipment, and by then he is often lured away from the Service.

For the purposes of this article, we think not in terms of a missile whose reliability is gauged by the probability that it will make a kill when it is dispatched, but rather in terms of a system which is in constant use; and, if it fails, can be repaired and placed in operation.

Now, what is the reliability of such a system? We might very well define it in terms of the operational efficiency of the unit. This is made up in large part of two elements: (1) the mean time-to-failure of the system, that is, the number of hours on the average you can expect the equipment to operate before failure is encountered; (2) the time required after failure to restore the system to useful operation. Is it a minute, fifteen minutes, two hours, a day, a week, or may you never find the trouble at all? Reliability will be defined, then, as the efficiency of the equipment as measured by the ratio of the time that the machine will do the job to the total operational time desired. If it's useful all the time, it has an efficiency of unity; if it is never useful, it has an efficiency of zero.

When one builds an electronic system, he strives to achieve the utmost in terms of reliability in components and engineering. Assuming that one has done the best be can in this respect, we establish, for a given equipment, a mean time-to-failure which is a function of the design of the equipment and its environment. Not much can be done about the design after the equipment is in the field. The environment may be a product of Nature, and not much can be done about that either. Then the efficiency depends on the ability to repair a defect when a defect occurs.

What can be done to minimize the down-time? Since machines are assuming more and more the duties of the human, operation-wise, and becoming capable of doing operations automatically, we might inquire into the ability of machines to conduct their own maintenance, which after all, is normally a human problem. What is involved in its maintenance? Errors must be detected when they occur; the source of the difficulty must be located; the defective components must be replaced; the system must be cleared of error and caused to resume its job.

All of these aspects of system performance can be made automatic by suitable means, except, perhaps, that of component replacement, which does not seem practical at this time. Once a human knows what plug-in unit or chassis to replace, the problem of replacing it becomes a small part of the over-all maintenance work — most of which in large systems today, lies in the location of the defective component rather than its replacement. This was not always true. We remember some radars during the last war in which finding the trouble was not nearly so difficult as getting underneath various sub-chassis to remove the part that was at fault.

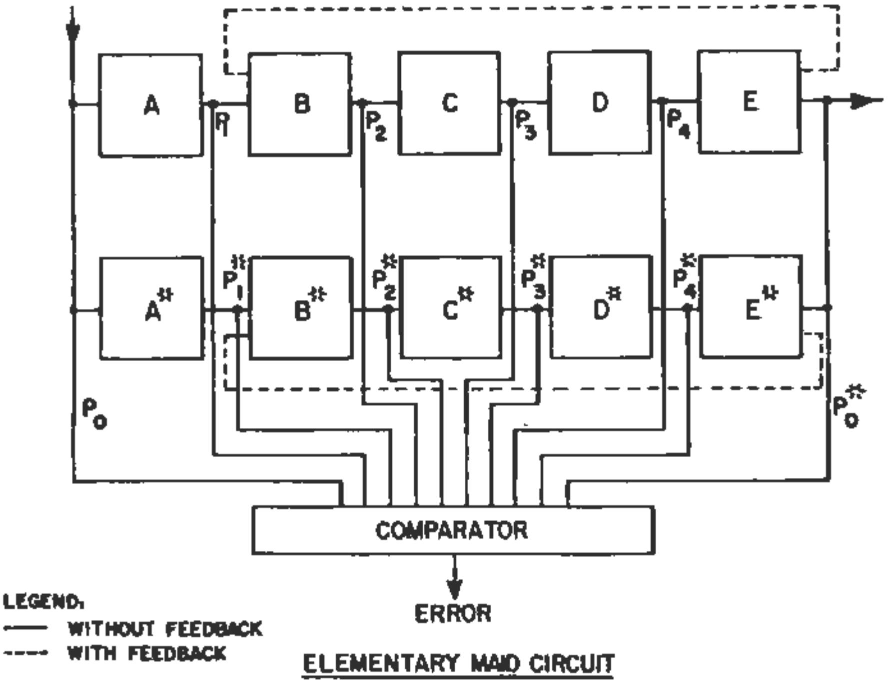
In 1953, a prototype automatic fault location means was brought to fruition in the laboratory; it was called MAID —short for Monroe Automatic Internal Diagnois. The MAID monitors, detects and locates troubles in digital equipment automatically, and since the experimental development in 1953, the system has been put into several full-scale digital calculators, the first one of which was delivered to the Air Force in 1955. Several others embodying the system have been delivered since.

Without too much technical detail, we may discuss the basis of the system briefly before discussing the philosophy of it and what it can do.

One can think of all the points of an equipment as a set which, when the equipment is performing properly, consists only of points of proper operation. When a trouble condition occurs, some ubset of points of that system is also oing to be in trouble. If we knew what was going on at every point of the quipment, then we would know which ubset was defective. Further, if a trouble condition exists in an equipment, here must be a group of points which are in trouble at the *earliest time.* Obviously, the trouble is going to show up in these points before others, which are dependent on it in time. The problem then may be defined as one of finding, of all the points that show trouble, that set of points which shows trouble at the earliest time and from that set of points, then, selecting the one which is least dependent upon the others.

The problem is complicated, of course, if there are feedback loops because one may start anywhere and the trouble will propagate around the entire loop, so that seemingly one could not tell which point shows the fault earliest. In any such feedback loop, there is delay. Therefore, it takes time for the trouble to get around the loop. The delay time may be in microseconds, but it is nevertheless detectable.

In a very small system, one means of finding out if there is trouble in the equipment is to have two such equipments doing the identical job, namely, the set without the asterisk and the set with the asterisk (Figure 1). If there were trouble in Box A and the system were a straight feed-through proposition, then that trouble would be reflected in Boxes B, C, D and E. Further, if one monitors such pairs of points in a comparator and picks up the error, one can scan backwards from the output to the input, and that point showing trouble which is nearest the input is the source of the trouble since the others are dependent upon it.



ELEMENTARY MAID CIRCUIT

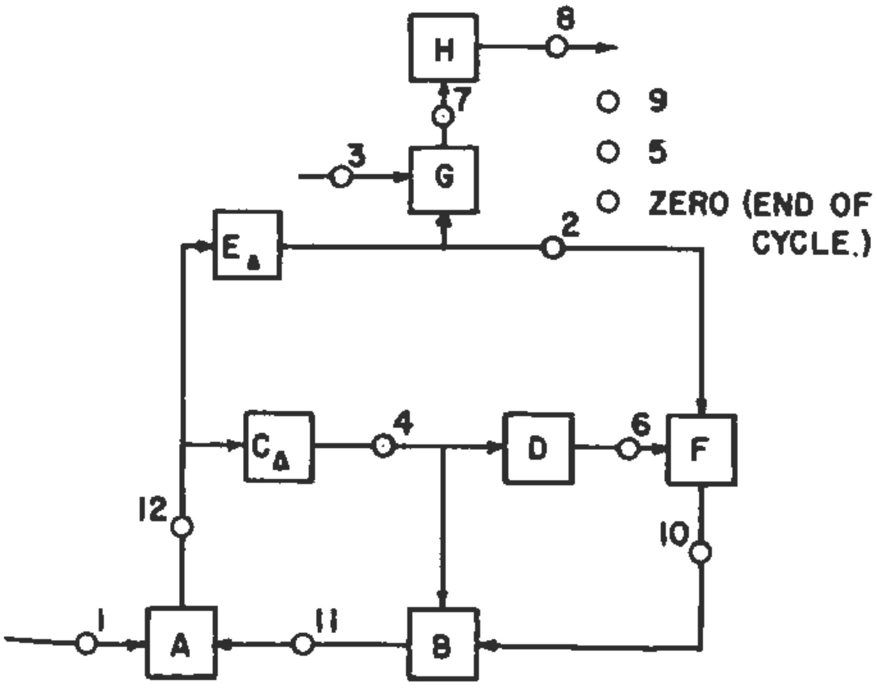
Figure 1

As is usually true with a television set or radio receiver where one goes from stage-to-stage, it is not difficult to locate the earliest point. Figure 2 shows a situation which is, perhaps, a little more typical of a complex system such as a digital computer. In this case one has feedback loops, so that the human with an oscilloscope, trying to find out which stage is the source of the trouble, is in difficulty because the trouble can appear everywhere in the loops. However, electronic circuits can readily be made to detect which point has the earliest time of occurrence because they can measure in microseconds, and the human eye cannot.

If an electronic monitor in the MAID finds that trouble occurs at say, point 12 of the unit shown in Figure 2, it can then scan back to point 11. If the trouble occurs at point 11, the MAID system notes that point 11 is in trouble, re-cycles the system and then takes a look at point 10, comparing the performance with that of point 11, so far as error of operation is concerned. Now a defect which lies in Box B in the diagram will show trouble at points 11 and 12, but not at point 10. Therefore, the monitor unit in stepping backwards to points 10, 9, 8, 7, 6, 5, etc., ultimately going back to zero, will find no trouble which is earlier than point 11, either in time or in dependency. Consequently, the unit which marks point 11 as being in difficulty is in essence saying that Box B was the source of the trouble. The same is true of any other box selected.

Duality has been mentioned as one means by which one can detect proper performance of a point. The first MAID system made use of the redundancy available in duality not only to detect errors, but also to step back and use that duality to locate automatically the source of the error. One does not always, of course, have duality; other approaches to the problem will be discussed later.

What has been the result of actual use of this system in the field? In the equipment delivered to the Air Force which contained on the order of 1500 vacuum tubes and some 6000 germanium diodes, the down-time on that equipment was reduced to a value perhaps 25% of what it was without the automatic diagnosis system. A greater down-time reduction was not achieved for two reasons. One is that in any system,



BASIC MAID OPERATION

Figure 2

troubles occur which are not remediable merely by replacing a component, as, for example, broken wires inside of cables, or a stray piece of dust getting between the contacts of a switch. The other reason is that not quite as much was known about the application of diagnosis systems to equipments then as today. This equipment was the first one to which the principle had been applied. Several computers have been delivered to the field since and similar results, namely, about 25% of normal down-time has been achieved with the diagnosis system. This is achieved without any change in the mean time-to-failure which is a function of the components and the design of the system.

Other advantages of the MAID system and automatic maintenance are that a reduction takes place in maintenance skill required. That is, one does not need people of so high a caliber to locate the faults.

In production trouble shooting where one always has more than one of a kind of a unit, duality is inherent. One may not have it where machines are in different locations, but certainly while they're in the factory, any two together are dual equipments and the dual MAID system can be applied. Also, training on equipments becomes much easier because with the use of the automatic diagnosis unit, the trainee is told by the machine much about the functioning of the system. Of course, as with all positive monitoring systems, you have the security of knowing whether or not at any given moment the system is in proper functioning order.

So much for the past and what has been achieved with the system to date. What about the present and the future? The early systems used dual equipments as the means of obtaining knowledge of proper operation of each of the points in the equipment. Where one has a dual system, it is still, perhaps, as good a means as any, because the equipment required for the diagnosis is exceedingly simple. The early sy to digital computers wh the system changed di time intervals, and it Monroe to apply it to cause that was our business. We do believe the same basic princip tended to large equip kinds, such as radars ev may not be digital. Noth losophy of the system r creet clock system.

Several improvements h ized since the delivery of totype MAID unit. In the the dual system, where tr used to require a matter of in very difficult cases, scanning means has been that today, on medium sp one can locate the source within one clock interval. equipment, that interval is 8 onds; you don't have to any longer on that equi trouble occurs. An interm can then be located imme

Quite a bit of work has applying automatic diagno lar electronic complexes, that having only one set of circuits. different criterion of proper ance is used—one which is app the system in question and do quire the use of dual circuits.

Thirdly, much has been do field of pre-cognition, that is, marginal checking while act erating the equipment so th known in advance whether or unit is marginal without forci the point of failure. In this c have the option of continuing operation and removing the p trouble at some later date, during periodic maintenance.

Editor's Note: The successful experimental MAID unit, shown above, was on display and demonstrated at the Monroe exhibit booth during the 1957 AFCEA Convention.

Monroe Maid Unit

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# SCATTER PROPAGATION

### *Part II*

### *U. S. Air Force Presentation*

*By*

***Colonel Robert C. Sears, USAF***

Synopsis, Part I

*In the August issue, RAdm. J. N. Wenger, as panel moderator, introduced the subject of Scatter Propagation by reviewing the principles and phenomena involved, and stressed the great importance of the new techniques of ionospheric and tropospheric scatter to the Military Services.*

*Colonel W. A. Ross, representing the Army Signal Corps, discussed the information which has been and is being obtained from the ionospheric scatter system in Alaska and the tropospheric scatter system between Washington and Fort Monroe, Va. He told of the amazing progress that is being made at the U. S. Army Signal Engineering Labs which have successfully demonstrated communications over a path in excess of 1900 miles. For tactical operations, he stated, further evaluation is required on presently developed equipment.*

*Captain W. A. Ellis, representative of the U. S. Navy, discussed the difficulties confronted in ship to shore and ship to ship communication circuits due to the great size and weight of scatter antennas, and to the focalization problem resulting from pitching ships. He stated that tests have determined that tropospheric and meteor burst modes of communication may be feasible for Navy application.*

As you know, the Air Force has been using both ionospheric and tropospheric scatter for some time. Our selection of these two modes of communications was based primarily on our requirement for highly reliable communications to support offensive and defense air operations in which both sides enjoy a 600 mph bomber capability. The problem of reliability was most serious in the high northern latitudes where both high frequency and low frequency circuits were often blacked out by auroral disturbances. These outages were particularly serious because of the important role the Arctic plays in strategic air operations between the United States and Russia. I would like to trace briefly the history of the Air Forces' experiences with the scatter techniques as a solution to this Arctic communications problem.

Shortly after the first successful tests of long range VHF propagation in January 1951, the National Bureau of Standards was requested by the Air Force to investigate the possibilities of employing long range VHF propagation operationally to meet urgent communications requirements to Laborador and Greenland, where other means of radio communication were difficult and unreliable. A survey was conducted by Bailey and Bateman, then of the National Bureau of Standards, accompanied by an Air Force officer. The survey was to ascertain the feasibility of providing long range VHF circuits between Goose Air Base in Laborador and Thule Air Base in Greenland. As a result of the recommendations which stemmed from the survey, the Air Force asked the National Bureau of Standards to establish a simplex test circuit to transmit from Goose Bay to Sondestrom at the earliest possible date. This path was selected for three principle reasons: First, the path length of approximately 1000 statute miles was thought to be nearly optimum for this mode of propagation and was substantially longer than previously tested paths; second, the mid point of the path was very near the region of maximum auroral occurrence; and third, the path connected two important Air Force bases between which serious difficulties were being experienced with other means of communication. This circuit was established with an operating frequency of approximately 50 megacycles which was essentially the frequency that was used on other VHF experimental circuits, therefore performance data could be readily compared. Vertical polarization was used on this test circuit since the only other existing long range VHF experimental circuits were employing horizontal polarization and little was known experimentally about vertical polarization. The transmitter was a modified AN/FRT-6 with an output of 40 KW. The antenna was a four element vertical half rhombic. The receiving antennas were 45 degree corners with collinear elements in space diversity. The tests were started in the latter part of January 1952. In October 1952 the half rhombics were replaced with vertical full rhombics as the half rhombic antenna gain was adversely affected by changes in the reflecting plane with snow, rain and dry weather. Single channel teletype messages were transmitted over this circuit in March 1952 and four channel time-division multiplex teletype traffic was initiated in January 1953. The Goose Bay to Sondestrom test facility continued in operation until December 1953. At this time the experimental facility was dismantled having been replaced by a new installation.

In May 1952, after a short evaluation of the test circuit, the decision was made to proceed with the installation of three VHF circuits linking the United States with Thule, via Goose Bay and Sondestrom. This early decision resulted from pressing operational requirements for reliable communication between these points. This phase of the program has been nicknamed "Bitter Sweet." The first objective of this program was to establish a single teletype channel. As a further objective the possibility of providing a reliable multichannel teletype service was to be investigated. Bitter Sweet was completed by November 1953 and the first two way tests were begun in December. Horizontal polarization was used throughout the system; due to the experience gained on the test circuit vertical polarization was abandoned. Full rhombics were thought to be the most desirable antennas, but at some sites the terrain was so rugged that large flat areas for rhombic construction could not be obtained. Horizontal corner reflector antennas were developed and used at these sites. Where the rhombics were used they were stacked to give additional gain. The corner reflectors were 60 degree with collinear arrays. The aperture dimensions are five wave-lengths across and three wave-lengths high.

The Bitter Sweet circuit was supplemented by a program which was approved by the Joint Communications-Electronics Committee in December 1953. This program, which was nicknamed Fat Girl, was to provide for an extension of the Bitter Sweet circuit to the United Kingdom via Iceland, and for an additional link between Goose Bay and Narsarrsuak, Greenland. These circuits were scheduled for operation in December 1954. The equipment and antennas used were essentially the same as in the case of the Bitter Sweet circuit.

One link of the original Bitter Sweet circuit was known to be somewhat short for reliable propagation, but the link was implemented because of operational urgency. This short link was from Loring, Maine, to Goose Bay, a distance of about 570 statute miles. Recently the Loring Terminal was moved to Wachusett Reservoir near Worcester, Massachusetts, increasing the path length to about 920 miles. I will discuss this move later, because the facility at Wachusett incorporates some of the latest improvements in ionospheric scatter.

Ionospheric scatter is used for DEW Line rearward communication. There are five circuits in support of DEW Line with terminals in the United States and Alaska.

Ionospheric scatter is not always a perfect answer to long range communication. During 1954 the Air Force and the National Bureau of Standards conducted tests over a path from Newfoundland to the Azores, a distance of about 1440 statute miles. Evaluation of the results of these tests led to the decision that ionospheric scatter was not economically feasible over that path, primarily due to the transmitter power required. As the state of the art advances other circuit parameters may compensate for the increased power requirement and at that time extreme range rcuits may be economically implemented. Note should be taken hat the circuit was technically possible, but the cost of installa-on and operation of higher powered transmitters is the factor hat led to consideration of other methods of communication to meet the operational requirement.

In addition to the Air Force North Atlantic ionospheric scatter ystem which has been mentioned and the DEW Line rearward catter circuits, the Air Force also operates an ionospheric catter test circuit between Cedar Rapids, Iowa, and Scituate, Massachusetts. This circuit is used primarily to test modulation echniques. At the present time the Air Force is planning an dditional test facility between Rome Air Force Base in New York nd Eglin Air Force Base in Florida. This circuit will be used rimarily to service test equipment designed for ionospheric catter operation.

In the establishment of reliable communications both forms of catter must be considered. It is fortunate that the tropospheric catter distances and the ionospheric scatter distances supplement ach other. In support of the air defense radar sites communica-ionswise, as has been pointed out, ionospheric scatter lends itself best for rearward communication. The distances between adjacent adar sites makes tropospheric scatter ideal for communication between them. The Air Force today operates approximately 150 ropospheric scatter terminals used in support of the Air Defense Mission.

## *Study and Development*

On the 5th of December 1953, the Director of Communications U. S. Air Force initiated a staff study concerned with communications in support of the Laborador-Newfoundland Air Defense system. This study pointed out that high frequency and low frequency communication in the northeast area were inadequate to provide the reliability demanded for an air defense system. It recommended that communications support should consist of microwave and cable to give the reliability desired. The system was to have fifty stations of line of sight microwave. Equipment and construction programming were such that the lower half of the system, St. Johns to Goose Bay, was scheduled for completion in late 1955. No target date had been set for the completion of the upper half of the system, but the best estimates placed completion in late 1956. At the time of the staff study approximately fifteen and one half million dollars were available for the microwave and cable system. The total cost of the system was estimated to be about forty four million.

Tropospheric scatter was suggested in the study as being a technique which might bring the upper portion of the Pole Vault system into operation by late 1954, or two years previous to the date for microwave. Estimates made at that time indicated that a twelve channel tropospheric system would approximate five million dollars for the upper portion of the system. To expand the system to thirty-six channels the cost would be ten million. The big saving moneywise, as compared to microwave, was in the cost of construction: thirty-two million for the microwave system compared to two and one-half million for tropospheric scatter for the whole system.

The drastic savings in construction costs stem from the collocation of the tropospheric scatter buildings and the radar facility on the same site. With the reduction in the number of stations, the logistical support and personnel requirements were significantly reduced. In the Laborador-Newfoundland area these two factors are many times more vital economically than in the United States.

I should point out that the system proposed, that is tropospheric scatter, to replace microwave over the Pole Vault system was new and untried on an operational circuit. Experiments conducted by the National Bureau of Standards and by the Air Research and Development Command through Lincoln Laboratories and Bell Telephone Laboratories indicated that the *exact* degree of reliability and channel capacity could not be predicted accurately, but the concensus among the scientists was to the effect that reliable communication with minimum channel capacity could be expected. Further, the experimental data indicated that marginal propagation could be expected at times; but the data also indicated that high power and large antennas would compensate for the degradation of propagation. These large antennas and power amplifiers necessary to overcome the degradation of performance were not available and had to be developed, but this development was well within the state of the art. The use of tropospheric scatter offered advantages—operational as well as economic. We could have a system in being two years before a microwave system could be completed. The findings of the staff study pertaining to tropospheric were approved, and action was taken immediately to divert money from the microwave system to the development of the tropospheric scatter system. The result was the first operational tropospheric scatter system, installed by Bell Telephone Company of Canada—a reality in less than two years from the time the study was completed.

In Alaska the Army provides communications in areas of joint military and civil interest. While in the outlying areas the Air Force and CAA provide their own facilities. With expansion of the Air Defense Radar System in Alaska in 1951, the limited channel capacity of the Air Force system then in being was inadequate to provide the operational circuits necessary to support the expanded operation. Here again the rugged terrain and climate proved microwave or cable uneconomical and infeasible. In May 1954, as an indirect result of project Pole Vault, a study was submitted for the improvement and expansion of the Air Force circuits in Alaska using tropospheric scatter as the primary means for point-to-point communication. In December 1954, the Department of Defense approved a plan of implementation, and in January 1955, a contract was awarded to the Western Electric Company. The system was designed to serve all government and territorial agencies requirements for communication over the routes of the Air Defense circuits. An overload and future requirements capability of fifty percent was designed into the system. Contractual costs for equipment and installation are estimated at fifty-six million dollars; construction is estimated at forty-two and one-half million. The project, known as White Alice, is now underway and completion is scheduled in February 1958. White Alice comprises eight microwave links and twenty-three tropospheric scatter circuits.

The Air Force has recently tested an extreme range tropospheric scatter circuit in the Arctic, in this case a distance of 690 statute miles. This is the longest single hop attempted with tropospheric scatter for an operational circuit. The path loss tests just completed dictate that transmitter powers in the order of 50 KW and 120 foot paraboloids will be necessary for successful circuit operation. The frequency for this circuit is in the 400 megacycle range. Both space and polarization diversity will be used for the received signal.

## *Experiences and Techniques*

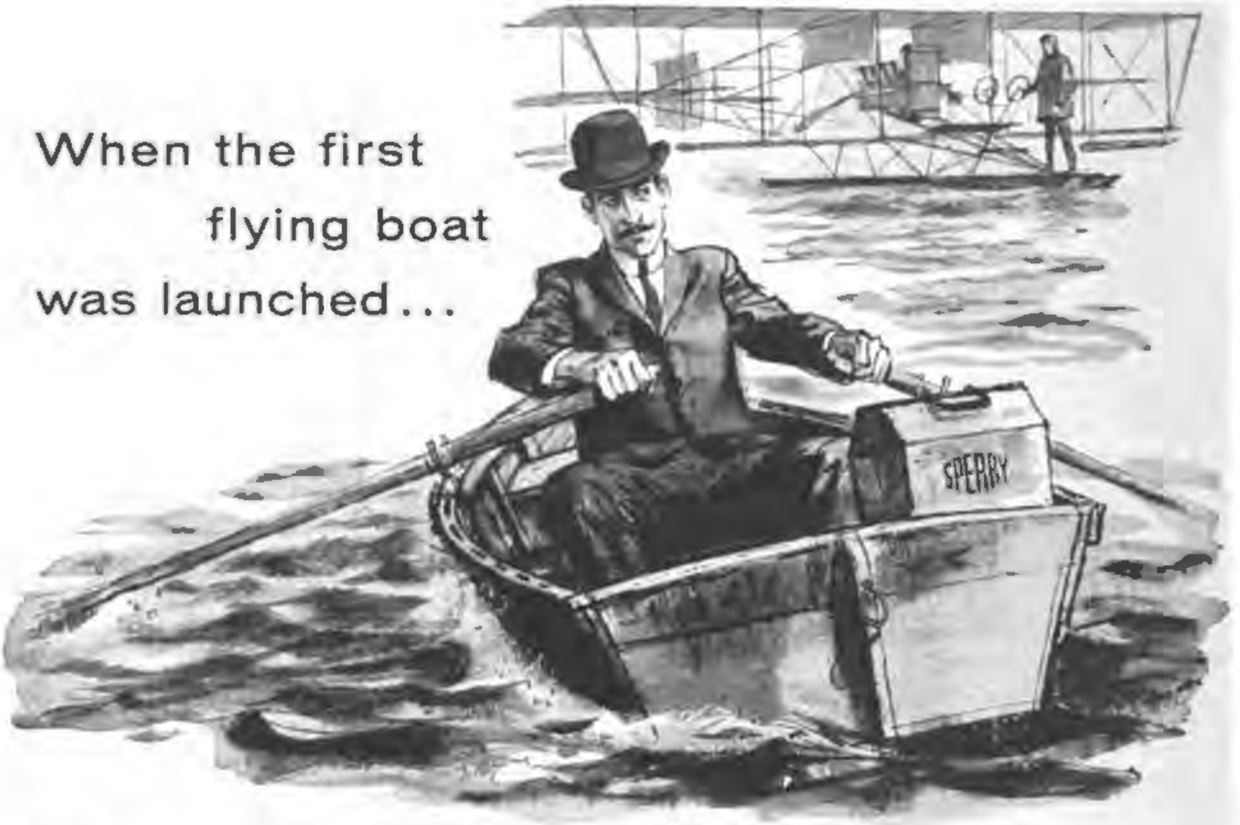
It is appropriate at this time to look at some of the experiences we have had as a result of operation of the circuits that have been mentioned thus far. First let us consider the ionospheric scatter mode of propagation. The Air Force originally bought the ionospheric scatter mode to increase communication reliability thru the northern auroral zone. High frequency and low frequency operation did not give the reliability required. In fact when both of these techniques were available between the same two points, the ionospheric scatter mode gave better performance than HF and LF combined. Another factor worth mentioning is that when HF and LF circuits deteriorated due to propagation, the scatter signal was enhanced by the same phenomenon which adversely affected the HF and LF circuits. As has been mentioned the high sun spot number has increased our outages due to propagation difficulties, but when the ionospheric scatter circuits operate above the maximum useable frequency for F-layer propagation the reliability figure remains good. The over-all performance figures for the Bitter Sweet system are lower than they should be because of the short link from Goose Bay to Loring, Maine. This path has now been lengthened and a significant increase in system performance is expected.

The scientists tell us that for operation in the ionospheric scatter mode we must stay above the maximum useable frequency for F-layer propagation. As the MUF goes up this means that we must operate at a higher frequency. But operation at a higher frequency requires more power and thus is more expensive. In order to remain in the ionospheric scatter mode it now appears that two frequency operation will be necessary. The Air Force is investigating the possibility of rapidly changing between a low and a high frequency using a transmitter modified for ionospheric scatter operation. We envision changing frequency on a push button basis, but this will depend on the results of our investigation.

When the decision was made to lengthen the path by moving the terminal from Loring to Wachusett Reservoir, an opportunity presented itself to incorporate some improvements as well as to test several new ideas. As an example, the length of the transmission lines and the amount of power transmitted through these lines led to the idea that some of the difficulty caused by off path reception may have been due to radiation from the line. Incorporated in the new installation is a coaxial transmission line and coaxial feeders, which replace the open wire transmission line and feeders. Beam splitting is provided in an attempt to reduce multipath reception. The beam is split remotely by rephasing some of the driven elements. The power in the main lobe is split into two lobes approximately 8 degrees on each side of the center of the normal beam. The idea behind this technique is that when delayed signals due to multipath are received when operating with the normal beam, a change in propagation path may alleviate

(*Continued on page* 45)

When the first
flying boat
was launched...



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the effect of multipath signals. Splitting the beam gives us this change in path. Another idea which has been incorporated should probably be considered a procedural rather than a technical change. At the Wachusett Terminal two transmitters are driving the antenna simultaneously. The two transmitters are normally considered one operating and one spare. But in this case both are operated at half power and both are on the line. In the event of failure of one transmitter the other continues to supply energy at the half power rate until the maintenance man boosts the power. Thus the circuit doesn't become inoperative due to equipment failure. This scheme permits a hot running spare and prolongs the life of the equipment because the units are loafing along most of the time.

## Improvements for Performance

The Air Force has had an antenna improvement program underway at the United Kingdom terminal for some time. Several deas have been advanced to improve the characteristics of the corner reflector antenna as far as side and back lobe radiation is concerned. As I have mentioned, shielding transmission lines and antenna feeders by replacing them with coaxial cable was one of he first improvements that was accomplished. Another idea had o do with providing greater shielding of the driven elements of he antenna; the reflector screen consists of horizontal wires which, it was believed, did not discriminate sufficiently against a back scattered signal which was randomly polarized and had a ignificant vertical component. In order to give protection against he vertical component as well as the horizontal, vertical wires were added to the screen. To afford greater shielding of the lements the ends of the corner reflector were closed in, and the lements themselves were moved closer to the corner. Moving the lements gave a one decibel loss but compensation in the form of greater freedom from back scatter was expected. What we really need is an antenna with no side or back lobes, but until such a ystem is designed which will be practical for our use we will ave to continue trying different schemes which may improve the haracteristics of existing antennas.

Due to the rapidity with which the ionospheric scatter circuits were implemented none of our transmitters is standard. By this we mean that the equipment has not been standardized for use by he Services. The equipments we are using are high frequency ransmitters which have been modified for ionospheric scatter peration. At the Wachusett terminal we have two transmitters which were designed and built for ionospheric scatter. The riginal circuits of the North Atlantic System used BC-779 and FSK-I receivers. At the present time the receivers and transmitter xciters are known as the FSK-II system. The teletype multiplex quipment has been the four channel AN/FGC-5. A sixteen hannel time division multiplex for teletype has been incorporated n the system from Wachusett to Thule on a service test basis. Operational traffic continues to be passed over the circuit during he tests. This equipment is identified as the AN/TCC-35. We ave recently set forth production specifications for the AN/FRC-5, a system which we believe incorporates the latest ideas for onospheric scatter transmission. These specifications are for roduction models and are designed as tentative standard at this me.

At the present time we have a capability of one voice and xteen teletype channels to Thule. The circuit to the United ingdom has the capability of one voice and four teletype hannels. Our goal is three voice and sixteen teletype over our onospheric scatter systems.

The performance of our tropospheric scatter circuits has been uite good—better than 99 per cent reliability. But due to the itical requirement for communications in support of the Air efense Mission, we are striving to improve this mode of comunication in an attempt to come as close to 100 per cent as ossible. The equipment used thus far for tropospheric scatter as been of commercial type. Specifications have been written r two standardized packages, one package could contain either one KW or ten KW transmitter, and the other a fifty KW transitter. The antennas used for this mode are paraboloids of one pe or another—either the dish, which may be twenty eight or xty feet in diameter, or the billboard, which may be sixty or ne hundred-twenty feet in effective diameter.

Tropospheric scatter has a channel capacity which usually epends upon the operational requirement. That is, by increasing e size of the antennas or the transmitter power, or both, the hannel capacity can be significantly increased. In general the ir Force circuits are designed for thirty-six or seventy-two voice hannels.

I have mentioned that rhombic antennas were originally used n our ionospheric scatter circuits. Now it appears that the rge corner reflector antennas probably give the best results for nospheric scatter. But in the process of searching for the best ntenna several types were tried. Probably the most remarkable of these is the large stacked yagi which was constructed at Goose Bay to receive the Narsarrsuak signal. This antenna is actually an array of four yagis with some sixty-two elements.

All receiving antennas are placed in space diversity to enhance the received signal. This does not mean that the two receiving antennas have necessarily the same configuration. At Thule for instance we are using two rhombics and a corner reflector of smaller dimensions than I've previously described to give triple space diversity.

In the design of tropospheric scatter systems, in addition to space diversity which has become standard in all installations, provision for polarization diversity is being considered more and more routine. Frequency diversity, although desirable in many cases, is usually ruled out due to the difficulty in obtaining additional frequencies.

We feel that scatter in both modes has a potential which has not been fully exploited at this time. The Air Force has contracts to study various phases of scatter which indicate that scatter can be used to a greater degree than we are using it today. We would like to use meteor trails as the scattering medium. The meteor scatter mode of propagation appears to offer a great degree of immunity to interception. It is probable that meteroic scattered signals would be difficult to jam. There exists a possibility that scatter communication can be used to extend the ground-air communication range. This possibility must be further investigated. The present concept of operation in the Air Force dictates that we must provide circuits which give an increase in capacity and versatility in the type of information which can be transmitted. In addition to our voice and teletype capability we would like to transmit computer data, weather facsimile and television over scatter circuits. We would also like our scatter circuits to be so reliable that error correction would not be required.

Some of the studies now underway in the meteoric scatter mode indicate that we may be able to use meteoric scatter and ionospheric scatter simultaneously on the same circuit in order to increase our traffic handling capability. Meteoric scatter mode offers a capability which is comparable to ionospheric scatter and requires less power in most applications. These factors may permit mobile meteoric scatter installations capable of thousand mile ranges, without the large antennas and critical siting requirements now necessary for ionospheric scatter installations. Tropospheric scatter lends itself quite readily to mobile installation. Our Tactical Air Force is quite interested in the application of mobile tropospheric scatter to meet their communications requirements.

## Men, Money and Mode

With the advent of new techniques of communication and the attendant change in equipment, we are faced with a problem which though it is always with us, takes on an even more serious aspect. The problem is that of training maintenance men. To increase our training capability we have a contractor technician at each scatter site who is responsible for training the airmen at the site as well as to perform maintenance on the equipment to keep it operating. To further enhance our training capability in the field of scatter, we are establishing formal courses of instruction in both the tropospheric and the ionospheric modes.

The added training problem is just one factor which we must consider when we figure the cost of operation of our scatter circuits. The North Atlantic system consisting of four links has cost about eight and one-half million dollars. Included in this cost is the initial test circuit from Goose Bay to Sondestrom and many modifications made subsequent to the initial installation. This cost figure represents the cost of engineering, installation, modification of transmitters, and cost of some equipment. The terminal at Wachusett, which we consider our most modern terminal, has cost about 1.2 million dollars, including buildings, power units, equipment and installation. If our reliability can be increased by the use of the scatter mode of propagation, we must use that mode of propagation even though the cost may be somewhat higher than other methods. If scatter techniques provide the means whereby radar early warning is reliably communicated from the DEW Line; or the means whereby strategic bombers can be re-routed to alternate targets and thus increase the effectiveness of our retaliatory effort, then I think that we would consider the money spent on improving our communication by the use of scatter had been well worth it. But in the Air Force concept of constant radar surveillance and a retaliatory bomber force in being, we cannot wait for these eventualities to occur. Our situation is such that we must investigate and exploit every new technique as it is discovered if by doing so we increase our capability in the communications area. But actually, in the Arctic the cost of scatter communication is lower than other methods capable of providing reliable communication; this is especially true of tropospheric scatter, as I've mentioned earlier.

*Editor's Note: This concludes the panel presentation on Scatter Propagation by representatives of the Department of Defense.*

# photoprogress

## by FRANK SMITH

**PHOTO EDITOR**
**SIGNAL**

Bell & Howell
8mm Motion
Picture Camera

### New Sun-Powered Automatic 8mm Motion Picture Camera by Bell & Howell

With a great many devices being sun-powered these days, such as telephones, radio sets, etc., it would be only natural that the same idea would sooner or later be applied to photographic equipment in some form or other. That this has been done is contained in a recent announcement by the Bell and Howell Co., 7100 McCormick Road, Chicago 45, Ill., who have harnessed solar energy to set the lens of a new automatic 8mm motion picture camera designated as the "Electric Eye." The new camera is said to be the first in the world in which solar energy alone supplies the power to generate the electric current which adjusts the lens. No batteries, motors or springs are used for the exposure setting. The current is transmitted directly from the photoelectric cell to a mechanism controlling the lens iris.

It is also said to be the world's first completely automatic motion picture camera in 8mm size. All the operator has to do is wind the camera, sight, and shoot. The electric eye, which adjusts to changing light faster than the human eye, sets the lens for proper exposure before the starting button is touched. It can operate the lens through its full range of stops from f/1.9 to f/16 in less than one second. This means that without knowing what an f/stop is, the novice can be sure of properly exposed film every time, a result not consistently achieved even by experts.

To make feasible the design approach of the electric eye, Bell and Howell engineers developed a new type of lens iris so sensitive that it moves at the touch of a human hair. Yet it is sturdy and shockproof and has withstood the most vigorous environmental and field tests.

Through the use of thermistors, the electric eye mechanism adjusts to temperature changes. The camera can be used at any temperature extremes the film itself will withstand.

Light reflected from the subject enters a reticular honeycomb lens which controls the angular coverage to match that of the camera lens. Upon reaching the photocell, the light generates an electric current which is fed to the meter mechanism. The meter computes the correct exposure and opens or closes the lens as required. Linked to the control mechanism is a needle pointer which moves back and forth along a visible scale, indicating the opening at which the lens is set. The scale is marked in f/stops of 1.9, 2.8, 4, 5.6, 8, 11 and 16. The camera can also be operated manually.

Features of the new camera include a 10
run with continuous run lock and single fram
a picture-window viewfinder which shows th
actual size, and Bell and Howell Super Comat
lens. It uses economical 8mm roll film. Wid
telephoto attachments are available as accesso

The camera is immediately available. Pric

### "Sylvatron" Image Producing Panel

The production of images on flat panels, by comb the sciences of lighting and electronics, has been announced by Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

The image producing panel, called "Sylvatron," combines the principles of electroluminescence and photo-conductance to produce images on flat panels. It is believed that the device will have important possibilities in development of radar, air traffic control, computers, and instrumentation.

Development of the panel is an outgrowth of "Panelescent" lighting which was introduced by Sylvania six years ago. The "Panelescent" lamp produces light by electroluminescence, or the production of light by direct excitation of certain phosphors in an electric field.

The new image-producing panels utilize not only this principle of electroluminescence, but also the principle of photo-conductance, which is the influence of light on the flow of electricity through a solid.

The device consists of flat glass electroluminescent panels with various control layers. These control layers are thin coatings of photo-conductive and electro-conductive surfaces.

When electrical or optical signals and a power source are applied to the panel, a visual display, or image, is produced.

Three types of panels, which produce different images have been developed. They include: an electroluminescent panel on which the position of a mobile dot of light can be manipulated electrically; a display panel which reproduces optically the track of a mobile spot of light. The image thus created can then be held or "stored" indefinitely in visible form on the panel; an electroluminescent panel which can reproduce optically a motion picture with good resolution and rapid response.

The device to date has been produced in the laboratory in two-inch and four-inch squares. Larger units are now

(*Continued on page* 48)

*TACAN unit shown with covers removed; plane is a composite model.*

tube

# 78-~~page~~ road map for jets

An 800-foot carrier may be as hard to find as a needle in a haystack, when the plane seeking it is at 20,000 feet and the time is 0200 hours.

To make the homing plane a homing pigeon, we build the "ARN-21" TACAN equipment illustrated above. Its 78 tubes and associated components add up to a self-contained transmitter and receiver, rugged in its ride-resistance and accurate to pin-point tolerances.

The manufacture of equipment as important and complicated as this demands *perfection,* and nothing less. On the military as well as the home front, Stromberg-Carlson has long displayed the ability to take such problems in stride.

S-C

**STROMBERG-CARLSON**

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

GD

being developed for certain military applications. The only limitation in size is the size of the production machinery itself.

While the device is considered to be still in the laboratory stage, it is considered to be advanced enough for application development by electronics and defense laboratories and for such application development under military contracts.

One item alone which is sure to excite considerable interest in the motion picture field is a statement by the company that two of the three types of panels can be combined to form a fourth type which could electronically (as opposed to optically) reproduce motion pictures!

## Bureau of Mines Safe Photoflash Unit

A new era in coal mine photography has been opened by the Bureau of Mines, Department of the Interior, with the announcement that it has developed the first safe photoflash unit for underground use. The unit (shown above) can be used anywhere in a coal mine without igniting coal dust or the explosive gas, methane.

The unit is essentially a 7-7/16 inch diameter reflector and socket which will accomodate flash bulbs up to and including the size"50," in an explosion-proof aluminum housing. Its over-all dimensions are 8⅝ inches in diameter and 5⅝ inches deep and weighs 12 pounds. It is so designed that the bulb can be safely inserted in the presence of explosive atmospheres.

The flash bulb can be triggered by the contacts in a camera or by a photo-electric cell mounted on top of the unit, in which case it serves as a slave unit.

The energy in the cord between the photo-electric cell and the bulb circuit inside the lamp housing is below the value at which it is possible to get an incentive spark.

The energy for setting off the flash bulb is supplied by a condenser discharge. The components for this circuit are all enclosed within the explosion-proof housing behind the reflector.

The unit features a foolproof arrangement which permits bulbs to be removed quickly and safely. Flash bulbs are changed merely by removing the socket base, since no wires are attached. An electrical interlock makes the internal circuit dead when the base is unscrewed less than one turn.

Development of the photoflash unit followed the perfection last October by the Bureau of an approved floodlight for use in coal mining motion picture photography. Commercial firms are free to manufacture the photoflash units without license. Persons interested in further detail of both units should write the Branch of Electrical Mechanical Testing, Bureau of Mines, 4800 Forbes Street Pittsburgh 13, Pa.

## High-Speed Photography

As stated before in this column, the reviewing of book is generally left to our book department, but occasionally an unusual book covering some phase of photography i received which practically dictates that it be reviewed i this column. Such a book is the one entitled *Third Inter national Congress on High-Speed Photography,* just re ceived from the publishers, Academic Press, 111 Fift Ave., New York 3, N. Y. This beautiful volume is edite by R. B. Collins and consists of 417 pages of the pro ceedings and discussions of the above congress whic were held in London in 1956.

All papers submitted for presentation at the congre were considered by an editorial panel, who, as far a possible, accepted only reports of new work and a matically rejected any material which had been publish elsewhere. This strict editorial policy has meant th the papers published in these proceedings are of a hig standard, describing techniques and applications n otherwise available in published literature.

As an indication of the extensive coverage of this v ume, one has but to scan through the various sectio into which it is divided and which total 16 in all. Title of some of these sections are as follows: "Flash Lig Sources" (I and II); "Image-Splitting and Image-Sa pling Techniques;" "Inertialess Shutters;" "Applicatio to Ballistics and Explosives;" "Photographic Materials;" "X-Rays;" "Film Evaluation;" "Schlieren and Interfero metric Techniques;" "Rotating Mirror Cameras;" "Me dium Repetition Rate Cameras;" "Application to Aero dynamics," and "Application to Hydrodynamics." Som 60 papers are included under these headings coverin practically everything that is new in the way of tech niques, materials and processes in the field of high-speed photography.

The book is well written and contains 243 excellent illustrations which form a fitting accompaniment to the text. Priced at a modest $13.00, the volume is a "must" for anyone interested in high-speed photography.

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While we are on the subject of photographic literature, your attention is called to a volume of 35 pages entitled *Bibliography on High-Speed Photography* compiled by Elsie L. Garvin, Librarian, Research Library, Eastman Kodak Co., Rochester, N. Y.

According to an announcement in the bibliography, the material up through 1953 was originally compiled by Elsie L. Garvin and classified by John H. Waddell, Chairman of the High-Speed Photography Committee of the Society of Motion Picture and Television Engineers. It was published in two installments in the Journal of Motion Picture and Television Engineers, 56: 93-111, January 1951, and 61: 749-757, December 1953. References through December 1955 have been added and classified, as in earlier publications, under the following headings:

(1) General; (2) Cameras; (3) Lighting; (4) Oscillograph Photography; (5) Schlieren Photography; (6) Technical and Techniques and (7) X-Ray.

(*Continued on page* 50)

# FRONT-LINE STORY

**Seen and heard at Command Post by means of world's smallest TV and Radio Communication facilities**

**Transistorized radio receiver transmitter completely concealed in helmet has up to 5-mile range.**

**"Telemite," smallest TV camera, features newly developed RCA ½-inch Vidicon tube, size 1⅞" x 2⅜" x 4¾", weighs about one pound.**

The soldier you see carries the new RCA one-pound, postcard-size ultra-miniaturized TV camera connected to a miniature TV transmitter on his back. Concealed in his helmet is a complete radio receiving-transmitting set weighing only a few ounces. He is one of several similarly equipped men covering the battle area from a number of positions in the air and on the ground.

At the command post the troop commander *SEES* enemy movements on television screens and *HEARS* first-hand reports. Their resulting immediate control of the situation is based upon accurate, instantaneous first-hand knowledge.

In achieving this miracle of miniaturization, through the use of transistors, printed circuits and the latest electronic technology, RCA has again made a major contribution to the industry and all our armed services.

DEFENSE ELECTRONIC PRODUCTS

**RADIO CORPORATION of AMERICA**

CAMDEN, N. J.

Tmk(s) ®

This little volume provides a convenient reference to a vast amount of knowledge accumulated over the years about high-speed photography and its application in many, many branches of science and engineering. It forms a fitting companion to the one reviewed above and is recommended for anyone interested in the subject.

## Fast Photography—15,000,000 Pictures Per Second!

Although details of the 15,000,000 frame per second camera of the Los Alamos Scientific Laboratory of Los Alamos, New Mexico, are well known to most specialists in the field of high-speed photography, it is thought that these details would also be of interest to non-specialists who may not be familiar with this camera.

This camera, which was developed by the staff of the laboratory has been considerably improved since the first model 6 was announced by Mr. Berlyn Brixner of the laboratory staff in October 1952 at a meeting of the Society of Motion Picture and Television Engineers in Washington, D. C.

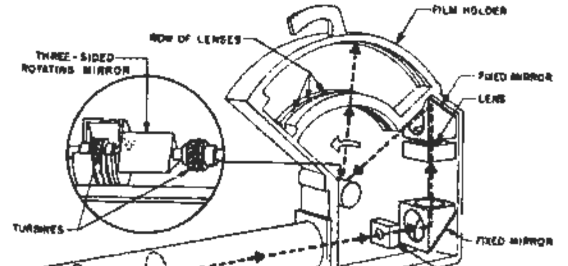
The improved version, known as model 8 and believed to be the fastest of its kind ever constructed, takes motion pictures of explosive phenomena and other high-speed actions at the remarkable rate of 15,000,000 frames per second, and will take up to 96 consecutive pictures of a single event.

In order to increase the speed from 3,500,000 to 15,000,000 frames per second, the three-sided mirror in the new model 8 camera has now been made to revolve 23,000 times per second (1,380,000 times a minute).

The mirror is made of special steel having a tensile strength of over 300,000 pounds per square inch; this great strength is needed because of the tremendous forces tending to explode the rapidly revolving mirror. The mirror spins in a helium atmosphere on oil pressure lubricated bearings and is powered by a small helium-driven turbine.

The shutter system is another novel feature of the high-speed, rotating-mirror camera. Since the entire strip of film is exposed in about 1/150,000th of a second, no mechanical shutter could be devised to close fast enough to prevent the reflected beam from sweeping across the film a second time and double-exposing the film. Brixner and his staff arranged an electric detonator to shatter a glass block in the light path, the shattered block being opaque enough to bar the light until a mechanical shutter can close.

The improved camera's speed of 15,000,000 frames per second is illustrated by the fact that a beam of light, traveling across the field of view at 186,300 miles per second, moves only a little over 65 feet in the interval between one picture and the next.



A schematic diagram of the Los Alamos Model 8 15,000,000 frame-per-second camera, showing the path of light rays.

Although the new model 8 camera is [illegible] cast aluminum frame to withstand s[illegible] light enough to be easily carried. Desp[illegible] speed, it is simple enough to be operate[illegible]

The light from the explosions photo[illegible] camera is so brilliant that the optical s[illegible] slow as f/25 to f/100. The film used [illegible] speed 35mm film, and is not "souped up.[illegible]"

In the case of a non-luminous even[illegible] graphed, the necessary light is furnishe[illegible] source. An explosion shock front trave[illegible] gon gas is sometimes used as such a sec[illegible] light; the argon atoms give off an in[illegible] excited by the shock front.

One more item of interest: Operating [illegible] the new camera makes pictures at 625,0[illegible] used for standard motion picture theate[illegible]

## Thermography—Photography in th[illegible]

An entirely new concept in infra-r[illegible] called "Thermography" has been annou[illegible] nes Engineering Company, 30 Commer[illegible] ford, Conn.

Briefly, "thermography," or the reco[illegible] red radiation, is done by a device kno[illegible] Therm imaging attachment, which is es[illegible] bination scanner and photographic recor[illegible] the detector field of a radiometer over [illegible] simultaneously produces a photographic [illegible] or "thermograph" of the scene. Variatio[illegible] the photograph correspond to the radian[illegible] perature of the object being scanned.

A large plane scanning mirror in fron[illegible] meter scans a 10-degree horizontal by 10-[illegible] field. The radiometer is stationary and "l[illegible] plane scanning mirror; thus the radiation[illegible] on its axis at all times. A cam drive causes [illegible] oscillate horizontally to scan a line 10 deg[illegible] each extremity of this scan, the mirror is [illegible] tically by another cam through an angle [illegible] height of the detector field of view. This c[illegible] 10 vertical degrees are covered.

A small mirror mounted on the back of the [illegible] ning mirror deflects a spot of light from [illegible] modulated glow tube onto Polaroid Land film. [illegible] mirror is rigidly fixed to the large scanning [illegible] light spot traces out a raster on the film whic[illegible] the same as the radiometer scan pattern. Th[illegible] output signal from the radiometer is used t[illegible] the intensity of the glow tube. Thus while the [illegible] being scanned, a "thermal" image of the scene [illegible] simultaneously produced on the film.

The OptiTherm scanning attachment is useful [illegible] any application where a two-dimensional radiance or temperature distribution is required, i.e., a thermal contour map of an object or scene. For example, it could be used to obtain the temperature distribution over the surface of an airfoil in a wind tunnel or over chemical reaction equipment, such as a cracking tower. Another class of application is to the study of background radiation and radiation from military targets such as tanks and aircraft.

The imaging attachment may be mounted quickly and easily in front of the radiometer, and all electrical connections required are readily made to existing receptacle on the radiometer amplifiers. A 10-degree by 10-degree field of view is formed on Polaroid Land film, or standard cut film, in as little as 30 seconds. Temperature differences of 0.2 degree C are easily detectable at maximum sensitivity.

# Association affairs

## Honor Graduate Awards

The Armed Forces Communications and Electronics Association Award for outstanding scholastic achievement was recently presented to honor graduates at the Signal School, Fort Monmouth, N. J.

Eleven of the honored officers were enrolled in the Signal Officers Basic Course which is designed to give a working knowledge of the duties and responsibilities which the newly commissioned officers may expect during their early service with the Signal Corps.

Highest percentiles in the basic course were held by the following:

Section 740—Second Lieutenant Richard N. Bazinet of Lyons Hill Road, Athol, Mass., is a graduate of Worcester Polytechnic Institute, and majored in E.E.

Section 741—Second Lieutenant Glenn W. Long of 805 Third Avenue, Selma, Ala., who studied industrial management, is a graduate of Alabama Polytechnic Institute.

Section 742—Second Lieutenant William T. McKay of Clough Hill Road, RFD #8, Concord, New Hampshire, is an E.E. graduate from Northeastern University.

Section 743—Top honors went to Second Lieutenant Robert A. Weaver, Jr., of 86 Parker Road, Osterville, Mass.

Section 744—Second Lieutenant Benny B. Barnes, of 105 Brentwood Dr., Rt. 6, Gadsden, Ala., is a graduate of Alabama Polytechnic Institute and majored in E.E.

Section 745 — Second Lieutenant Joe R. Tucker, of Rt. 1, Weatherford, Texas, studied M.E. at the Texas A & M College.

Section 746 — Second Lieutenant Ernest E. Tabor, of Box 395, Delbarton, West Va., took top honors.

Section 747 — Second Lieutenant Chester H. Walters, of 2637 Jackson Street, Ashland, Ky., was a major in M.E. at the University of Kentucky.

Section 748 — Second Lieutenant Robert B. Phillips, of 1685 Highland Avenue, Vero Beach, Fla., majored in E.E. at Tennessee Polytechnic Institute.

Section 749 — Second Lieutenant Jerry C. Russell, of 1303 East Second Street, Indianola, Iowa, studied E.E. at Iowa State College.

Section 750 — Second Lieutenant James C. Lake, 4333 Fairview Avenue, Downers Grove, Ill., is a graduate of Purdue University where he majored in E.E.

In the Radar Maintenance and Repair Officer Course, Section 4018, Second Lieutenant Lawrence C. Seybold, of 215 State St., New Orleans, La., who is a graduate of Tulane University, scored highest academically. This course is designed to train officers to supervise the maintenance and repair of radar and counter measures equipment.

First Lieutenant Bill C. Powell of 2321 13th St., Lubbock, Tex., a graduate of Texas Technological College, took high honors academically in the Electronic Warfare Officer Course. The purpose of the course is to train officers to direct and supervise electronic counter measures activities.

## Introducing AFCEA's New Group Member

The AFCEA welcomed Union Carbide Corp., of New York City, N. Y., as a group member in August. Union Carhide is a long established firm in the New York area and deals primarily in chemicals, plastics, metals, alloys and batteries.

The members of the firm who will be company representatives in AFCEA are: H. H. Bahcock, Assistant Secretary-Treasurer; F. S. Badger, Vice President, Haynes Stellite Co., Kocomo, Indiana; M. H. Barnes, Associate Manager of Research, Linde Co., Speedway Laboratories, Indianapolis, Indiana; W. J. Canavan, Assistant Manager, Product and Process Department; L. M. Currie, Vice President, U. C. Nuclear Co.; R. L. Glover, Assistant to Vice President, National Carbon Co.; R. M. Joslin, Manager, Fine Chemicals Division, U. C. Chemicals Co.; L. J. Sinnott, General Sales Manager, Silicones Division; H. R. Spendelow, Jr., Manager, Patents and Licenses, Electro-Metal Co.; C. O. Strother, Assistant Manager, Physical Chemical Research Administration.

# ROTC AWARDS—1957

*The Association takes great pleasure in announcing the names of the winners of the Armed Forces Communications and Electronics Association Gold Medal Honor Awards. These medals are awarded annually to outstanding senior Army ROTC, Navy ROTC, and Air Force ROTC students majoring in Electrical Engineering. Selection is made by the Military Staff and the Dean of Engineering of the respective university or college. Some of the criteria for selection include proficiency in education and leadership, moral character, and participation in recognized campus activities—all to a high degree.*

*In addition to the Gold Medal, the award includes a certificate, a year's membership in AFCEA, and a subscription to SIGNAL Magazine, the official journal of the Association.*

**& M College of Texas**
Bobby R. Ammer, *Army*
Warren B. Johnson, *Air Force*
**& T College of North Carolina**
Jesse J. Bass, *Air Force*
**abama Polytechnic Institute**
Robert C. Haley, *Army*
Harry O. Lindstrom, Jr., *Navy*
**righam Young University**
Horce D. Crandall, *Air Force*
**alifornia Institute of Technology**
James N. Giles, *Air Force*
**arnegie Institute of Technology**
Richard G. Abraham, *Army*
Alvin H. Boerio, *Army* (jr.)
Ivan E. Sutherland, *Army* (soph.)
**ase Institute of Technology**
Roy A. Wells, Jr., *Air Force*
**atholic University of America**
E. Joseph Thompson, *Air Force*
**he Citadel**
William I. Brownfield, *Army*
Robert C. Fleming, Jr., *Air Force*
**The City College of New York**
Eli Glazer, *Army*
**larkson College of Technology**
Robert A. Wood, *Army*
**Clemson Agricultural College**
Homer B. Goff, Jr., *Army*
John H. Turner, Jr., *Air Force*
**Colorado State University**
Jack D. Gaskill, *Air Force*
**Columbia University**
Philip T. Mahoney, *Navy*
**Cornell University**
Army winner not reported
Raymond W. Sears, *Navy*
**Dartmouth College**
James J. Ventura, *Army*
Richard D. Bughee, *Navy*
**Drexel Institute of Technology**
Werner T. Ullrich, *Army*
**Duke University**
John D. Peyton, *Air Force*
Navy winner not reported
**George Washington University**
Charles M. Hunter, IV, *Air Force*
**Georgia Institute of Technology**
Frank B. Cole, *Army*
Harry A. Ecker, *Air Force*
Donald C. Brown, *Navy*
**Illinois Institute of Technology**
David S. Hall, *Navy*
**Iowa State College of A&MA**
William J. Ackerman, *Army*
Earl F. Augspurger, Jr., *Air Force*
**Johns Hopkins University**
William A. Teso, *Army*
**Kansas State College**
Richard W. Wilson, *Army*
Jerome J. Ewald, *Air Force*

**Lafayette College**
Army winner not reported
**Lehigh University**
Richard H. Simpson, *Army*
**Louisiana Polytechnic Institute**
Air Force winner not reported
**Louisiana State University**
Irvin T. Strenge, Jr., *Army*
Air Force winner not reported
**Manhattan College**
Donald F. Metz, *Air Force*
**Marquette University**
Terrence R. Scott, *Army*
Richard A. Shantz, *Navy*
**Massachusetts Institute of Technology**
Richard D. Smallwood, *Air Force*
**Michigan College of Mining and Technology**
Irwin Feldman, *Air Force*
**Michigan State University**
Gordon R. Morin, *Air Force*
**Mississippi State College**
Donald E. Meiners, *Army*
Thomas J. Williams, *Air Force*
**Montana State College**
Army winner not reported
Dennis L. DuVall, *Air Force*
**New Mexico College of A&MA**
Thurlow Caffey, *Army*
Donald C. Wunsch, *Air Force*
**Newark College of Engineering**
Frederick M. Stumpf, *Air Force*
**New York University**
John P. Gsell, *Army*
**North Carolina State College of A&E**
Louis R. Ledbetter, *Army*
Ashley G. Leggett, Jr., *Air Force*
**North Dakota Agricultural College**
Air Force winner not reported
**Northeastern University**
John S. Tuck, *Army*
Neal W. Atkinson, *Army* (jr.)
John E. Radcliffe, Jr., *Army* (soph.)
**Northwestern University**
Air Force winner not reported
**Norwich University**
Richard E. Campbell, *Army*
**Ohio University**
Theodore C. Fisher, *Army*
Jerry F. Thompson, *Air Force*
**Oklahoma State University**
Keith O. Eaton, *Army*
Keith C. Moumblow, *Air Force*
**Oregon State College**
William F. Ettlich, *Army*
**Pennsylvania Military College**
Edward J. Glanfield, *Army*
**Pennsylvania State University**
Army winner not reported
Thomas D. Quinn, *Air Force*

**Polytechnic Institute of Brooklyn**
John J. Schultz, *Army*
**Pratt Institute**
Ronald M. Danno, *Army*
**Princeton University**
Spencer O. Chagnon, *Navy*
**Purdue University**
Richard C. Havens, *Army*
William M. Newport, *Air Force*
James W. Cave, *Navy*
**Rensselaer Polytechnic Institute**
Clement A. Skalski, *Army*
Arthur M. Bennett, *Air Force*
William R. Sutherland, *Navy*
**Rose Polytechnic Institute**
Robert L. Overpeck, *Army*
**Rutgers University**
Orville LaMaire, *Army*
Richard J. Gowen, *Air Force*
**Seattle University**
Thomas I. Eisiminger, *Army*
**South Carolina State College**
Army winner not reported
**South Dakota School of Mines & Technology**
Gerald M. Munson, *Army*
**South Dakota State College of A&MA**
Air Force winner not reported
**Southern Methodist University**
John E. Davis, *Air Force*
**Southwestern Louisiana Institute**
Richard D. Daigle, *Air Force*
**Stanford University**
Stanley C. Fralick, *Air Force*
Alan J. Keller, *Navy*
**State College of Washington**
Glen G. Langdon, Jr., *Army*
**Syracuse University**
Arthur J. Heidrich, *Air Force*
**Tennessee Polytechnic Institute**
Charles B. Jett, *Army*
**Texas College of Arts and Industries**
Army winner not reported
**Texas Technological College**
Lewis F. Sitterly, *Air Force*
**Tufts College**
Richard A. Northrup, *Air Force*
Charles F. Price, *Navy*
**Tulane University of Louisiana**
Leon M. White, *Air Force*
Fred A. Wulff, III, *Navy*
**Tuskegee Institute**
John B. Ginwright, *Air Force*
**Union College**
Donald E. Mack, *Air Force*
**University of Akron**
Allan R. Thomas, *Air Force*
**University of Alabama**
William R. Bowen, *Army*
**University of Arizona**
Air Force winner not reported

- **University of Arkansas**
  - Heyden Z. Lewis, *Army*
  - James N. Holt, *Air Force*
- **University of Buffalo**
  - Wayne L. Fischer, *Air Force*
- **University of California (Berkeley)**
  - John P. Loughboro, *Army*
  - Allen C. Slutman, *Navy*
- **University of California (L. A.)**
  - Air Force winner not reported
  - William W. Novak, II, *Navy*
- **University of Cincinnati**
  - Carlisle M. Stickley, *Air Force*
- **University of Colorado**
  - Robert W. Prior, *Army*
  - John S. Brown, *Air Force*
  - George E. Howell, *Navy*
- **University of Connecticut**
  - Joseph J. Haloburdo, *Army*
  - Gerald L. Hoefler, *Air Force*
- **University of Delaware**
  - Leo A. Freeman, *Army*
- **University of Denver**
  - Richard W. Herter, *Army*
- **University of Detroit**
  - Army winner not reported
- **University of Florida**
  - John S. Pohl, *Army*
  - Walter G. Frederickson, *Air Force*
- **University of Idaho**
  - Warren J. Seyfert, *Army*
  - Peter J. McConnell, *Navy*
- **University of Illinois**
  - William E. Bicknell, *Army*
  - Earl L. Heacock, *Air Force*
  - Robert L. Haymaker, *Navy*
- **University of Kansas**
  - Ned Joslin, *Army*
  - Paul E. Peters, *Air Force*
- **University of Kentucky**
  - Henry T. Jaggers, *Army*
  - Elmo C. Matthews, *Air Force*
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  - Don R. Winner, *Navy*
- **University of Maryland**
  - Charles G. Pettit, IV, *Air Force*
- **University of Massachusetts**
  - Donald G. Fugere, *Army*
  - William E. Carroll, Jr., *Air Force*
- **University of Miami**
  - Stuart H. Sanfield, *Air Force*
- **University of Michigan**
  - David E. Thouin, *Navy*
- **University of Minnesota**
  - Duane P. Robertus, *Army*
- **University of Missouri**
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- **University of New Hampshire**
  - Lawrence R. Maloney, Jr., *Air Force*
- **University of Notre Dame**
  - James S. Rice, *Army*
  - Nunzio J. Lizzio, *Air Force*
  - William F. Reeve, *Navy*
- **University of Oklahoma**
  - Donald E. Wheatley, *Army*
- **University of Pennsylvania**
  - Air Force winner not reported
  - Gary H. Rush, *Navy*
- **University of Pittsburgh**
  - Frederick E. Symons, *Army*
  - James D. Anderson, *Air Force*
- **University of Rhode Island**
  - Richard E. Mosher, *Army*
- **University of Santa Clara**
  - Richard P. Dolan, *Army*
- **University of South Carolina**
  - Edward C. Prettyman, *Navy*
- **University of Tennessee**
  - Air Force winner not reported
- **University of Texas**
  - Mitchell L. Martin, *Air Force*
  - James D. Browning, *Navy*
- **University of Toledo**
  - Donald H. Saunders, *Army*
- **University of Utah**
  - Gordon T. Longerbeam, *Navy*
- **University of Vermont**
  - Frederick S. Cramer, *Air Force*
- **University of Virginia**
  - Frederick J. Aichelmann, Jr., *Army*
  - Paul R. Little, *Navy*
- **University of Washington**
  - Carl R. Powers, *Army*
  - Paul M. Mettret, *Navy*
- **University of Wisconsin**
  - Robert E. Suelflow, *Army*
- **University of Wyoming**
  - Charles P. McAlister, *Army*
  - Thomas E. Osborne, *Air Force*
- **Vanderbilt University**
  - Kenneth W. Madden, *Army*
  - Henry Beatty, III, *Navy*
- **Villanova University**
  - John M. Husted, *Navy*
- **Virginia Military Institute**
  - Milton I. Hargrave, Jr., *Army*
  - James C. Kyle, Jr., *Air Force*
- **Virginia Polytechnic Institute**
  - William L. Coburn, *Army*
  - William D. Ballard, Jr., *Air Force*
- **Washington University**
  - Robert G. Dietrich, *Army*
  - Paul E. Glaab, *Air Force*
- **West Virginia University**
  - Richard L. Miller, *Army*
  - Joe N. Nay, *Air Force*
- **Worcester Polytechnic Institute**
  - Richard G. Bedard, *Army*
- **Youngstown University**
  - Robert J. Mazur, *Army*

***Pictured on the opposite page are some of the ROTC award winners. They are, reading from top to bottom and left to right:***

***Top Row, Army***

- ***Homer B. Goff, Jr.***
  ***Clemson Agricultural College***
- ***Clement A. Skalski***
  ***Rensselaer Polytechnic Institute***
- ***John P. Gsell***
  ***New York University***
- ***John W. Gray***
  ***University of Nebraska***

***Second Row, Army***

- ***Richard G. Abraham***
- ***Alvin H. Boerio***
- ***Ivan E. Sutherland***
  ***Carnegie Institute of Technology***
- ***William I. Brownfield***
  ***The Citadel***
- ***Richard L. Miller***
  ***West Virginia University***

***Third Row, Navy***

- ***Fred A. Wulff, III***
  ***Tulane University of Louisiana***
- ***Philip T. Mahoney***
  ***Columbia University***
- ***Nunzio J. Lizzio***
  ***University of Notre Dame***
- ***Duane P. Rubertus***
  ***University of Minnesota***

***Fourth Row, Air Force***

- ***Arthur M. Bennett***
  ***Rensselaer Polytechnic Institute***
- ***John D. Peyton***
  ***Duke University***
- ***John B. Ginwright***
  ***Tuskegee Institute***

***Fifth Row, Air Force***

- ***Charles G. Pettit, IV***
  ***University of Maryland***
- ***Jerome J. Ewald***
  ***Kansas State College***
- ***Earl F. Augspurger, Jr.***
  ***Iowa State College of A & MA***
- ***Mitchell L. Martin***
  ***University of Texas***

FORT GORDON, GEORGIA—Brigadier General Kenneth F. Zitzman (left), representing the Office of the Chief Signal Officer, USA, presents the Armed Forces Communications and Electronics Association Award to newly appointed Second Lieutenant John S. Tuck, of Dedham, Massachusetts. The award was made to Lieutenant Tuck as the outstanding cadet of the 1957 Army Signal Corps ROTC Camp, held at Fort Gordon. The cadet, an honor graduate of Northeastern University's College of Engineering, previously served in the Army as an enlisted man, reaching the rank of sergeant. He was commissioned at the ceremonies, following General Zitzman's address to the cadets on their responsibilities as future officers.

It is significant to note that Lieutenant Tuck was also the winner of the AFCEA Gold Medal Honor Award at Northeastern University as being an outstanding senior ROTC cadet majoring in electrical engineering.

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## Communications—Electronics—Photography

*Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By this membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.*

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American Cable & Radio Corp.
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E. H. RIETZKE, President, CREI
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• *One of a series of institutional messages.*

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**1. WHO ACCREDITS THE CURRICULA OF TOP TECHNICAL INSTITUTES?** Capitol Radio Engineering Institute curricula have been accredited for a number of years by Engineers' Council for Professional Development, the nationally recognized organization for the accreditation of the curricula of engineering colleges and technical institutes. CREI is a founder member of the National Council of Technical schools which first established strict educational and ethical standards for this important area of technical education. CREI is listed in the U. S. Office of Education Directory, "Higher Education". CREI is authorized by the District of Columbia Board of Education to grant the Degree of Associate in Applied Science.

**2. WHAT KIND OF PERSONNEL DO WE TRAIN?** Our Institute trains sound, *practical* supporting engineering personnel. This is especially important in view of the growing trend in engineering colleges toward less and less specialization. Their major emphasis is on turning out broadly educated men qualified for basic research assignments. Both are essential and in short supply.

**3. ARE TECHNICAL INSTITUTE GRADUATES "TECHNICIANS" OR "PRACTICAL ENGINEERS?"** CREI does not claim to turn out "Engineers" in the accepted professional meaning of the term. However, the term "Technician", as very often used in the field and as customarily applied to graduates of technical institutes, in our opinion is not an adequate designation for our graduates. In fact, graduates of CREI start in practical engineering capacities and at average salaries generally comparable to those of engineering college graduates.

**4. WHERE ARE TECHNICAL INSTITUTE GRADUATES QUALIFIED TO START?** CREI graduates are qualified to start, and do start in industry, in a supporting engineering capacity, in production, design or testing, alongside of graduates of engineering colleges. While the latter may ultimately be of maximum value in research assignments, the technical institute graduate will generally find his most useful role as project engineer, design engineer or field engineer.

**5. WHAT IS THE CURRICULUM LEVEL OF OUR TECHNICAL INSTITUTE?** It is of college level, and is highly practical in the applications of mathematics and theory with relation to the practical problems encountered in industry.

**6. HOW LONG IS THE COURSE OF INSTRUCTION?** At CREI three collegiate years are condensed into an average of 28 months. Students attend classes 35 hours per week, 48 weeks per year. All of this time is devoted to practical engineering subjects. Strictly liberal arts subjects are minimized.

**7. WHAT ARE THE QUALIFICATIONS FOR ENTRANCE?** Students must be graduates of high school, or the real equivalent (to be determined by proper examination) with adequate preparation in mathematics and science. As a matter of fact, at the CREI residence school, students are accepted only through strict aptitude tests. More than half the applicants are rejected by these tests.

**8. WHAT DOES OUR TECHNICAL INSTITUTE OFFER TO STUDENTS?** We offer an educational program which will equip them in a minimum of time, for happy professional lives in rapidly growing industry, where advancement will be limited only by their own ambition and willingness to work.

**9. WHAT DOES OUR TECHNICAL INSTITUTE OFFER TO EMPLOYERS?** To employers interested in hiring men who have a sound background in practical engineering and who "can get the job done", we invite you to join the long list of the nation's leading firms who regularly look to us for new technical talent.

You can do a service to your industry, your company, and technically inclined young men, by understanding this type of educational program and recommending it to interested, qualified personnel. We will gladly furnish complete information upon your request.

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**Lightweight, ground-based, air-transportable tracking antenna pedestal for mounting 8-ft. diameter, s-band segmented parabolic reflector and nutating scanner; highly accurate 2-speed data systems in elevation and azimuth.**

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Airborne reflector mounting and drive unit for x-band antenna; 2-speed, continuous rotation in azimuth, either direction; 40° and 60° sector scans; remote manual tilt; line of sight stabilization.

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# Chapter News

## *Baltimore*

A tour of the U. S. Coast Guard Yard was the feature of the April meeting. Hosts to the chapter were Capt. V. E. Day, Commandant of the Coast Guard Yard, and Lt. Cdr. Joseph G. Bastow, a vice president of the chapter.

The highlight of the tour was an inspection trip aboard the 125-foot experimental boat, the cutter "Cuyahoga," which is used for radio and radar testing programs in the Chesapeake Bay.

Other points of interest were: a light tunnel where tests are made on flashers, timers and other controls used in the operation of beacon lights; a new Ozalid machine; a prototype of an unattended and automatic lighthouse which operates navigational lights and fog horns; testing areas for various types of foreign-made fog horns and for paints; lamp changers which will place a new lamp into burning position in the event of a lamp failure, and batteries for use on shore beacon lights.

On May 16th, the chapter commemorated the occasion of the tenth anniversary of the Marine Corps Battalion in Baltimore. A dinner-meeting at the Park Plaza Hotel was addressed by Maj. Gen. Edward W. Snedeker, USMC, Assistant Chief of Staff G-3. Other distinguished guests were: Brig. Gen. James P. S. Devereaux, USMC (Ret.); Maj. Gen. F. McAllister, USMC, Assistant Chief of Staff G-4; Col. Charles L. Cogswell, USMC (Ret.); Col. Robert Walton, USMC; Mr. A. E. Abel, General Manager of Bendix Radio, and Brig. Gen. Ivan L. Farman, Air Research Development Command.

General Snedeker gave a brief review of the history and mission of the Marine Corps and then discussed the importance of radio and electronic equipment in modern combat. He stated that communications were relatively simple in World War II when Marines made mass, waterborne landings. But in the future, he said, troops using helicopters to land over a wide area will need vastly improved radio communications. He also described progress made by the Marine Corps in electronics research.

Two films completed the evening's program: "Ships from the Sky," showing the part the Marine Corps plays in a vertical assault to provide a beachhead when and where needed, and "Marine Corps and Close Air Support," depicting the importance of the use of helicopters.

The Westinghouse Electric Corporation was host to the chapter at its new electronics plant on June 11th. Mr. B. M. Brown, Westinghouse Vice-President, welcomed the group and gave a resume of the plant's facilities.

Mr. Carl Sersted, Assistant Sales Manager of Electronics, detailed the various departments housed in the plant, namely: X-ray; industrial electronics; maintenance and repair shop; sales office; defense electronics activities consisting of (a) the ordnance group which is responsible for the torpedo system; (b) the air arm group responsible for airborne systems; and (c) the electronics group responsible for ground and shipboard electronics.

A tour of the plant facilities, including the paraballoon antenna, followed.

Nominees for new officers for 1957-58 were submitted by E. Charles Meyenburg, chairman of the nominating committee, and were elected as follows: president—Henry B. Yarbrough, Bendix Radio, who had served in this capacity in 1955-56; vice presidents—LCdr. Joseph G. Bastow, USCG; Col. Timothy McKenzie, USA; LCdr. John Greksouk, USN; Col. Charles L. Cogswell, USMC (Ret.); Emmett T. Loane, Chesapeake & Potomac Telephone Co.; Adam A. Fiedler, Bendix Radio; Jo M. Pearce, Hoover Electronics, Inc. Josel M. Jacobson, Aircraft Armamen Corp.; Beaufort M. Brown, Westinghouse Electric Corp.; Brig. Gen. Iv L. Farman, ARDC; Edwin R. Harr Bendix-Friez, and Thomas E. Thomson, Glenn L. Martin Co.; secretary—Trevor H. Clark, Westinghouse Electr Corp.; treasurer—Ray Moore, Hoov Electronics, Inc.; chairman, board o directors—George C. Ruehl, Jr., Electronics Specialties Co. of Maryland, outgoing president.

## *Boston*

Col. Murray D. Harris, Professor of Military Science and Tactics, Northeastern University, was elected president of the Boston Chapter at the recent annual elections.

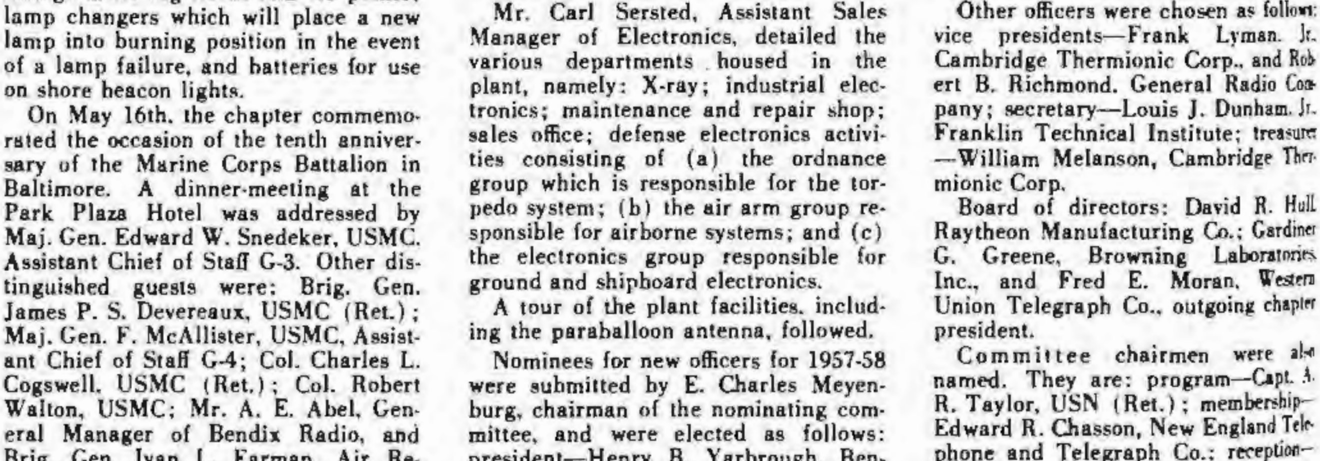
Other officers were chosen as follows: vice presidents—Frank Lyman, Jr., Cambridge Thermionic Corp., and Robert B. Richmond, General Radio Company; secretary—Louis J. Dunham, Jr., Franklin Technical Institute; treasurer—William Melanson, Cambridge Thermionic Corp.

Board of directors: David R. Hull, Raytheon Manufacturing Co.; Gardiner G. Greene, Browning Laboratories, Inc., and Fred E. Moran, Western Union Telegraph Co., outgoing chapter president.

Committee chairmen were also named. They are: program—Capt. A. R. Taylor, USN (Ret.); membership—Edward R. Chasson, New England Telephone and Telegraph Co.; reception—William Holdich, Boston Naval Shipyard; publicity—Jack Hobby, Raytheon Manufacturing Co.

## *Dayton-Wright*

New officers for the 1957-58 term have been selected as follows:



**Baltimore**—Shown at the dinner-meeting commemorating the tenth anniversary of the Marine Corps Battalion in Baltimore are, left to right: Mr. A. E. Abel, General Manager of Bendix Radio; Brig. Gen. James P. S. Devereaux, USMC(Ret.); Maj. Gen. F. McAllister, USMC; Maj. Gen. Edward W. Snedeker, USMC, guest speaker, and George C. Ruehl, Jr., chapter president.

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New York: 350 Fifth Ave. Washington, D.C.: 1001 15th St., N.W.

*Boston and Northeastern University*—Fred Moran, president of the Boston Chapter, displays to President Carl S. Ell of Northeastern University and Col. Murray D. Harris, PMS&T at Northeastern and president-elect of the Boston Chapter, the Chapter of the Year Award plaque won by the Northeastern University Student Chapter at the National Convention. Mr. Moran re-presented the plaque at the Annual Spring Awards Ceremony held at Northeastern.

President — Col. S. A. Mundell, Wright-Patterson AFB; vice presidents —W. M. Hilt, General Mills, Inc.; Col. L. J. Israel, Wright Air Development Command; J. W. Kinnally, Philco Corp.; Col. L. N. O'Connor; R. A. Root, Jr., Radio Corporation of America; C. D. Small, Emerson Electric Mfg. Co.; Lt. Col. J. H. Terrell, Jr., WADC; J. Wilkinson, American Phenolic Corp.; secretary-treasurer—Jack G. Anderson, Hoffman Laboratories, Inc.

### Fort Monmouth

The executive board of the chapter met on July 23rd for dinner and a business session to formulate plans for the resumption of activities in the fall. Special guest was the new Commanding General of Fort Monmouth, Maj. Gen. W. Preston Corderman, a charter member of the AFCEA and, for the past two years, a vice president of the Washington Chapter.

Col. Robert P. Haffa, Director of the Components Division, USASEL, was appointed to the Board of Directors to replace Col. Olin L. Bell who had been transferred.

Present at the meeting were: Col. Robert B. Tomlinson, president; Halsey F. Hubbard and Norman Freeman, vice presidents; Harry C. Ross, secretary; Col. Paul Langguth, Harry Sundermeyer, Col. Joseph E. Heinrich, J. P. Hoffman, Raymond Gilbarte, Brig. Gen. Earle F. Cook, directors, and Dr. B. Caldwell, representing Director Edward F. Kolar.

### Lexington

The program of the chapter's May meeting was presented by the General Telephone Company of Kentucky and the Automatic Electric Sales Company, and featured a program on the Automatic Teletype Switching Center AN/FGC-30. Mr. R. E. Stoffels of the Chicago district office conducted the program.

The following new officers were chosen during the annual elections: president—Lt. Col. Randolph H. Vinding, Deputy Commanding Officer, Lexington Signal Depot, and a former president of the North Texas Chapter; executive vice president—Charles L. Morrison, General Telephone Co. of Kentucky; vice president—Dr. Zygmunt S. Gierlach, Central Baptist Hospital; secretary—Harold V. Madden, Lexington Signal Depot; treasurer—Merrill L. Whitmer.

### London

A meeting of the executive committee was held at the Columbia Club on July 31st. The purpose of the luncheon-meeting was to establish a tentative schedule of meetings for the coming year and to organize three working committees.

The program committee will be headed by Sir Reginald Payne-Gallwey and the membership committee chairman will be Maj. Fred E. Stant, USAF, chapter treasurer. A publicity committee, whose function will be to publicize the London Chapter activities in the British communications-electronics trade papers and publications, was als organized.

### Louisiana

Civil Defense was the theme of th chapter's August 5th meeting, with Co W. J. Given, Office of Civil Defense State of Louisiana, as the guest speaker His subject was "Problems of Commu nication Planning for the State of Lo isiana."

The dinner-meeting was held at th Naval Air Station and was preceded a social hour.

### San Francisco

The Lenkurt Electric Company, sec ond largest manufacturer of telephone and telegraph carrier equipment, was host to the chapter on July 25th, with 100 members and guests present.

Following a social hour and dinner, Ralph Robertson, Manager of the Military Division at Lenkurt, gave the group a brief history of the company's phenomenal growth since it was formed in 1935. He stated the company now has over 2300 employees, carries on a large research and development program for the Armed Services and recently opened an international division with headquarters at Geneva, Switzerland.

A tour of the company plant at San Carlos covered the engineering laboratories and the manufacturing, testing and shipping departments.

### San Juan

The chapter's annual "Ladies' Night" meeting took place at the Officers Club of Fort Brooke on June 27th.

Sixty-five members, wives and guests enjoyed their choice of charcoal-broiled steak or filet mignon with all the trimmings. A five-piece combo furnished music for the occasion. The chapter reports the ladies are asking for a "repeat" engagement.

### South Texas

The chapter's July 23rd meeting was addressed by Col. Roy D. Maxwell, Medical Service Corps. The dinner-meeting was held at the Fort Sam Hous-

*San Francisco*—Chapter members pictured during a tour of the Lenkurt Electric Company plant at San Carlos. Left to right: Ralph Robertson; Maj. Gen. James A. Code (Ret.); Scot Robertson of Lenkurt; C. J. Napier, Sylvania Electronics; S. N. Barton, chapter president, and Col. Lloyd C. Parsons, AFCEA regional vice president.

**exington**—Chapter officers and guests at the head table of a recent dinner-meeting are, **eft to right**: Lt. Col. R. H. Vinding, president-elect; E. W. Brown, Jr., exec. vice president; **am Long**, General Telephone Co.; Col. Sterling C. Bush, CO, Lexington Signal Depot; Maj. C. J. Holmes, president; Leith Johnston and R. E. Stoffels of Automatic Electric Co.; Raymond Soard, vice president, and Charles Morrison, General Telephone Co.

on Officers Club, with members and guests first assembling for a social hour.

Colonel Maxwell, whose current assignment is with the Army Medical Service School at Fort Sam Houston as Special Assistant to the Commandant for Mass Casualty Courses, is classed as one of the foremost authorities in the United States on medical problems of radioactive fallout. He delivered an excellent talk in connection with these problems and those of disaster planning.

### Southern California

The annual election of officers was held at the June meeting, with Lester R. Daniels of Daniels Engineering, Inc., chosen to head the chapter during the ming year.

Other new officers are: first vice president—John W. Inwood, Western Union Telegraph Co.; second vice president—Jack Warner, Jr., Warner Bros. Pictures, Inc.; secretary—Col. Frank J. Shannon, Jr., USAF (Ret.), Pacific Mercury Television Manufacturing Corp.; treasurer—Ray E. Meyers, Lockheed Aircraft Corp.

Board of directors: Richard Fuller, Bendix-Pacific; Charles F. Horne, Convair; Loyd C. Sigmon, Radio Station KMPC; C. A. LaHar, Radio Corporation of America, outgoing chapter president; L. D. Callahan, Gilfillan Bros.; John Atwood, Hughes Aircraft; John Byrne, Motorola, Inc.; J. H. Goodrich, Pacific Telephone and Telegraph Co.; Richard Leng, Packard-Bell; James McLean, Hoffman Electronics, Inc.

On August 2nd, the chapter officers were hosts to Rear Adm. Frederick R. Furth, USN (Ret.), new National President of the AFCEA, at a luncheon meeting at the Knickerbocker Hotel, Hollywood. Admiral Furth discussed Association affairs with the group and outlined some of the plans for future activities.

Officers and directors in attendance were: Lester Daniels, John Inwood, Jack Warner, Frank Shannon, Ray Meyers, Loyd Sigmon, C. A. LaHar, John Atwood, John Byrne, J. H. Goodrich and Richard Leng. Guests at the luncheon were: J. A. Frabutt, Federal Telephone and Radio; Russ Smith, Nelson Technical Enterprises; William Cooke, Telemetering Corp.; and Phil Strang, Convair.

### Tokyo

The chapter's officers for 1957-58 are: President—Col. Thomas W. Riley, Jr., USA; 1st vice president—Cdr. Ellis Schiller, USN; 2nd vice president—Col. Steve J. Gadler, USAF; 3rd vice president—Frank Colonna, RCA; secretary—Donald A. L. Hughes, Philco Corp.; treasurer—Lt. Col. Robert Brewer, USAF.

New directors of the chapter are: Brig. Gen. Ned Sirmyer, USAF; Brig. Gen. Harold G. Hayes, USA; Col. A. R. Morley, USA; Capt. Robert H. Weeks, USN; Col. Thew J. Ice., Jr., USAF; William Thielz, Bendix Radio; Capt. D. I. Mathers, USN; Col. Roscoe Huggins, USAF; N. Ralph Chaerrigan, DAC, and Paul W. Becker, DAC.


CONTRAVES
ITALIANA

# ITEMS OF INTEREST

## From Government, Industry and the Services

### Automation On The Battlefield

The U.S. Continental Army Command (CONARC) hopes to bring automation to the battlefield, and preliminary studies indicate that it is *feasible* to process data electronically in the combat zone.

Military research and development agencies and civilian electronic computer manufacturers are working on the project under the guidance of Colonel Russell L. Hawkins, chief, General Division, Combat Developments Section.

According to Colonel Hawkins, by 1970 the battlefield commander will use automation to completely "war-game" his plans and orders before committing troops to combat. A computer will be able to indicate to him the probable results of his planned course of action.

The machine, Colonel Hawkins cautioned, can only give a commander the consequence of his decisions. "It can't predict the outcome," he said, "because as humans, we can't predict all the variables."

The automation project was inaugurated about a year ago to determine if electronic computing is compatible to combat conditions in three broad fields.

(1) Obtaining ultraswift information on available fire power, supplies and staff estimates.

(2) Removing as many non-combat troops as possible from the main battle position.

(3) Improving reaction time between front and rear units and within units themselves.

### Atomic Produced Power

During recent tests of the nuclear reactor and auxiliary components, electric power was produced for the first time by heat from the Sodium Reactor Experiment (SRE). The venture marked the initial production, from a non-military atomic energy reactor, of power for the generation of electricity by a private utility company.

Designed and built for the AEC by Atomics International, a division of North American Aviation, Inc., the SRE is a part of the commission's program to develop economically competitive civilian power from nuclear energy.

The Southern California Edison Co. installed electrical generating equipment, adjacent to the nuclear reactor, to convert reactor heat energy to electricity. The company purchases this power from the AEC.

Following numerous tests to evaluate the operation of all components, the plant will function at full power late this year. The reactor is designed to produce 20,000 kilowatts of heat from which the Edison equipment will generate approximately 6,500 kilowatts of electricity.

A huge, lead-shielded chamber for loading uranium fuel into the atomic energy reactor hovers over the "core" or heart of the reactor sunk deep beneath the ground. Heat from the atomic "furnace" is used by the experimental power station to generate electricity.

### Signals Bounced Off Moon

The Navy's highly sensitive Minitrack radio tracking equipment at Blossom Point, Md., has picked up signals bounced off the moon.

Using the giant radar transmitter, "Diana," Army Signal Corps engineers bounced signals off the moon which were picked up by the Maryland station.

The Blossom Point Minitrack Test Facility, operated by engineers from the Naval Research Laboratory, has conducted several successful test "pick ups." The experiments are executed in cooperation with engineers at the U.S. Signal Engineering Laboratories, Fort Monmouth, N. J.

Purpose of the procedure, the Navy said, is to perfect a technique to test Western Hemisphere satellite tracking stations as soon as they are completed and placed in operation.

The Navy's Blossom Point Test Facility is the first radio tracking station to be erected for detecting and measuring the path of the scientific earth satellite as well as for obtaining other information.

Located about 40 miles south of Washington, D. C., the station is one of 10 planned for operation during the International Geophysical Year. It is operated by Project Vanguard personnel of the U.S. Naval Research Laboratory as part of the National Academy of Sciences earth satellite program.

### Synthetic Mica Melt

Various Government agencies and manufacturers of high-temperature electrical and electronic equipment are watching with interest recent developments concerning the largest successfully completed commercial melt of Synthamica synthetic mica. Synthetic mica is superior to the natural material for applications involving temperatures in excess of 1000 degrees Fahrenheit.

Experiments are being conducted by the Synthetic Mica Corporation, a subsidiary of Mycalex Corporation of America, at its plant in Caldwell Township, N. J.

After approximately three weeks of cooling, the huge mass of crystalline mica will be broken up and then ground or split into useable form. It is too early to tell what progress has been made, but crystals as large as 4 x 4 inches have been produced consistently in the past.

The synthesis of this strategically important material had been brought to pilot plant production in Germany during the war, when the Axis countries were cut off from sources of natural mica in India and elsewhere. They consequently found their electrical and electronics development severely curtailed.

Foreseeing similar possibilities, the United States Government, through the U.S. Bureau of Mines and various industrial participants, initiated a program at Norris, Tenn., for the commercial production of synthetic mica.

In 1953, Mycalex Corporation of America entered into a cooperative agreement with the Bureau of Mines to produce the material, and at the conclusion of the agreement built plant facilities and became the only commercial producer of Synthamica synthetic mica.

## Proposed "Aerial Jeep"

Recent developments in direct lift devices have prompted the Army to undertake the development of an "aerial jeep." Consequently, the Department of the Army has awarded three contracts, totalling $1,702,000, for the design, construction and testing of flying research vehicles.

The contracts were awarded to Aerophysics Development Corporation, Santa Barbara, California ($388,000); Chrysler Corporation, Detroit, Michigan ($661,000), and to the Piasecki Helicopter Corporation, Philadelphia, Pennsylvania ($653,000).

The "aerial jeep" concept seeks to provide the Army with a compact vehicle having the versatility of a conventional jeep together with added hovering and self-propellent capabilities.

Ultimately the Army hopes to have a general purpose vehicle which can travel 50 miles per hour, stay in the air for several hours, and carry up to 1,000 pounds of equipment.

The small vehicle size is obtained through utilization of ducted propeller vehicles in forward flight and to determine the most promising control system. Different arrangements and configurations of ducted propellers and control systems will be investigated under the three contracts.

## Firm to Specialize in Scatter

Controlling interest in Scatter Communications, Inc., Bethesda, Md., has been acquired by L. H. Carr and Associates of Washington, D. C.

Lester H. Carr

The recently formed company specializes in the design, engineering and installation of complete scatter radio communications systems or components.

Scatter Communications, Inc. was organized earlier this year by a team of executives, engineers and support personnel. Prior to incorporating their own firm, this group engineered and supervised the installation of the Air Force's North Atlantic Scatter Circuit.

Officers of the company are: Lester H. Carr, chairman of the Board of Directors; Harry M. Tayloe, president; Clifton F. Foss, executive vice president; William E. Yost, Jr., vice president-engineering and F. L. McCutchen, project manager.

## Air Force Reveals Falcon GAR-2A

The Falcon GAR-2A, a new guided missile based on detection of infra-red radiation, is now in operation as a U.S. Air Force defense weapon. This armament is the latest in the GAR (guided aircraft rocket) series of air-to-air missiles produced as all-weather interceptors of the Air Defense Command.

Secret of the weapon's operation is its revolutionary guidance unit which senses, at a distance of miles, the infra-red radiation (IR) thrown out by invading aircraft.

Before the 2A is launched, the missile's IR guidance unit is "slaved" to the target by the radar armament control system of the interceptor. The unit sends signals to the Falcon's control mechanism and, when launched, the missile seeks out the target by steering toward the discerned source of radiation. The IR detector is so sensitive that a guided rocket propelled miles from a target will "lock on" and fly at tremendous speed to intercept and destroy it.

The 2A can be launched far below an enemy craft and will climb, surpassing supersonic speed, to an altitude higher than the operational ceiling of any known bomber.

News of the missile's operational use was disclosed jointly by the Air Force and Hughes Aircraft Company.

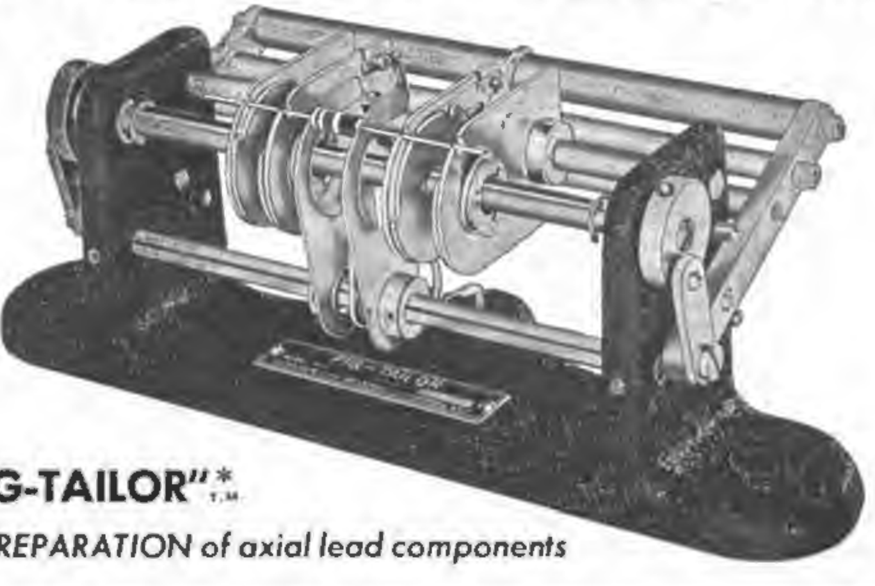
## E.C.I. Organizes Reliability Section

Due to the growing concern of the military with product dependability, Electronic Communications, Inc., Teterboro, N. J., has organized a Reliability Assurance Section.

The new department, one of the first in industry pertaining entirely to this area, brings together the following groups: test equipment, qualification testing, component evaluation, and reliability and environ-

(*Continued on page 68*)

# PROVEN - on the assembly line!



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> The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
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6. Individual cut and bend lengths.
7. Better time 'rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
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3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
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9. Excessive lead tautness!
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Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

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mental testing. To be staffed ultimately by 40 scientists and technicians, the section will be headed by G. Wendell Carr, head of test engineering for ECI.

"Heretofore, in common with most contractors for the military, reliability testing has been performed on a less integrated basis at ECI," said Clyde Councilman, chief engineer for the company. "The formation of the new Reliability Assurance Section makes that activity just as important a part of our operations as our research and development effort."

He further remarked that improved reliability is essential in order to reduce the large number of aborted missions, destroyed aircraft and pilot fatalities which have risen to alarming proportions throughout the world.

## Charactron Tube Developed

A Charactron shaped beam tube has been developed which is small enough for aircraft use, and yet able to reproduce a conventional radar display map and then print labels on it.

The new developmental product was announced by Stromberg-Carlson, San Diego, a division of General Dynamics Corporation.

The Charactron shaped beam tube accomplishes the dual function of a radar tube and a tube displaying characters by means of time sharing. The characters are printed on the phosphor screen at the rate of 20,000 a second and retained by the phosphor while the electronic device does its radar work in between letters and numbers.

The tube can be used:

(1) For radar displays combined with character and numeral printing to label the objects shown on radar.

(2) To condense flight data for a pilot. Instrument panels on some multi-engine aircraft must show an extensive array of constantly changing speeds, pressures and other data for each engine. All of this information can be consolidated and displayed in easy-to-read graphic and digital form by the new tube.

(3) To display command instructions from a ground data source aboard an aircraft.

(4) To display navigational information from an airborne computer by reproducing moving maps and symbols in a form which the pilot can read and understand quickly.

(5) In models for shipboard use to perform aircraft and ship surveillance now done at ground stations by larger models of the Charactron shaped beam tube for the SAGE system.

(*Continued on page 70*)

Van de Graff accelerator in ONR's Naval Research Laboratory. Many substantial contributions in the field of nuclear physics have been made by ONR scientists.

U. S. Navy Photo

# OFFICE OF NAVAL RESEARCH BRINGS SCIENCE OF FUTURE TO AMERICA'S SEA ARM

The Office of Naval Research, formed in 1946, has already become an extremely important contributor to the effectiveness of the Navy and a full-fledged member of the scientific community. ONR's mission is "to plan, foster, and encourage scientific research . . . as related to the maintenance of future naval power and the preservation of national security . . ."

The Navy has an enormous requirement for nearly every kind of scientific and technological information. Since its establishment, ONR has supported scientific research in nearly every major scientific field. Its research results support development in Navy bureaus, in aircraft, guided missiles, ships, medicine, training, logistics and other areas. ONR also supports exploratory development to test the feasibility of radically new weapons concepts.

Most ONR research is performed under contract in universities, non-profit institutions, and industrial laboratories. Research is also performed at the four laboratories under ONR supervision: the Naval Research Laboratory, the Training Device Center, the Underwater Sound Reference Laboratory, and the U. S. Naval Biological Laboratory.

Out of ONR's laboratories have come such developments as the earliest radar; major advances in radio telescopy; high altitude research (employing both balloons and rockets, such as the well-known Viking); many contributions in nuclear physics, nuclear power, metallurgy, mechanics, and chemistry; advances in physiology, biology, and psychology as well as an extremely wide range of developments in weapons controls, armament, amphibious warfare systems, underwater ordnance, aircraft instrumentation, undersea warfare—and in many related fields.

Typical of ONR's latest work is logistic support of the Earth Satellite Program, being carried on by ONR's Naval Research Laboratory. The entry of the satellite into space should bring many contributions in physics, geodesy, and geophysics, with many long range applications in transportation, communications, meteorology, navigation, mapping—and space travel.

This is one of a series of ads on the technical activities of the Department of Defense.

**FORD INSTRUMENT CO.**
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Engineer at Ford Instrument checks out computer developed and built for U. S. Navy.

**ENGINEERS** of unusual abilities can find a future at FORD INSTRUMENT CO. Write for information.

## ITEMS OF INTEREST

### Rixon Becomes Independent

Rixon Electronics, Inc., a research and development firm of Silver Spring, Md., has become an independent company. James L. Hollis will serve as the new president.

The firm was formerly a subsidiary of Page Communications Engineers, Inc., Washington, D. C. The change was made through a stock transfer in which Mr. Hollis relinquished his interest and resigned as an executive in the Page concern.

Organized primarily for the purpose of developing prototype models of electronic equipment, Rixon has designed and produced equipment of all sizes.

Most of the efforts to date have been concentrated on specialized equipment for use in scatter communications. Special purpose test and monitoring equipment, antenna preamplifier stages, special purpose exciters, and various components of terminal or interconnect equipment developed by Rixon are in service today in important scatter communications circuits.

Two successful major developments are the TX-264 60 Kw VHF Transmitter and the MUX-16 (An/TCC-35) Sixteen Channel Teletypewriter Multiplex System. Both were developed under contracts with MIT Lincoln Laboratory and Page Communications Engineers, and prototypes are now in service in Department of the Air Force installations.

Starting with three employees when first organized five years ago, Rixon now employs over 100 people.

## Names In The News

**Brigadier General Kenneth F. Zitzman** has recently been named to the high post of Deputy Commandant of the Industrial College of the Armed Forces, Fort McNair, Washington, D. C.

**Harry M. Stephey** has joined the General Electric Company as manager of advanced sales for the Missile Guidance Section of the company's Heavy Military Electronic Equipment Department in Syracuse, New York. For the past several years, Mr. Stephey has been Government field sales manager in Washington, D. C., for Philco Corporation's Government and Industrial Division.

The late **Vernon B. Bagnall** received a posthumous recognition recently when the Canadian government named a lake on the western coast of Melville Peninsula in his honor. Mr. Bagnall, who died of a heart attack on April 10, 1956, was project manager of the Distant Early Warning Line, built for the U. S. Air Force by the Western Electric Company. In this position, which he held from December 1952 until January 1956, he directed the initial planning and construction of the chain of radar stations spanning the North American Continent's northern rim inside the Arctic Circle.

**Rear Admiral George Dufek**, USN (Ret.), has been designated U. S. Antarctic project Officer by direction of the President. He also will continue as Commander of Task Force 43, the logistic support force known as Operation Deep Freeze III, until completion in 1959 of the Navy's Antarctic participation in the International Geophysical Year.

**Dr. William H. Martin**, Director of Research and Development, Department of the Army, was awarded the degree of Doctor of Science by The Johns Hopkins University in June. Part of the citation read: "Following his retirement from the Bell System, he entered the service of the Government as Deputy Assistant Secretary of Defense and then in a precedent-breaking decision, he became the first civilian head of research and development for the United States Army by appointment to the post of Director of Research and Development for the Department of the Army."

**George W. Bailey**, Executive Secretary of IRE, has been appointed adviser and consultant on telecommunications matters to C. Douglas Dillon, Deputy Undersecretary of State for economic affairs. During World War II, he served in many key capacities with the Government and for his contributions to the war effort he was awarded the President's Certificate of Merit. Mr. Bailey is a former National President of AFCEA and is now a National Director.

**Brackett K. Thorogood** retired as Executive Director of Franklin Technical Institute on June 30. He is succeeded by **Louis J. Dunham, Jr.**, who has been a member of the faculty of the Institute since 1948.

**Major General Rodney Smith**, USA, has become a member of AFCEA. Upon retirement last month, he joined the ranks of International Telephone and Telegraph Corp., and will head their European office with his headquarters in Paris.

**TYPE AK**

Input voltage 6 to 230. VA output capacity up to 250. 3600 rpm.

**TYPE BK**

Input voltage 12 to 230. VA output capacity up to 600. 3600 rpm.

**TYPE CK**

Input voltage 28 to 230. VA output capacity 750 to 1500. 3600 rpm.

# Make SANGAMO your regular source for Rotary Converters

**FOR COMMERCIAL AND MILITARY**

Sangamo manufactures a complete line of Rotary Converters for commercial, military, or special purpose applications. Three basic models are available in an extended range of electrical characteristics. All units are designed to provide truly dependable power. They are conservatively rated—built to withstand much tougher service than required with big reserves in every detail of design.

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The modern accelerated production techniques used in Sangamo's new "controlled conditions" factory in Pickens, South Carolina aid in fulfilling all delivery schedules. This new plant is equipped for full capacity production of Rotary Converters, Dynamotors, Generators, and Special DC Motors. Specify Sangamo for *dependable* units and *dependable* delivery.

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SG57-8

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**Electric Company**
SPRINGFIELD, ILLINOIS

# PERSONNEL CLEARING H[illegible]SE

### *AFCEA Members Available to Ind[illegible]*

**The pages of SIGNAL are open to active AFC[illegible] [illegible]bers who are seeking positions in the communicatio[illegible] [illegible]nics and photographic industries. Any member is enti[illegible] [illegible]pace free of charge in this column for three issues [illegible] [illegible]gazine. Please limit your notice to five lines. In [illegible] employers are asked to address: Box ........, SIGNA[illegible] Eye Street, N. W., Washington 6, D. C. Letters will [illegible]arded to the AFCEA member.**

MANUFACTURERS LIAISON REPRESENTATIVE. Retired [illegible]lonel, Communications-Electronics Officer with twenty-o[illegible] experience. Education: Electrical Engineering and [illegible] Administration. Familiar with Operational Suitability [illegible] and R & D. Desires to represent manufacturers or act [illegible]n for companies conducting business with Eglin Air [illegible] Base, Florida. Box 126.

MANUFACTURERS REPRESENTATIVE with over sixte[illegible]rs experience, partly as a USAF employee, in nego[illegible] and liaison engineering of contracts with the USAF [illegible]right Field and Gentile AF Depot has time available for [illegible]tional companies desiring or doing Air Force business. [illegible] 127.

GOVT. PROCUREMENT AND ADMINISTRATIVE CO[illegible]TANT. Wide background and experience includes practice [illegible] taxes, accountant with Attorney General of New York [illegible] Congressional Committee. Worked with U. S. Dept. o[illegible]efense in formulating ASPR, dealing with termination, re[illegible]iation and contract administration. Box 128.

REPRESENTATIVE with a wide following among manu[illegible]turers of electronic equipment and government agencies [illegible]n the Eastern seaboard has an opening for an additional [illegible]ne of quality components. Straight commission basis. Box [illegible]29.

FIELD ENGINEER OR MANUFACTURERS LIAISON REPRE[illegible]NTATIVE: Retired CWO experienced in radar, closed cir[illegible] TV. b&w and color and Kinescope recording, data processing and automation, and R & D work. Will relocate with family only. Box 130.

WORKS MANAGER OR CHIEF ENGINEER. Record of managerial competence in integrating engineering, sales and manufacturing. Broad technical background covering several engineering fields such as missile ground support equipment and instruments, solid related manufacturing experience, top sales contacts for military R & D and production work. Box 131.

### *Positions Available*

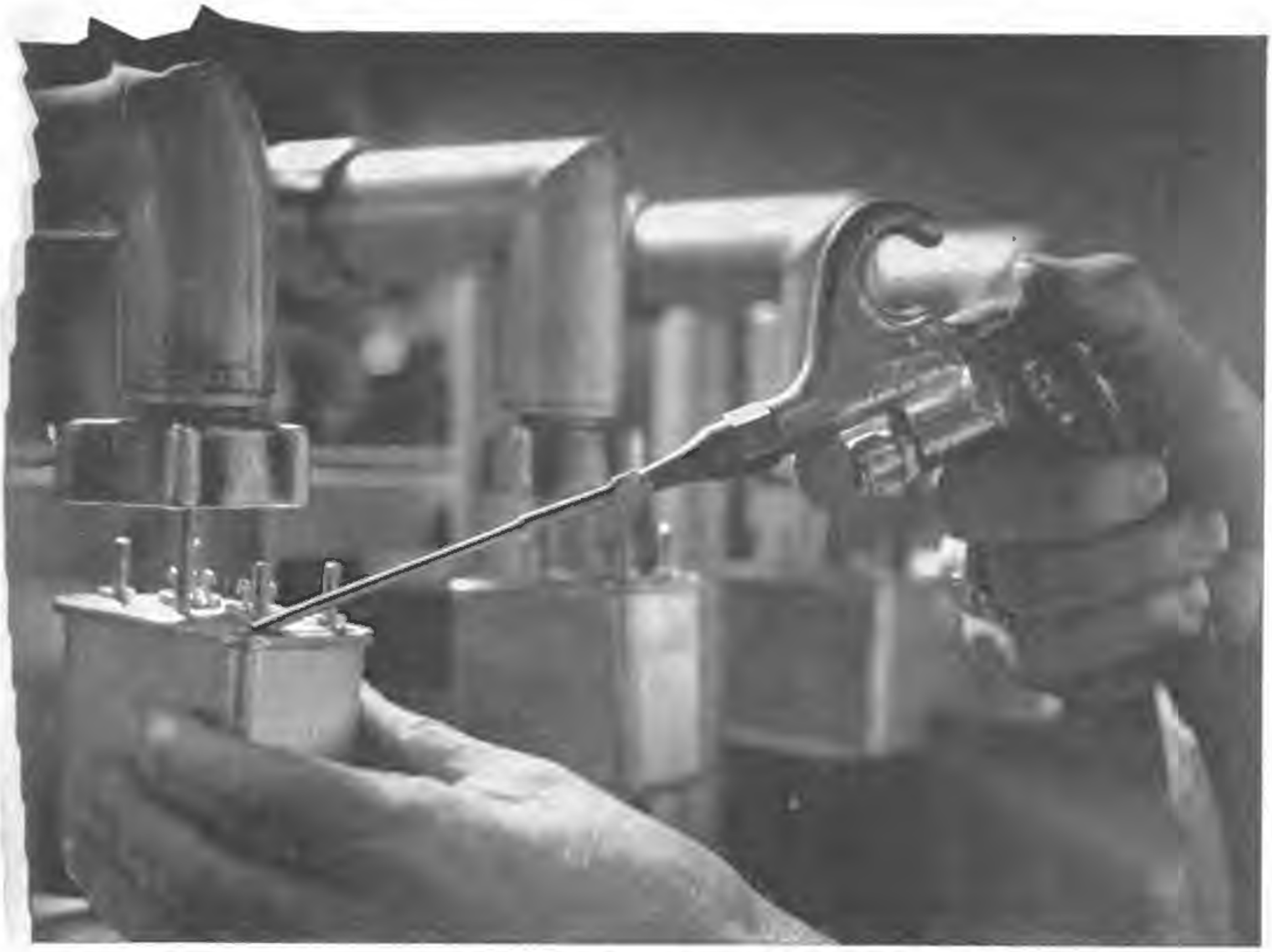
**Industry, government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.**

U.S. CIVIL SERVICE COMMISSION. Vacancies now exist for Electronic Technician positions in the Civil Aeronautics Administration in Alaska. Starting salaries are $4,080 and $4,525. No written test required. Full information on how to apply may be obtained at many post offices throughout the country or from the U.S. Civil Service Commission, Washington 25, D. C.

U.S. CIVIL SERVICE COMMISSION has announced vacancies for communications cryptographic coding clerks at $3,415 a year. Applicants must have general experience as a clerk, typist, teletypist or telegrapher, plus 6 months of specialized experience in enciphering and deciphering messages, involving the use of a variety of current cryptographic systems and devices. Radio broadcast technician positions are also available in the International Broadcasting Service at $5,915 a year. No written tests required. Further information and application forms from the U.S. Civil Service Commission, Washington 25, D. C.

ELECTRONIC ENGINEERS. Starting salaries $5,335 and $6,115. Electronic Technicians, salaries from $3,670 to $5,440. Vacancies now exist at the Electronics Division of the New York Naval Shipyard, located at Navy and Sands Streets, Brooklyn 1, N. Y. The shipyard is engaged in activities ashore and afloat, including construction of new super-carriers. Direct inquiries to the Industrial Relations Officer, Telephone Main 5-4500, Extension 2877, 2379 or 2593.

(*Continued on page* 78)



*Tracer gas is sprayed over the relay enclosure while it is under high vacuum*

STANDARDS THAT DETERMINE RELAY QUALITY /

# 100% leak-free hermetic sealing

**We reject relays with leaks so tiny that it would take 30 years to admit 1 cubic centimeter of air!**

Hermetically sealed relays are safe from the dangers of human tampering, and from severe conditions of dust and dirt, sand, moisture and high humidity, fungi, salt spray and reduced air pressure. To insure this safety, however, sealed relays must be absolutely free from leaks.

That is why, at Automatic Electric, every single hermetically sealed relay undergoes a sensitive mass spectrometer test. This highly refined method of testing detects leaks so tiny that it would take *more than 30 years for one cubic centimeter of air to pass through!* To protect you, we reject "leakers" able to pass ordinary immersion tests with ease.

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One of America's great communications systems

GENERAL SYSTEM

# NEW PRODUCTS FROM INDUSTRY

## Electrochemical Integrator

Believed to be a scientific breakthrough, the development of an air navigation control device which operates in an iodine solution on very low electrical current and which features great reduction in size, weight and cost, has been disclosed by the U.S. Naval Ordnance Laboratory of Silver Spring, Md.

Designated the "electrochemical integrator," the unit contains an "inertia" principle of operation which, after initially put in motion in one direction, will detect any subsequent change of course effected by atmospheric or mechanical difficulties.

Initial movement of the plane results in chemical changes inside the integrator which produce electrical current. Any change in this movement causes a measureable difference in current output. The current produced operates recorders which reveal amount of change and specific direction.

Operating on very low battery current, no electrical generating gear is required. Additional advantages of the unit are said to be reliability, long life, simplicity of operation and ease of manufacture.

## New Amco Blowers

Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill., has developed two new blowers to provide a maximum delivery of filtered air while utilizing a minimum of panel height.

Designed for use in Amco's Modular Instrument enclosure system, the two models, designated B350 and B800, deliver 350 and 800 cubic feet of air per minute, respectively. Each is adequately filtered and fused.

A space saving feature is demonstrated with Model B350 which absorbs only 3½" of the vertical panel space in a standard Amco Modular frame.

## Mechanized Microtome For Neuropsychiatric Research

The Leonard Hill Technical Group, 9 Eden St., London, England, has recently publicized a noteworthy advance which was achieved by a novel use of a servo-control speed drive. Now fully-motorized, the microtome was previously a manually-operated device used for cutting a vast number of undistorted sections of the brain at thicknesses varying between 0.001 and 0.0001 inch.

Believed to indicate a wide scope for mechanization in neurological research, the Spencer rotary microtome is equipped with a knife and cutting facets accurate to within one twenty-five-millionth of an inch. A counting mechanism can stop the microtome at any pre-determined figure up to 10,000.

Since preparation of serial sections of 25 human brains requires ½ million slides, the facility with which the technician may work in the orientation of sections within a series, with number and thickness of a section instantly available, is considered a highly advantageous feature in the use of the new microtome.

## "Trak" Morse-to-Teleprinter Code Converter

A new 300 word-per-minute Morse-to-Teleprinter Code Converter has been developed by CGS Laboratories, Inc., 391 Ludlow St., Stamford, Conn.

Accepting Morse Code either as tone or keyed dc, the new system, Model CMP-13, operates a page printer, high-speed punch, and a recorder. By releasing 4 fasteners and a cable plug, the conversion matrix may be removed and replaced by another matrix for different conversions.

Army and Navy representatives see Morse code copied automatically at 300 words per minute at CGS Laboratories, Inc., Stamford, Conn. Left to right: Lt. T. Y. Dunn, U.S. Navy; Capt. G. V. Vaughn and Major W. S. Bell, U.S. Army and T. J. Waldron, CGS Laboratories.

Now in design is an improved transistorized model which will occupy only 10½" of panel space.

Of further interest are the CGS reports, entitled "Incereductor Notes," which contain data relative to new progress and development in the use of high-frequency electrically-controllable inductors. Reports are available upon request.

## Ultrasonic Drill

Powered by high-frequency sound waves, a new drill for boring a precise microscopic hole in very hard ferrite materials has been developed by Lockheed Missile Systems, of Sunnyvale, Calif.

When diamond-hard ferrites are made into magnetic memory cores for electronic computers and data storage devices, the face of each tiny ring-shaped core measures only 45 thousandths of an inch. Consequently, the drilled holes necessary for threading fine coil wires must be only slightly larger than a human hair.

Operating the "silent" drill with a jack-hammer type of action, the ultrasonic frequency put out by an oscillator is of 28,000 cycles per second which is amplified to provide the current driving the drill. A magnetostrictive effect is gained by the rapid cycling of the frequency.

## Pocket-Size TV Camera

For military airborne, mobile, and field closed-circuit TV applications, a new miniaturized TV camera has been developed by Radio Corporation of America, New York, N. Y.

Small enough to be operated in the palm of the hand, the new camera was made possible through the use of transistors, a specially developed transistor circuitry, and a new RCA ½" vidicon camera tube.

Weighing less than a pound, the camera measures only 1⅞ x 2⅜ x 4½ inches.

## High-Frequency Crystal Filter

Claimed to play a major role in bringing about dependable world-wide communications, a new radio-radar device developed by Hycon Mfg. Co., 1030 Arroyo Pkwy., Pasadena, Calif., and known as a "high-frequency crystal filter," is said to simplify electronic equipment and to make possible more radio stations for transmitting without overlapping or interfering with one another.

Radio receivers with crystal filters

(Continued on page 77)

*Progress Report on New Computer Developments*

# Now General Electric Offers You Complete Computer Machine Time and Computer Services

## AT YOUR SERVICE: AN EXPERIENCED STAFF AND THE NEWEST COMPUTER

Immediate assistance in the form of a complete range of General Electric computer services is now available to business, industry and government. Facilities include an IBM 704 Computer having high-speed, random-access core storage of 8192 words, magnetic drums, and ten magnetic tape units. The peripheral equipment provides for complete flexibility in selecting the input and output media.

A staff of 70 specialists which includes leaders in the computer applications field can provide immediate assistance in solving your problems. In addition to supplying the most versatile programming services, the staff is eminently qualified to perform advanced work in the following:
*Mathematical Analysis . . . Operations Analysis . . . Simulation*

These are resources with which you can supplement the capabilities of your present staff and facilities.

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*The three basic areas of General Electric's Computer Service:*

**1. COMPUTATION SERVICE**
G.E. supplements your present computing capabilities by handling problem overflow resulting from the fact that your own computer time and personnel are scheduled far in advance.

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G.E. provides complete data processing service, including the submission of interpretive reports to fulfill your exact requirements. Machine time is now available for either single or recurring tasks.

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G.E. can evaluate your requirements for data processing and assist you in selecting the correct computer for the task. In addition G.E. will coordinate the installation, develop the program and train personnel to operate the computer.

For complete information contact: General Electric Company, Computer Department, Marketing Section, 1103 North Central Avenue, Phoenix, Arizona.

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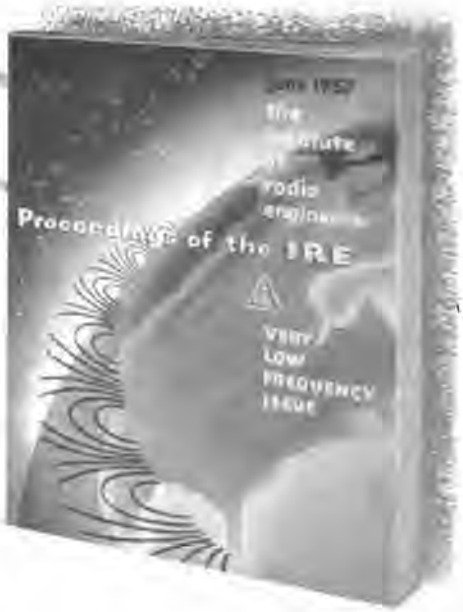
CPA-2 (6-57)



## ABOUT VERY LOW FREQUENCY PROPAGATION!

**ABOUT VERY LOW FREQUENCY PROPAGATION!** Smaller antennas, lower transmitter power, and relative freedom from atmospheric noise are reasons behind our communication services' gradual migration to the upper end of the frequency spectrum. Lying fallow and awaiting rediscovery has been the very low frequency band below 30 kc.

Now, because VLF offers a reliable means of communicating over vast global distances, there is a marked revival of interest. It is now known that VLF has highly stable propagation characteristics which make it possible to transmit data to distant points with unusual fidelity and precision. Where greater accuracy is required, such as very long range radio navigation systems and international transmission of frequency standards, VLF promises to open doors to many new and important uses.

## *June Proceedings of the IRE gives you the facts about VLF*

This year, the Boulder Laboratories of the National Bureau of Standards and the IRE Professional Group on Antennas and Propagation co-sponsored a Symposium at Boulder, Colorado, on the propagation of very low frequency radio waves. From the papers given at this important meeting the editors of *Proceedings* have chosen those of broadest interest for publication in the June, 1957, issue.

Typical of the service offered members of IRE is this VLF report — to be used now and referred to for years to come. If you are not a member of *The Institute of Radio Engineers* be sure to reserve a copy of the June *Proceedings of the IRE*, today!

## *Partial Contents of this VLF Issue:*

- **"A Technique for the Rapid Analysis of Whistlers,"** by J. K. Grierson, Defense Reserve Board, Ottawa, Ontario, Canada.
- **"VLF Radiation from Lightning Strokes,"** by E. L. Hill, School of Physics, University of Minnesota.
- **"Some Recent Measurements of Atmospheric Noise in Canada,"** by C. A. McKerrow, Defense Reserve Board, Ottawa, Ontario, Canada.
- **"Intercontinental Frequency Comparison by Very Low Frequency Radio Transmission,"** by J. A. Pierce, Croft Laboratory, Harvard.
- **"The Mode Theory of VLF Ionospheric Propagation for Finite Ground Conductivity,"** by James R. Wait, National Bureau of Standards, Boulder, Colorado.
- **"The Geometrical Optics of VLF Sky Wave Propagation,"** by J. R. Wait & A. Murphy, National Bureau of Standards, Boulder, Colorado.
- **"Characteristics of Atmospheric Noise from 1 to 100 Kc/s,"** by A. D. Watt & E. L. Maxwell, National Bureau of Standards, Boulder, Colorado.
- **"The Present State of Knowledge Concerning the Lower Ionosphere,"** by A. H. Waynick, The Pennsylvania State University.
- **"Noise Investigation at VLF by the National Bureau of Standards,"** by W. Q. Crichlow, National Bureau of Standards, Boulder, Colorado.
- **"Reflection at a Shapely-Bounded Ionosphere,"** by I. W. Yebroff, Stanford University.
- **"The Attenuation Versus Frequency Characteristics of VLF Radio Waves,"** by J. R. Wait, National Bureau of Standards, Boulder, Colorado.
- **"The Waveguide Mode Theory of the Propagation of VLF Radio Waves,"** by K. G. Budden, University of Cambridge, England.

### *PROCEEDINGS OF THE IRE*

1 East 79th Street, New York 21, New York

☐ Enclosed is $3.00
☐ Enclosed is company purchase order for the June, 1957, issue on VERY LOW FREQUENCY.

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Company ..........................................
Address ..........................................
City & State..........................................

All IRE members will receive this June issue as usual. Extra copies to members, $1.25 each (only one to a member).

The Institute of Radio Engineers
1 East 79th Street New York 21, New York

do not normally have to be aligned, once manufactured. Quartz filters, each about ½ the size of a dime, are extremely stable despite severe environmental conditions or change, it is said.

Use of crystal filters in the circuit eliminates need for multiple conversion; thus fewer parts are required in the radio or radar receivers.

Primary applications will be in mobile communications equipment. Others include a tiny button microphone, worn on the lapel, which transmits messages several hundred yards without connecting power sources.

## "Spacistor"

The "Spacistor," claimed to represent a scientific breakthrough with vast potential in the electronics field and said to combine many of the best properties of the vacuum tube and the transistor, has been developed by Raytheon Manufacturing Co., Waltham, Massachusetts.

The semiconductor device is as tiny as a transistor and operates electrically like a vacuum tube. However, the high temperature Spacistor can be made from materials unsuited for transistors and is expected to operate reliably at 500°C. It is predicted that the Spacistor will amplify at frequencies up to 10,000 megacycles—50 times higher than transistors.

Among electronic equipment expected to benefit materially from the device are guided missiles and rockets, radar and communications equipment, and TV sets.

Claiming other advantages similar to the transistor, the Spacistor operates on a fraction of vacuum tube power, has no filament to heat or burn out, and can be packaged in minute assemblies.

## Electronic "Tracks" for Transatlantic Air Traffic

"Dectra," a long-range navigation system designed to provide for the pilot a precise electronic navigational display covering a range of 2300 miles, is now being manufactured by Bendix Aviation Corporation, Pacific Div., N. Hollywood, Calif.

Used in operation with Decca, a similar shorter-range system, the two systems will automatically plot the exact course of either plane or ship. Combined, they weigh 97 lbs.

Pairs of "master" and "slave" sending stations transmit wave patterns occupying specifically known and stable geographical positions, and thus form accurate position lines or "electronic highways." These are picked up by receivers in the aircraft. The position information is then automatically computed and displayed on a "highway map," a navigation chart mounted in the cockpit. A moving pen tracks the position of the plane.

Although traffic control systems require a lateral separation of 120 miles between planes, this system reduces the space to 30 miles or less. With the advent of jet transatlantic airliners, it is believed the system will be of extreme value.

## Lightweight Traveling-Wave Tube

A new traveling-wave tube, developed for use in microwave relay and radar equipment by Radio Corporation of America, is said to offer drastic reduction of weight and substantial increase in operating reliability as compared to many present types of traveling-wave tubes.

The compact electrostatic focusing element built into the tube and given a permanent proper alignment during assembly, eliminates the need for bulky external magnetic focusing equipment. Complete with focusing element, the new "plug-in" tube weighs less than a pound.

Although employed thus far as a microwave amplifier, it is believed the new tube promises application in airborne-radar and counter measures equipment as well.

## New Humidity Test Chamber

Claimed to provide unsurpassed quality, reliability and appearance, the new humidity test chamber recently developed by Environmental Equipment Co., 369 Linden St., Brooklyn 27, N. Y., also features all-automatic recording, controlling and programming.

Control tolerance maintained is said to be better than ±2°F., simulating environmental conditions over the temperature range of 0°F. to +200°F., and the relative humidity range of 5% to 98%.

Controls include a 12" diameter wet/dry bulb recorder, controller and programmer.

Having a test volume of 8 cubic ft., Model H8 measures 30 x 20 x 24 inches. Low air velocities are maintained throughout the test space.

## TV Microscope

Designated the "ultraviolet, color-translating television microscope," a new instrument which combines techniques of color TV and ultraviolet microscopy for staining cells electronically has been developed at Rocke-

feller Institute for Medical Research, New York, N. Y.

Permitting study of living cells without disturbing their motion and development as do radioactive and fluorescent particles, the microscope can be used to trace distribution, utilization and metabolism of specific materials within living cells with an accuracy claimed to be previously unavailable.

## New Literature

### Printed Circuitry Booklet

The dry screen process is believed to represent an important step forward in solving the knotty problem plaguing electronics manufacturers of reconciling high quality, high volume and low unit cost in the production of printed circuitry.

Providing information on this recently developed process, a new booklet entitled "Superior Printed Circuitry" is now available, free of charge by writing a request on company letterhead, to Dry Screen Process, Inc., 1016 Madison Ave., Pittsburgh 12, Pa.

Unified background data, assembled from many earlier proven installations, also provides research engineers with a description of a fast proven method used to perform work later to be accomplished on a production basis.

### Reliability Design Handbook

Supplying information on new materials, processes and techniques, as well as design aids and reliability concepts, the Navy Electronics Lab.'s "Reliability Design Handbook," designated PB 121839, may be obtained from OTS, U. S. Dept. of Commerce, Washington 25, D. C., at $3.00 a copy.

Intended to coordinate data on almost all subjects related to reliability or preferred circuitry in electronics, the handbook assembles in large part material contributed by [illegible] engineers, scientists and med[illegible]

Beginning in October, [illegible] supplements will be di[illegible] by OTS on a subscription b[illegible]25 a year ($3.00 foreign).

### X-Ray Inspection B[illegible]

Detailing methods used [illegible] automatic X-ray inspection of [illegible]miniature electron tubes, a new b[illegible]tin issued by the Instruments [illegible]vision, Philips Electronics, Inc., [illegible] Mount Vernon, New York, is now [illegible]ailable free of charge.

Description is offered of the mass quantity inspection of components for missiles and aircraft systems, and of the X-ray work which involves welds on wire stock measuring .003 to .015 inch in diameter.

Use of this new technique permits the daily check of 18,000 tubes and the inspection involves lead, glass, nickel, barium, aluminum, iron and other materials which exist in alloys and chemicals of subminiature tubes.

## Personnel Clearing House

*(Continued from page 72)*

Electronic Engineers (up to $7570 per year) are needed by the Civil Aeronautics Administration to apply latest knowledge of electronics to air traffic control, telecommunications and navigational aids. Individual engineer positions concerned with the design, procurement and specifications, factory inspection, installation, calibration and maintenance of ground and airborne electronic equipment. Equipment includes radar, distance aids, VHF radio transmitters and receivers and radio and land line telecommunications. Employee benefits: paid vacations, sick leave, insurance and retirement programs. Write Civil Aeronautics Administration, Personnel Division (W-91.3), T-5 Bldg., 17th & Constitution Ave., N.W., Washington 25, D. C.

U. S. Army Electronic Proving Ground
Fort Huachuca, Arizona

| | | |
|---|---|---|
| 2 Supv. Electronic Engineer | GS-855-14 | General |
| 1 Military Intelligence Analyst | GS-134-9 | |
| 1 Contract Specialist | GS-1102-12 | |
| 1 Meteorologist | GS-1340-12 | General |
| 1 Meteorologist | GS-1340-11 | General |
| 1 Engineer | GS-801-11 | General |
| 1 Engineer | GS-801-9 | General |
| 1 Wildlife Manager | GS-485-9 | |
| 1 Electronic Engineer | GS-855-13 | General |
| 1 Electronic Engineer | GS-855-13 | Radio |
| 1 Electronic Engineer | GS-855-13 | Instrumentation |
| 1 Electronic Engineer | GS-855-13 | |
| 1 Supv. Electronic Engineer | GS-855-12 | Instrumentation |
| 1 Supv. Electronic Engineer | GS-855-12 | General |
| 1 Electronic Engineer | GS-855-12 | General |
| 3 Electronic Engineer | GS-855-12 | Wire Communication |
| 2 Electronic Engineer | GS-855-12 | Radio |
| 1 Electronic Engineer | GS-855-12 | |
| 1 Electronic Engineer | GS-855-11 | Wire Communication |
| 1 Electronic Engineer | GS-855-11 | General |
| 3 Electronic Engineer | GS-855-11 | Radio |
| 1 Supervisory Elct. Technician | GS-1671-12 | General |
| 1 Electronic Technician | GS-1671-9 | Instrumentation |
| 3 Electronic Technician | GS-1671-9 | |
| 1 Electronic Scientist (Supv.) | GS-1312-12 | General |
| 1 Electronic Scientist | GS-1312-11 | Radio |
| 1 Psychologist | GS-180-11 | |
| 2 Mathematician | GS-1520-13 | |
| 2 Mathematician | GS-1520-11 | |
| 1 Supv. Analytical Statistician | GS-1530-12 | Engineering |
| 1 Analytical Statistician | GS-1530-9 | Engineering |
| 1 Supv. Management Analyst | GS-303-12 | |
| 1 Management Analyst | GS-303-11 | |
| 1 Management Analyst | GS-303-9 | |
| 1 Supv. Physicist | GS-1310-13 | General |
| 2 Publications Editor | GS-010-9 | Phys. Sciences & Engr. |
| 1 Publications Writer | GS-010-9 | Phys. Sciences & Engr. |

Scenario Writer ($7570 per year). Six years of progressively responsible and successful experience in writing scenarios, script, dialogue for motion pictures or related fields. Experience must include three years in field of motion pictures. Substitution of education for experience: successful completion of study in college or university may be substituted for not more than 3 years of the required experience on the basis of one year of education for each 9 months of experience. No educational substitution will be allowed for experience in the field of motion pictures. Grade GS-1071-12. Army Pictorial Center, Long Island City 1, N. Y.

Teletype Operators, Coastal Station Radio Operators. International communications company. Liberal company benefits. Submit resume with name, address, age, past experience—if any, military experience—if any. FCC Second Class Radiotelegraph license required for Coastal Station Radio Operator. Write to Asst. Director of Personnel, RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

Packaging and Preservation Specialists GS-7 and 9 ($4525 to $6250 per year) are needed by the Philadelphia U.S. Army Signal Supply Agency to develop and write specifications for preservation, packaging, packing and marking of Signal Corps equipment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

# Books

***THE WAR POTENTIAL OF NATIONS, by Klaus Knorr. Princeton University Press, Princeton, N. J. 310 pages, $5.00.***

Klaus Knorr, of the Center of International Studies at Princeton, copes with 2 problematic issues in this pioneering treatise: What is the true concept of "war potential?" and, is it, as distinguished from mobilized strength, important in a world where total nuclear war can annihilate an enemy in a matter of days?

Rather than confining his study to one of "economic" or "industrial" potential, the author interrelates all other elements he believes constitute the latent strength of nations. Specifically, Professor Knorr is equally concerned with a government administration so effective that it allows no situation to be unforeseen or insurmountable, and with the morale components of a population so well motivated by government-fed mass media of communication that it has "the will to fight."

To illustrate and buttress his economic concepts, Professor Knorr cites many interesting historical accounts of economic mismanagement and strangulation.

Combining the methods and the researches of political scientists, sociologists, psychologists, historians and economists, the study nevertheless has been directed in its presentation to the non-specialist reader.

***FROM THE GROUND UP, by Sandy S. F. MacDonald. Aviation Service Corp., Ltd., Port Credit, Ontario. 156 pages, 256 illustrations, paper bound, $5.00.***

A complete coverage of material required in preparation for private or commercial pilot examinations is available in this newly-revised aviation training manual.

Offering solution and analysis of 193 typical examination questions, the handbook, however, does not cover instrument flying requirements for public transport pilot's license.

Timely additions to this tenth edition include Controlled VFR, Decca, Radar Advisory Service, the astro compass, new VHF radio equipment, omni and ADF, hazards of tip vortex, the by-pass gas turbine engine, new ADIZ rules and regulations, and "busy" signal at radio beacon stations.

***ATOMS AND ENERGY, by Professor H. S. W. Massey. Philosophical Library Inc., New York. 174 pages. $4.75.***

The potential of a hydrogen bomb, already highly publicized by newspapers, is an example of the immensity of the new power now available for war or for peace as a result of the development in atomic physics.

Analyzing those events in atomic research development which led to the large-scale release of atomic energy, Professor Massey presents this, his central theme, with concern for the non-scientific reader. Technical aspects of the development are eliminated from his discussion, but, it is believed, with no sacrifice of accuracy.

Included in the study is a chapter discussing the applications of atomic energy for medical and industrial purposes along with its destructive possibilities. Among the many interesting descriptions included in Professor Massey's study is the explanation of the conversion of atomic energy into heat in the sun and stars.

A final chapter focuses attention on present-day research.

***SPHEROIDAL WAVE FUNCTIONS, by Dr. Carson Flammer. Stanford University Press, Stanford, Calif. 220 pages, $8.50.***

The importance of spheroidal wave functions in the mathematical solution of many problems—both in acoustics and electromagnetic wave theory, and in atomic and nuclear physics—accounts for the prominent place which this up-to-date monograph is expected to fill as an essential reference tool for mathematical physicists, mathematical engineers and applied mathematicians.

Authored by the senior mathematical physicist in the Engineering Division of the Stanford Research Institute, the treatise presents a historical survey of the development of the functions together with an account of the many diverse physical problems to which the functions have been applied.

Coverage of the theoretical properties is claimed to be more nearly complete than any previous work in the field. As an aid in the use and calculation of spheroidal wave functions, tables and detailed accounts of the function properties are included.

***GUIDED WEAPONS, by Eric Burgess. The Macmillan Co., New York 11, N. Y. 255 pages, $5.00.***

Whether or not the concept of the deterrent power of technological weapons of mass destruction is sound, we are coming to regard science as synonymous with salvation. A rocket capable of vast destruction, continents away from its launching site, is no longer a fantasy, for it has been demonstrated that long-range guided weapons can be a part of a nation's armory.

For layman or engineer interested in this timely subject, this book provides essential details of every type of missile, both in production and in the planning. Classifying each type of missile according to use, the author treats the various categories separately, centering his discussion on specific technical features such as the guidance system, the power plant, the propellant, and lethal effectiveness. Explanations are simplified but accurate.

The dramatic account of missile development since the time Germany first used them against Allied shipping in WW II, the penetration into the dilemma of maintaining a balanced economy while creating a national defense system based upon guided weapons, and the exploration of future achievements in missile production—all should make the reading of Mr. Burgess's book an exciting adventure and a rewarding experience.

***RETIREMENT FROM THE ARMED FORCES, by A Committee of Retired Army, Navy and Air Force Officers. The Military Service Publishing Co., Harrisburg, Pa. 431 pages, $4.95.***

The increasing span of human life and the lowering retirement age for Armed Forces personnel has given an ever-growing importance to the need for consideration of the problems encountered in the transition from Service life to retirement.

Enlivened by a considerable amount of humor and informal discussion, the book presents an account of experiences and advice assembled from investigations of several thousand retired officers.

Treatment of numerous topics closely related to retirement is based on the advice of experts in those respective fields. Completely cross-referenced and indexed, the work includes reference data concerning: a new position; savings and investments; advice for the widow; V.A. benefits and Social Security; Service benefit restrictions; pay, allotments, taxes and claims, and means for setting up in business.

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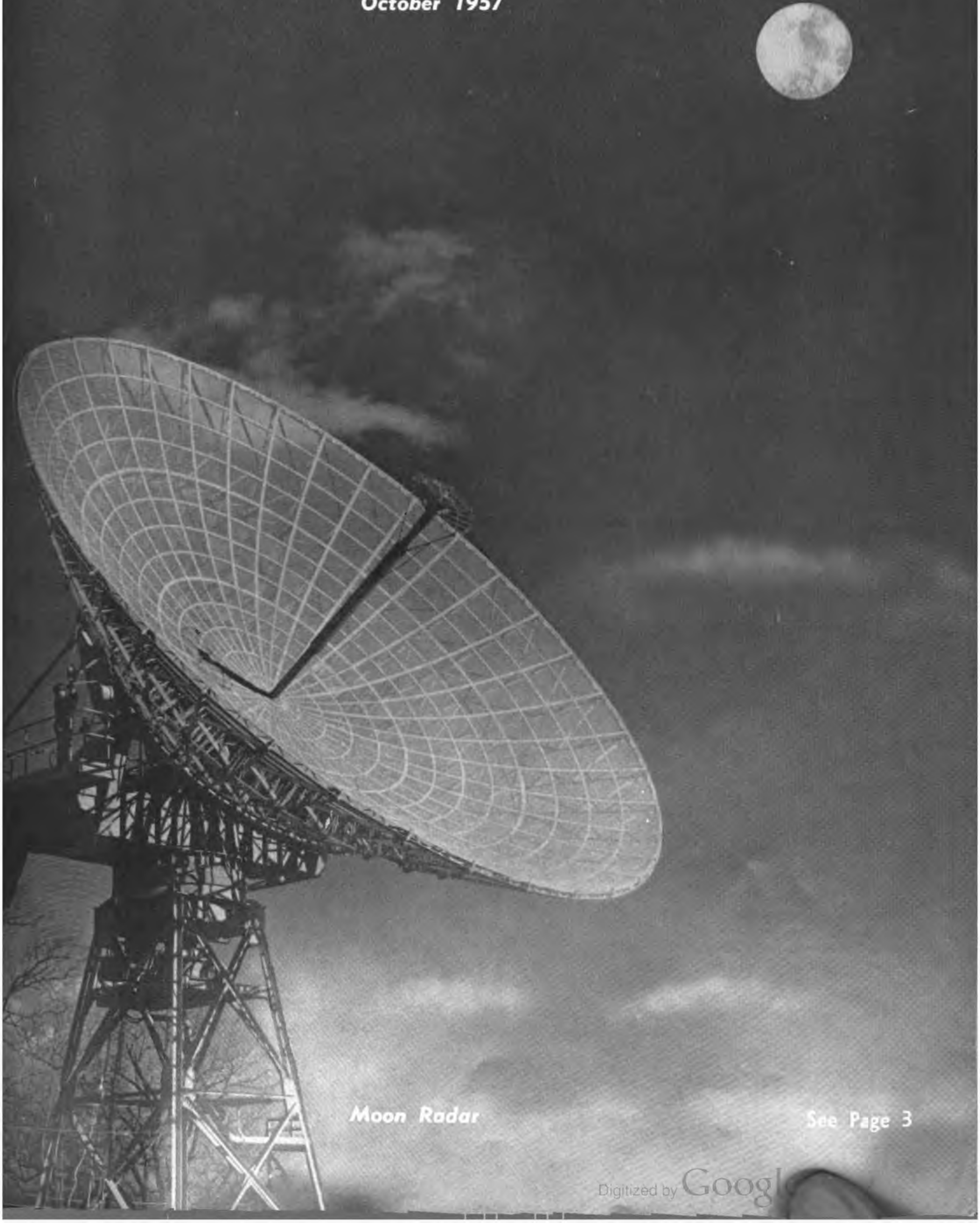
October 1957



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See Page 3

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**Communications-Electronics-Photography**

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hoto News
FRANK SMITH

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### COVER

*Someone is communicating with someone in space, and it could be the man in the moon!*

SIGNAL'*s cover pictures the giant moon radar antenna, DIANA, which has demonstrated the power to transmit signals strong enough to be reflected by the moon's surface and received by an earth satellite tracking station.*

*In preparation for Project Vanguard, this powerful equipment was developed by the U.S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., and is currently being used to calibrate equipment in the ten Minitrack radio stations which, when in operation, will report the movement of the earth satellite as it journeys around the world.*

### Special Notice

For the past year, the Association has assumed the increased cost of publishing a monthly magazine in place of a bimonthly publication. This additional cost, coupled with an increase in production and mailing rates, has been considerable. We now find it necessary to effect the following changes in our non-member rates for renewal of subscriptions to SIGNAL after November 1, 1957. The domestic rate will increase from $6.00 to $7.00; the foreign rate will increase from $6.50 to $8.00.

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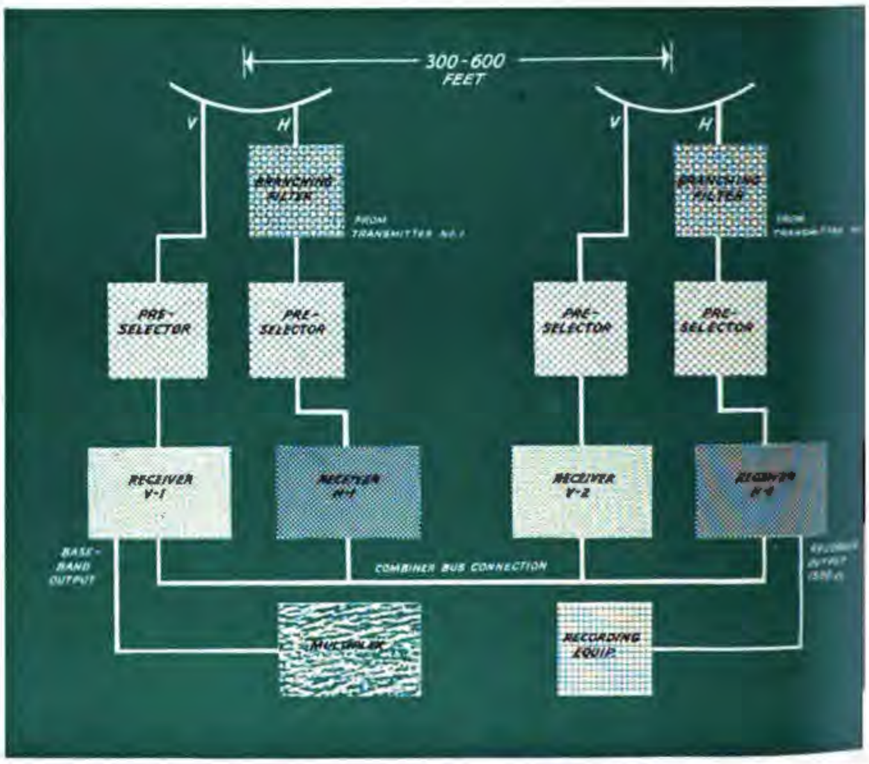

*Typical quadruple diversity operation of REL combining receiver. Output to multiplex available from all receiv V = vertical polarization, H = horizontal.*

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## WILFRED B. GOULETT

*Captain, USN (Ret.)*
*Executive Vice President, AFCEA*

★ ★ ★

**Having retired in 1955 after a distinguished Naval career which had centered his activities in the fields of communications, radio engineering and research, Captain Wilfred Bradley Goulett, USN (Ret.), newly elected Executive Vice President of AFCEA, assumed his new position on October 1, 1957.**

**Born in Stevenson, Conn., Captain Goulett evinced interest in communications during the early years of his schooling when he became a Western Union telegraph operator. He spent his summer vacations following this trade until his appointment to the United States Naval Academy, for which he had prepared at the Werntz Preparatory School, Annapolis, Maryland.**

**Following his graduation from the Naval Academy in 1925, and until 1930, Captain Goulett served aboard the *USS California*, the *USS Neches* and the *USS Saratoga*.**

**In June 1930, he received postgraduate instruction in communications engineering at Annapolis. Subsequently, he continued this study at Yale University where he received his MS degree in 1932. Captain Goulett was then assigned to the *USS Indianapolis* for two years, and from 1934 to 1942, respectively, he was Radio Officer on the staff of Commander Battleship Division TWO; a member of the Radio Division, Bureau of Engineering, Navy Department, Washington, D. C.; Radio Officer on the staff of Commander Battle Force, *USS California*; Fleet Radio Officer on the staff of the Commander in Chief, U.S. Fleet, *USS Pennsylvania*, and Officer Representative for Radio and Underwater Sound at the Naval Research Lab., Anacostia, D. C.**

**For his extremely meritorious service during the fulfillment of duties as Radio Officer on the staff of the Commander in Chief, U.S. Pacific Fleet (1942-1945), Captain Goulett was awarded the Bronze Star Medal.**

**Captain Goulett assumed command of the *USS St. Mary's* in 1945 and the *USS Navarro* in 1946, following which he attended and graduated from the Naval War College in 1947.**

**With subsequent duty in Washington and at sea, he reported for duty in 1950 as Head of the Plans and Readiness Branch, Communications Division, Office of the Chief of Naval Operations. In February 1951, he became Assistant Director of that Division and in August of the same year, was appointed Director.**

**After a year's service as Commander Transport Division 23, Captain Goulett spent 4 months as Commanding Officer of the Naval Station at Long Beach, Calif. Returning to Washington, he served as Staff Director, Communications-Electronics, Office of the Joint Chiefs of Staff, until June 1954, and then served a year as Group Commander, Long Beach Group, Pacific Reserve Fleet, prior to his retirement on June 30, 1955.**

**Captain Goulett has the American Defense Service Medal; the American Campaign Medal; the Asiatic-Pacific Campaign Medal; the World War II Victory Medal, and the Navy Occupation Service Medal, Asia Clasp.**

**AFCEA is pleased to welcome Captain Goulett aboard as its Executive Vice President.**

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# *what price* RELIABILITY?

**by Angus A. Macdonald**
**Director of Engineering**
**Communications and**
**Industrial Electronics Div.**
**Motorola Inc.**

IF YOUR NEIGHBORS ACCUSED YOU of being a thief, a vandal and a traior you would undoubtedly be shocked and hurt and would certainly protest your innocence. Start preparing your case, because you stand here accused on each of these counts if you have in any way contributed to the present state of poor reliability in our field. Untold millions of dollars are being wasted annually due to our faulty practices in procurement, design and production of electronic equipment.

If you are a contracting officer, a purchasing agent or a design engineer, you have probably contributed materially to this serious state of affairs. Unless our design and purchasing practices are changed and a significant improvement is made in terms of real reliability of electronic equipment, the growth of electronics in our economy is doomed to be self-limiting. I am certain that these practices will change, and are even now being changed because of economic considerations.

It is vital that we all appreciate that poor reliability is largely determined by our design and purchasing concepts and that we take appropriate corrective steps now so that the growth of electronics will not be stunted.

I am convinced that there are four basic contributors to poor reliability in electronic equipment:

(1) Excessive detail in specifications for basically new equipment.
(2) Inadequate experience and training of the design engineer, leading to immature design philosophies.
(3) An inadequate product evaluation program prior to full-scale production.
(4) A lack of continuity of production and use, or a lack of a complete feedback loop from the user back to the designer.

In explanation of these four basic factors, let us investigate first the result of excessive detail in design specifications for new equipment. Where the purchase of new equipment is governed by specifications, rather than experience and competitive performance tests, these specifications are usually written around specific design details rather than providing a comprehensive review of all performance requirements. In writing specifications on design details, it is practically impossible to avoid writing in requirements which hurt reliability.

For example, the specifications of unduly stringent size, form factor and weight limits can lead to poor reliability through crowding and overheating of the components. Oftentimes, also, through a desire to achieve the universal gadget and to make all users happy, the specifications require excessive complexity in the equipment. This is a sure path to poor reliability. A simple thing like the specifications of continuous tuning in a communications receiver or transmitter can seriously degrade reliability. It is frequently found in such cases that the end use does not actually require continuous tuning.

Detailed equipment specifications, to some extent also relieve the manufacturer of responsibility for equipment performance and place this responsibility in the hands of the specification writer. To a large degree, detailed specifications also remove the competitive motive, again because the specification writer assumes responsibility which should rightfully be in the hands of the equipment designer.

Second among our four factors is that the design engineer is probably the one person most responsible for reliability, or lack of it, in any equipment design. It is his basic design philosophies and ingenuity which permit the incorporation of a wide safety margin or, failing that, result in a marginal design. The engineer can be severely hampered by detailed specifications or a complete lack of information regarding the end use or field performance. These are, as we shall see, contributing factors for good or bad. The major responsibility still rests with the engineer.

It is almost impossible for an immature engineer to design a basically sound piece of equipment. A poor choice of components, or a misuse of components, will both lead to poor reliability. However, the fact remains that even if all components are properly chosen and are used within their ratings, the basic design may still be unreliable if the design philosophies do not make maximum use of adequate system margins and "go-no-go" circuitry. The immature or inexperienced engineer does not have the background or knowledge of design history and customer application of the equipment to permit him to achieve the maximum reliability for a given equipment price range. It is necessary to devote considerable time and effort toward indoctrinating new engineers in the optimum design philosophies which are gradually established in a mature electronics field.

Third, as a fundamental factor contributing to poor reliability, is an inadequate product evaluation program. The product evaluation program should be planned to serve as a check on the validity of the basic design, rather than serve as a proving ground where fundamental design modifications are tried out. I think it is safe to say that a sound design will require only minor modifications as the equipment progresses through various tests.

You have all seen cases where an evaluation program showed up the requirement for major design modifications. These situations indicate an unsound design. On the other hand, minor modifications are frequently indicated. It often happens that an evaluation program will show up not only component or design defects in new equipment, but also defects which have existed in older designs. As an example, just recently we had a case where evaluation of a new design indicated that the crystal oven in a transmitter was not reaching operating temperature in a —30° C ambient. Investigation showed that the heater voltage at the oven was below the design center in other equipments as well as the transmitter being evaluated. This finding led to a change in the design center of the oven voltage. The other equipment had all been previously evaluated and had functioned perfectly in the low temperature environment. How can this happen? It is always amazing how new problems continue to crop up in old designs running in continuous production. *It is often painfully apparent that continuing product evaluation programs are vital to equipment reliability.*

The fourth contributor toward poor reliability is a lack of continuity of production and use of the equipment, or a broken feedback loop from the user back to the designer. In a normal commercial operation the manufacturer of equipment assumes a continuing responsibility for its performance. This responsibility is forced on him by the fact that he must successfully compete over a long period of time if he is to make a profit.

In order to show a profit, a commercial organization must produce a product which not only appeals to the purchaser originally on the basis of value received for the dollar spent, but also continues to provide a performance equal to, or better than, a competitive piece of equipment which might have been purchased and which may be purchased next time. In other words, the customer has to remain sold. Due to this profit motive, leading manufacturers in any commercial field achieve a high degree of maturity in their product as a result of a well-organized and continuing feedback loop from the user to the design engineer. Checks and balances are imposed upon the procedure for bringing out new products so that the product reaches the market at a high point of maturity. In this manner the maximum customer satisfaction is achieved, and the correction of field problems does not burden the producer.

We recently had a case of poor reliability in a particular tube type. which cropped up several years after the tube had been incorporated in production equipment. In this case. the problem was found as a result of feedback from the user. Investigations showed that failure of the heater of the defective tube was occurring as a result of vibration and was damaging other components in the equipment. In this case, failure of the heater usually resulted in a heater-to-cathode short which provided almost normal operation. Therefore, the failure was not evident to the user. However, as long as the defective tube remained in its socket, other tubes and components were damaged. After investigation, it was found that the manufacturer had changed the number of folds in the heater of the tube and had so weakened it that early failure due to environmental conditions was frequent. This was corrected by changing the heater design back to the original, which had provided good reliability.

Note well that in the long run in commercial markets, the manufacturer and not the user assumes responsibility for the reliability of his product.

Unfortunately, military procurement is not now set up on a basis which will permit either a continuing production or a complete feedback loop from the user to the designer. In military equipment the responsibility for the performance of the equipment in the end use is assumed by the *user* rather than being properly brought home to the equipment manufacturer.

Naturally, if the electronic equipment is built in accordance with detailed technical specifications supplied by the user, he must, of necessity, assume a large degree of responsibility for the product he receives. However, this is an artificial situation. In commercial markets vou will generally find an extremely high degree of reliability at a reasonable price, not only in electronic equipment but in other complex designs because the profit motive remains as a continuing factor in the product evolution.

### *Control of Fundamental Factors*

What must be done, then, to achieve a high degree of reliability in both commercial and military electronic equipment? A program must be established which recognizes and makes a specific effort to control the fundamental factors contributing to reliability:

(1) Detailed specifications should only be written to permit duplication of existing equipment. In any other case, specifications should permit sufficient latitude to achieve the desired reliability.

(2) Top engineers with long experience in the particular field involved should be responsible for new development.

(3) Component evaluation and selection must be made with th end use in mind.

(4) A specific program for equipment evaluation prior to production and continuing durin product life must be established.

First, unless you have a finishe piece of equipment which reliabl performs the task it was designed t do, you should not write detaile specifications. To do so implies th the specification writer knows a that is required to obtain an opt mum design for that equipmen Specifications which are written o *new* equipment to perform a *new* ta should specify the reliability require and should concern themselves pri cipally with considerations of the e vironmental factors to be encou tered. They should detail the inpu and output requirements, and the should give the broadest possible i terpretation on size, weight and for factor limitations. This type of spec fication will permit the designer a tually to incorporate reliability as prime consideration in his desig rather than an afterthought.

Second, the key engineers respo sible for the design should be th best and most experienced that ca be found, not only by reputation bu as judged by actual past performance. The key engineers should b completely familiar with the end us requirements for the equipment an should be well versed in the partic lar field involved in the design. Th basic philosophy of the design shoul aim toward the achievement of th maximum possible safety factors consistent with economic and space considerations. The engineer should appreciate the vital importance of "go no-go" circuitry as contrasted to proportional. He should establish optimum basic design and then find out how to achieve it within the dollar budget. Oftentimes, the exercise of considerable ingenuity will lead to a design philosophy which yields a higher degree of reliability than prior, similar designs. For this reason the best engineers are required for any fundamental design projects even small ones.

Third, as the basic design concepts are established, component selection and evaluation will play an important part in the over-all reliability. It is this stage that determines the detailed reliability for the initial design. It is also component selection which is most frequently affected by both in-plant evaluation tests and feedback from similar field uses.

Finally, a specific program should be established for equipment evalua-

*on prior* to production, and if you e really serious about desiring a *gh degree* of reliability, it is necesary to set up a system whereby con*uing* feedback may be established etween *the user* and the design en-ineer.

*In order to* achieve the continuing edback loop and the benefits from *ell-qualified* and well-trained engi-eers, it will be necessary for mili-*ry procurement* to establish some ew policies:

(a) Different types of electronic gear should be purchased on a continuing competitive basis from at least two sources. Competition should be based on both price and performance of the equipment. Performance should be evaluated as a result of feedback from the actual user in the field. Correction of reliability problems should be done on a continuous basis.

(b) The soundness of the fundamental design should be established, not only by an evaluation program but also by the qualifications and training of the engineers responsible for the design. This means, for example, that communications equipment should be purchased from manufacturers who have a position in the communications field, and not from an untried organization which is low bidder.

Let's put competition and the profit notive to work for the military to elp achieve reliability rather than o hurt it.

In commercial communications products we have found that the optimum results are achieved by the following seven programmed steps in evaluating a new product:

1. The breadboard design is evaluated to determine that the basic philosophies are sound and that it is producible by standard techniques which are capable of providing a high degree of reliability.
2. A preliminary model is screened by engineers, manufacturing personnel, field quality control and field service personnel. At this screening, all factors affecting producibility, reliability, serviceability and customer satisfaction are reviewed. Design modifications are made as a result of this screening. In some cases it may be necessary to hold a second screening meeting if the design modifications are extensive. In any case, approval of the product leads next to a production pilot run. The quantity involved in the production pilot run is based upon the quantity to be produced. It has been found desirable to run extensive pilot runs on equipment to be built in large quantities. The pilot run not only permits an evaluation of the product itself, but also indoctrinates all phases of the production activity.
3. The pilot-run equipment is given a complete in-plant evaluation consisting of special engineering tests to determine that the design centers are properly established. In addition, the equipment is checked completely by environmental tests. Subsequent to this, pilot-run equipments are put in service in the field in a planned program to obtain field evaluation and accelerated follow-up on any problems which arise. After this program has established the validity of the basic design, production is started.
4. The first units off the production line are again evaluated in every respect by special engineering and environmental test to make sure that the production product is the same as the pilot run.
5. As production continues, inspection and tests of incoming components and finished goods assure that the manufacturing quality remains at a high level.
6. Spot checks of the production units in great detail by a superposed quality control group give assurance that the production quality continues to meet the bench marks established in the pilot run.
7. Once production has been started on a continuing basis, feedback from the user to the designer, or the engineer responsible for the design, assumes a position of major importance in furthering product maturity. In order to achieve the greatest advantage from the feedback loop, it is essential that the communication path from the user to the engineer having design responsibility is as short as possible. This makes it desirable that the engineer visit user groups at frequent intervals to discuss their problems and the application of the product.

Despite all the checks and balances which have been installed up to the point that the equipment is shipped to the field, it has been found that the omission of the feedback loop can permit serious reliability problems to creep into the product and build up to gigantic proportions prior to correction. The closed loop, on the other hand, permits the proper emphasis to be placed on field problems so that by process of successive approximations, the design is improved and maintained at a point of maximum reliability. It should be pointed out that it may be necessary as a result of field experience to institute research programs to solve reliability problems which are encountered as the life of the equipment continues. It has been found that careful sifting of user complaints or criticisms will yield early information regarding a potential reliability problem.

### *Some Basic Steps*

We should all agree to stop weighing down our economy with immature equipment and take those steps required to achieve electronic equipment with a maximum of reliability. The four major steps required are:

1. Write specifications on equipment operational requirements for new equipment, rather than design details.
2. Adopt basic design philosophies which will yield the maximum reliability for a given dollar invested. This is best accomplished by experienced engineers.
3. Adopt component evaluation programs to provide components having maximum reliability for a specific application.
4. Provide an extensive equipment evaluation program which assures a maximum of reliability prior to starting production. Also provide a closed feedback loop from the customer to the designer to mature the product on a continuous basis.

Maximum reliability is achieved as the result of an arduous process of successive approximation toward an optimum solution, and not as a result of a one-shot command performance. If we are to assist the growth of electronics, we must promote the achievement of maximum reliability for both commercial and military equipment.

# DOPPLER SYSTEMS [illegible]D FUTURE AIR NAVIGA[illegible]N

### by William J. Tull, Vice President General Precision Laboratory, Inc.

### a Military Contribution

THE FACTS AND FIGURES OF A NEW page in the history of air navigation, the Doppler page, have been released from security classification, and the operating techniques and accuracy that have revolutionized military air navigation in the past few years can now be revealed by General Precision Laboratory (GPL) of Pleasantville, New York.

Articles on Doppler navigation have appeared before, but the true impact of the systems, the remarkable accuracies and simplicity, and, as a result, the implications of these systems for commercial aircraft, awaited the recent Department of Defense release of GPL figures.

The navigation systems are completely self-contained within the aircraft. They operate by transmitting microwave energy to the ground and measuring the return reflection. The Doppler shifts, the difference in frequency between the transmitted and "echo" signal, give the pilot of today the basic information he needs for navigation, the ground speed and drift angle.

When connected to a variety of computers and heading references, the Doppler systems become completely automatic, and allow the pilot to fly "no hands"—anywhere, over the best and shortest routes, in any weather, over any terrain, over the poles, over water and at the best altitudes, taking advantage of the most favorable winds.

### Accuracy of the System

Accuracy of the Doppler systems, as revealed in figures obtained from hundreds of flights and now released for the first time, is the best recorded anywhere—so good, in fact, that the computers, the compass and human observations contribute far greater errors in over-all navigation than do the Doppler components.

As far back as 1951, a GPL prototype APN-66 system installed in an Air Force B-29, navigated the aircraft 2,400 nautical miles from Seattle, Washington, to Miami, Florida, with a previously unheard of 9.4-mile gross position error of 0.4%.

In 95 long-range flights over distances, in some cases, of several thousand nautical miles, the prototype APN-66 recorded probable range errors of 0.17%, probable transverse errors of 0.16° and probable system position errors of 0.63%. And these were total system errors, a figure combining errors in the computer, compass, human observation and the Doppler equipment. Over 500 shorter range flights have brought comparable results, the figures reveal.

Whereas previous wind errors and ground speed errors were so serious that further development of a precision compass seemed unnecessary, with GPL's Doppler equipment, the tables have been turned. Wind information and ground speed are now so accurate that errors in the compass itself introduce the major system accuracy problem.

The GPL APN-66 is referred to as a "one-percent" system, a system with specifications calling for total errors of less than 1%. Actually, the performance far exceeds the specifications, as shown by the 0.63% figure mentioned above. It operates at altitudes up to 70,000 feet and at speeds greater than the speed of sound.

Errors in the Doppler components of the "66" were so insignificant compared to over-all system errors that relaxing some of its rigid specifications has led to the development of another GPL Doppler system known as RADAN. This compact system was specifically and conceptually designed to reduce equipment weight and is not a transistorized version of the larger systems. It trades small additional errors for great savings in weight and spac and, altogether, probably represents the highest state of the present art.

RADAN equipment consists of an antenna-receiver-transmitter, a frequency tracker, one small control panel and a display panel. Ground speed with accuracies of 1% or better, and drift angle, accurate to ½° result from this equipment, although the system weighs only 89 pounds and occupies just 4.4 cubic feet of space. RADAN has altitude capabilities of 70,000 feet and speed capabilities up to 1000 knots.

Combined with computers, RADAN equipment gives position, course, destination and other information roughly comparable to the APN-66. Over-all system performance with a certain computer can make the RADAN computer combination a "two-percent" system, yet weigh as little as 150 pounds.

### Janus Techniques

All of the present GPL Doppler equipments utilize Janus techniques, so named after the mythical diety who looked forward and backward at the same time. Four pulsed microwave beams, two forward and two rearward, are transmitted from the plane in pairs, front-right and rear-left, then front-left and rear-right, at a carrier frequency of 8800 mcs.

A Doppler shift in the frequencies from one pair is compared automatically to the shift from the other pair. When a difference is discovered, this "error" signal actuates a servo-mechanism that drives the antenna to a position exactly lined up with the ground track. The difference between how the antenna is pointing and how the plane itself is pointing is the drift angle.

With the Janus system, when the difference between the pairs is eliminated, the actual measure of the Dop-

(Continued on page 12)

## and in knowing how...EXPERIENCE is the key factor

Lewyt's Coordinate Data Printer is designed to operate interchangeably with two types of Lewyt-developed Coordinate Data Monitors. This new Printer provides for instantaneous recording of target data displayed by the monitors.

Lewyt experience in working with such government research centers as Air Force Cambridge Research Center, Air Research and Development Command...and M.I.T.'s Lincoln Laboratories, has produced unusually effective data processing and data transmission equipment.

For example, the Coordinate Data Printer developed by Lewyt in close cooperation with the Air Force Cambridge Research Center and M.I.T.'s Lincoln Laboratories was actually designed, engineered and *the first production model delivered* IN JUST SIX MONTHS!

Lewyt's skill and resourcefulness in the most advanced electronic techniques are also being applied to other projects in Data Processing and Data Transmission, UHF and VHF communications, Navigation Guidance, Infra-Red and other related fields. Lewyt Manufacturing Corporation, Long Island City 1, N. Y.

**LEWYT**

pler shifts from the return echoes are proportional to the ground speed.

The many economical and practical advantages of a Janus system relate to the high accuracies obtained with very low necessary tolerances. For example, if a return echo must be compared to a transmitting frequency (as in non-Janus systems) it becomes crucial that the transmitting frequency be stable and known with great precision. Manufacturing of such transmitters, as well as maintenance, becomes difficult. Also, constant temperatures in the plane become necessary and expense becomes exorbitant. With Janus techniques, because beams are pulse propagated in pairs, only the echoes are compared. Therefore, if the transmitter has wandered off frequency, it does not matter.

Also, for 0.1% speed accuracies, non-Janus systems must know the vertical position of the antenna within 1/50th of a degree. With Janus techniques, knowing the vertical position of the antenna within 2 degrees will produce the same 0.1% accuracies. Again, the advantages in cost, ease of manufacture, ease of maintenance, etc., appear overwhelming.

The history of GPL Doppler equipment development goes back to 194 and 1945 before the General Precision Laboratory was organized. In a article written for the MIT Radiation Laboratory Series in 1944 the author outlined the basic Dopple techniques that could replace rada fix-taking procedures and achieve accurate ground speed and drift angl measurements automatically.

Several proofs that Doppler coul not work for aerial navigation hel widespread acceptance until D France B. Berger, now GPL's Director of Research Planning, usin Quantum Mechanics and Relativit Theory, proved that earlier assumptions were wrong.

The company was organized as subsidiary of General Precisio Equipment Corporation in November, 1945. Later, the first groun speed and drift angle measuring device utilizing Doppler shift wa "flight tested" from the top of a prewar Mercury automobile at the youn company's Westchester County Airport facilities.

### *Joint Venture*

Combined talents of GPL personnel and personnel of the Wright Ai Development Center, Wright-Patterson Air Force Base, Ohio, solved the theoretical and practical problems that confronted Doppler development In 1947, the first Doppler effect ground speed was measured in flight by an experimental forerunner of the APN-66. In April 1948, both ground speed and drift angle were measured for the first time in another experimental forerunner of the present systems.

The first complete automatic navigation gear incorporating these components was flown in 1949, and in 1951, GPL's APN-66 (XA-1) began navigating the series of flights which compiled the records for accuracy and performance described above.

Quantity delivery of GPL Doppler systems to the Air Force since 1954 has stamped GPL as the world's leading manufacturer of such equipment. From its beginnings in 1945 with some twenty "Radiation Laboratory" men, it has grown to a company employing more than 2000 persons.

Cooperation with and encouragement from the United States Air Force throughout GPL's history has now culminated in the release of these systems for commercial as well as military aviation, further indication of the military contribution to developing the commercial products of the future.

IMMEDIATE DELIVERY

# Two Versatile Instruments for Microwave Testing

## *Microline** 539 VSWR Test Set for fast check of X-band radars

his direct-reading test set accurately measures the oltage standing-wave ratio of X-band radars during stallation, maintenance and repair. Compact and portble, it consists of a klystron oscillator, high-directivity irectional coupler, detector, amplifier and indicator. ower supply and modulator. Meter gives continuous ndication, making the Microline* 539 valuable for djusting standing-wave ratio. As the AN/UPM-12, the icroline 539 meets all requirements of Specification IL-T-945A.

**MICROLINE 539 SPECIFICATIONS**

| | |
|---|---|
| VSWR Ranges | 1.05–1.3±5%<br>1.3–2.0±5%<br>2.0–3.0±10%<br>3.0–10.0 uncalibrated |
| Freq. Range | 8.5–9.6 kmc |
| Waveguide Connection | RG52/U (1 x ½ waveguide) or<br>RG51/U (1½ x ¾ waveguide)<br>through accessory adapter |
| Dimensions | Length 19½ in.<br>Width 12 in.<br>Height 10¼ in. |
| Weight | 35 lbs. |
| Power Requirements | 105–125 volts<br>50–1000 cycles<br>75 watts |

## *Microline** 555 Klystron Signal Source operates klystrons up to 3600 volts

A universal power supply and modulator for klystrons requiring up to 3600 volts, the Microline 555 also operates traveling wave tubes. It is used as a microwave source for measurements and testing experimental equipment. Main features include precise voltage regulation (0.025% max. variation), internal modulator which supplies sawtooth, sinewave or squarewave modulation to tube, convenient controls and repeatable settings.

*T.M. REG. U.S. PAT. OFF.

**MICROLINE 555 SPECIFICATIONS**

| | ANODE | REFLECTOR | GRID |
|---|---|---|---|
| Voltage Range: | −250 to −3600v | 0 to −1000v | 0 to −300 |
| Max. Variation: | 0.025% | 0.02% | 0.02% |
| Max. Ripple Voltage: | 10mv | 5mv | 50mv |
| Current Range: | 0–120ma (250 to 1250v)<br>0–15ma (1250 to 3600v) | | |
| Power Requirements: | 115v ± 10%, 50-60cps, 500w | | |
| Dimensions: | 19¼"W x 21½"H x 15"D | | |
| Weight: | 151 lbs. | | |

For prices and further details, phone or write our Microwave Electronics Division.

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# miniaturization

by W. W. Hamilton, Elgin National Watch Company

Manager, Commercial Sales, Micronics Division

MINIATURIZATION, LIKE automation, has been cursed by a variety of definitions that usually fall short of properly identifying the subject. I am not going to complicate this situation further with a new definition, other than to explain what we at Elgin feel is the logical picture.

At Elgin, for nearly 100 years now, we have dealt with things miniature, a factor which has set a pattern for making, gauging, inspecting and handling subminiature, and sometimes microscopically small parts and assemblies with considerable skill. Basically then, we are on firm ground from the point of heritage alone when speaking about miniaturization, especially as concerns its application to day-to-day mass production.

Elgin entered the commercial field of miniaturization less than two years ago because we were getting increasing requests from outside concerns for help with miniaturization problems. From the outset, the response to our entering this field was most encouraging. The success of the venture in so short a time has more than justified our decision.

An example of the type of problems the average manufacturer can have with miniaturization was brought to our attention not more than a month after our new program started. We were called upon by an established manufacturer of special control devices for help in producing a miniaturized version of one of their most successful items. It is important to note that they had already designed a smaller version of the device, a sensor, but realized they had no machinery or know-how to produce it. One of their chief problems was dimensional tolerance. They had no idea what strengths or stresses each pinion, pivot, fly-ball arrangement or plate should have, nor what materials to use to achieve these factors.

Elgin was permitted to re-design any part or major assembly in the device. We successfully delivered prototype models which are now under test for use in jet aircraft.

How was the job accomplished? First of all, our design engineers worked with the customer, learning necessary data to permit their intelligent re-design of the unit. It had already been established that manufacture would be directed by the size of Elgin's machines which were capable of producing a truly miniaturized version of the sensor. In actuality, we reduced the unit by a ratio of 5 to 1, or when figured cubically by a ratio of 100 to 1.

### *Parts Density Theory*

We applied what is called the parts density theory to the job. It works this way: One of the smallest precision mechanisms made at our plant is, of course, the movement for a ladies' wrist watch which consists of nearly 125 parts in an area the size of three dimes stacked together. This works out on a cubic inch measurement basis to about 104 parts per ¾ cubic inch of space and determines a size base to which our machines and personnel are normally geared, and which would not necessitate new, over-all tooling.

In the case of the sensor, we determined the number of parts needed and projected their reduction in size on a per cubic inch basis to learn whether or not the re-designed item would be in the particular size range for this project. This method also permits a close look at the device when it is broken down into its component parts and often permits simplification of several sections of the device as well as the employment of different principles than were used in its larger counterpart. Elgin engineers designed the fly-ball arrangement in the sensor by using a new spring made of watch alloys and it was this fly-ball that wa[illegible] terminant for our m[illegible] project.

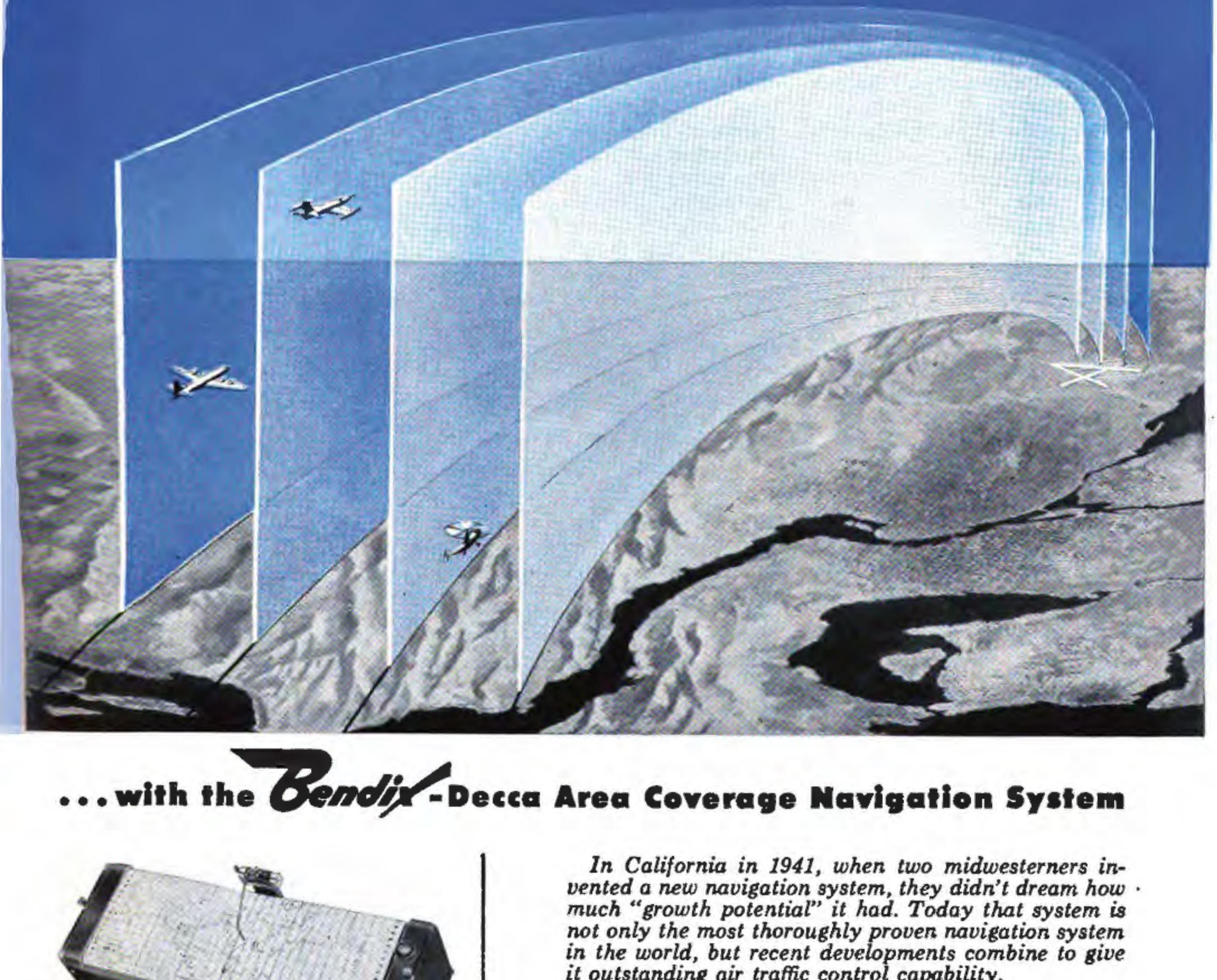
Recently a design engineer fo leading aircraft company, whose it is to procure electronic comp nents for his firm's planes, describ electronic miniaturization as a m chanical problem. The hue and c from the electronics industry today not, "*can* we make it?" It's, "*ho* do we make it?" As this aircraft d sign engineer said, the problem one of mechanical abilities — t ability to design and build speci machines, tools, gages, jigs and fi tures, that will produce the almo microscopically small parts that a needed for lightweight, tiny electro ic components.

The problem is increased by th lack of personnel equipped to ha dle these small parts, much less mak the necessary machines. This is on of the chief areas where, I believ the watch industry can help becaus we have long experience in skil that are not learned in a hurry. Th men who make our tools and die have at least 10 years experienc Those assigned to build a shape punch with a diameter of .004 of a inch, something they cannot see wi the naked eye, usually have mor than 14 years experience.

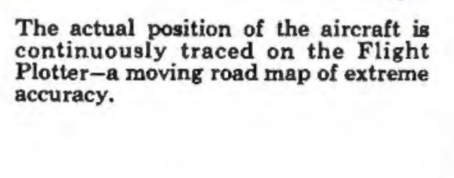
Many dies in the watch industr are of the compound, sub-press cate gory (incidentally, invented at El gin) and are capable of stampin precision-located pivot holes in plate not larger than a grain o wheat. A miniature relay plate armature assembly, or potentiomete plate requires the same machinin know-how. This work is, of course accomplished on special machines many of them made at Elgin, an which are inherent to the watch in dustry. It is only recently that the have been turned loose on commer

(*Continued on page* 16)

# TRACKS IN THE SKY



## ...with the Bendix-Decca Area Coverage Navigation System



The actual position of the aircraft is continuously traced on the Flight Plotter—a moving road map of extreme accuracy.

*In California in 1941, when two midwesterners invented a new navigation system, they didn't dream how much "growth potential" it had. Today that system is not only the most thoroughly proven navigation system in the world, but recent developments combine to give it outstanding air traffic control capability.*

The Bendix-Decca system permits maximum utilization of air space at all flight altitudes – along airways or in terminal areas. It continuously shows instantaneous position location to the pilot, *with precision never before approached,* thus permitting minimum track separation, so essential to effective air traffic control.

Fixed wing aircraft and helicopters can maintain holding patterns with absolute accuracy and can feed into an approach system from any point with complete certainty.

Bendix
**PACIFIC DIVISION**
*Bendix Aviation Corporation*
NORTH HOLLYWOOD, CALIF.

cial devices foreign to the horological field.

Today's requirements in the electronics industry make it necessary for electronic designers to familiarize themselves with the capabilities of these types of machines to enable them to design within their size ranges.

Many of you are familiar with the Neomite relay made at Elgin, but only a few know of the history of this tiny switching unit, no bigger than a pencil eraser. It is important to note that it was actually designed by an electronics engineer outside the watch industry. His design was good, based on the best relay theory then known, but the item proved too small for his firm's machinery or personnel to produce. His first prototype models were assembled by a local watchmaker from parts made by him at his repair bench.

Elgin Watch purchased this firm nearly two years ago and was fascinated by the Neomite which then had been placed on the shelf as unproducible. It was turned over to watch engineers and they began a year's study to work out, according to watch techniques, methods that would allow its mass production.

More than 10 basic designs were laid out, including a new type of armature assembly and the use of tiny threaded screws to precision adjust the contacts in the relay. These screws are so small it takes more than 8000 of them to fill a thimble. Because they were made of silver, it was decided to use the screw itself as the contact in one application.

The armature was designed to function similarly to the pallet or balance control arm in a wrist watch, which permitted accurate and continuous operation without having the armature jumping out of action. A tiny coil for the relay was made on a special coil winding machine designed and built at Elgin nearly five years before, during development work on an electronic wrist watch. The Neomite coil, by the way, is no bigger than the head of a paper match.

Mass production of the relay was accomplished by a team of operators with an average of 5½ years of experience working with tiny watch parts and assemblies, and capable of using vacuum screw drivers, watch tapping machines and other special tools. Machining tricks that made mass production possible included knowledge of special alloys used for contact springs, precision die-stamping for the coil frame and watch gauging methods to govern quality control on parts so tiny that each must be assembled into the final unit with the aid of magnifying lenses.

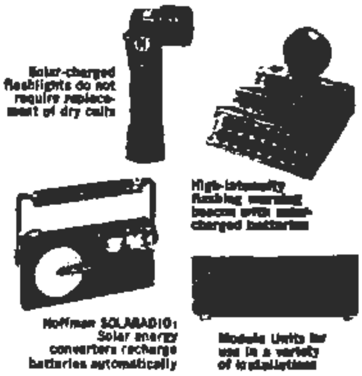
Part of the miniaturization approach must be considered as a *frame-of-mind* — actually, the ability to think small — from the standpoint of the design engineer, the tool maker and the production engineer. It is this frame of mind that has become a part of the watch craftsman's true miniaturization skill—his ability to approach a miniaturization problem with confidence because it's in "his neighborhood." I would add that current procurement policies are often unrealistic as concerns the producer of single-source items, especially with miniaturized components. It is tough enough for one manufacturer to produce a tiny, precision device to meet some particular application, much less expecting several to accomplish this task. Use of such an item gives the producer the necessary stimulus to continue to push ahead the frontiers of progress by spear-heading new research and development of miniaturized components.

### *Free Rein for Designers*

Miniaturization of necessary components should not suffer because of individuality.

In summary, I would say if you enter miniaturization, be prepared to give your design engineers a free rein to toy with new designs of old established devices. Let them enter the "dream world" of smallness. Successful miniaturization usually entails some untried method or principle, and always requires re-design.

New emphasis must be put on your tool and die facilities and personnel. You can expect to make more *inplant* machines since there are few outside the field who will even attempt to make what you need. The use of new materials will necessitate broader knowledge, longer learning time and new equipment expense, especially as concerns plastics, metals, ceramics and resins. Smaller parts mean finer gauging, increased inspection and quality control, as well as the use of special optical projection equipment scaled up as high as 100 to 1 just to see what you are doing. Miniaturization demands on-your-toes research and development to keep pace with what's available to help you, often in fields far removed from your own. And finally, it demands that new frame of mind—that ability to think small. You will know you have achieved it when the impossible of today becomes the commonplace of tomorrow.



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SIGNAL STAFF REPORT

# THE IBM 704

## its many applications

THE IBM 704 DATA PROCESSING System, a large-scale electronic digital computer, is a machine capable of various complex applications. The most familiar of these is the proposed orbital calculation and prediction of Project Vanguard's first satellite.

When the Navy launches the satellite during the International Geophysical Year, the 704 will play an important part in providing scientists with valuable data. Linked to a global network of official tracking stations, the computer will operate at electronic speeds many times faster than the satellite will move. Data will be received from each station in turn, and the 704 will produce predictions of the satellite's motion, including expected times of passage and a description of its arc. These forecasts will help observers at posts next in the path to make the most accurate measurements possible.

This artificial moon will serve as a carrying case for scientific equipment and collect information about temperature, particle density, meteoritic collisions, magnetic flux and energy emitted from the sun. In addition, the satellite itself will react as a sensitive instrument whose orbital fluctuations will reflect variations in the structure of the earth.

Once the orbit has been established and reliable, long-range predictions have been made, the IBM 704 installation will continue to process incoming data, enabling better forecasts as more complete information is obtained. At the same time, this data processing system will start the giant task of analyzing all intelligence stored in its "memory file" to produce a complete definition of the satellite's orbit.

The information gathered will enable scientists to understand better the cosmic forces which influence life on earth—forces which are almost entirely hidden from study by the blanket of air surrounding the world.

It is known that this relatively dense filter absorbs most of the radiant energy from the sun and causes many meteorites to burn out as they approach the earth at high speeds. But virtually nothing is known about the composition or behavior of the upper atmosphere and even less about conditions farther into space. If this planet and the forces which act upon it are to be understood, these important outer regions must be observed and analyzed. Consequently, methods for placing instruments beyond the atmospheric barrier are needed.

Until recently, rockets have been the only technique for penetrating the ocean of air blocking the view. Although they have collected a large amount of valuable data, the rockets' usefulness is limited. Each missile briefly records conditions above only one location and then quickly falls back to earth. An outpost on the edge of space is required to gain sufficient knowledge of the forces.

Man-made satellites will provide an answer to this need. Carrying scientific instruments high above the atmospheric screen, they will gather information over large areas for extended periods of time. Such information will be relayed to the 704 located at the Vanguard Computing Center in Washington, D. C. This computer, to be operated under a Navy contract by International Business Machines Corporation, is one of more than two score 704 machines now in the field.

The other computers are either now performing or scheduled to handle numerous other functions. Designed primarily for scientific and engineering calculations, in one second the 704 can perform 40,000 additions or subtractions or 5,000 multiplications or divisions of 10 digit numbers. These characteristics make possible the following applications:

The Midwestern Universities Research Association (MURA) is using the 704 in connection with development of a synchrotron, an atom smasher of radically new design. The new accelerator is such a tremendous leap forward in power that it will open up untouched fields for study. MURA, with headquarters in Madison, Wisconsin, is a group name for a non-profit corporation formed by 15 Midwestern universities for research and development in the field of high energy physics.

In Santa Monica, Calif., a 704 at Rand Corporation features the first model of an expanded high-speed storage unit which will more than double the effectiveness of the computer on many problems. Rand will use the 704 with enlarged memory to work problems in many areas, including the calculations of fall-out of idio-active particles following nulear explosions.

*At* General Electric's jet engine lant outside Cincinnati, a 704 is onducting automatic simulated flight ts *of aircraft* and engines still in e design stage. Air frame and en- *e performance* data are fed into computer on cards, and the de- *ed information* on the perform- ce of the proposed airplane is ned out by the 704 in short order often as short as 20 seconds.

Most of the intricate components nd circuits to be built into the IBM 'Stretch" super-computer will them- elves be designed with the aid of omputers, notably the 704. "Stretch" is being developed by IBM for in- stallation at Los Alamos Scientific Laboratory, operated for the Atomic Energy Commission by the University of California. Its speed is expected to be about 200 times that of the fastest general purpose computers in use today.

In Arlington, Va., the Council for Economic and Industry Research, Inc., used a 704 to figure the direct and indirect effects of the nation's 13-year highway-building program on 190 industries. In addition to calculating the impact on each industry, the machine determined that the program will create an average of 880,000 jobs a year. Computing time: 40 seconds.

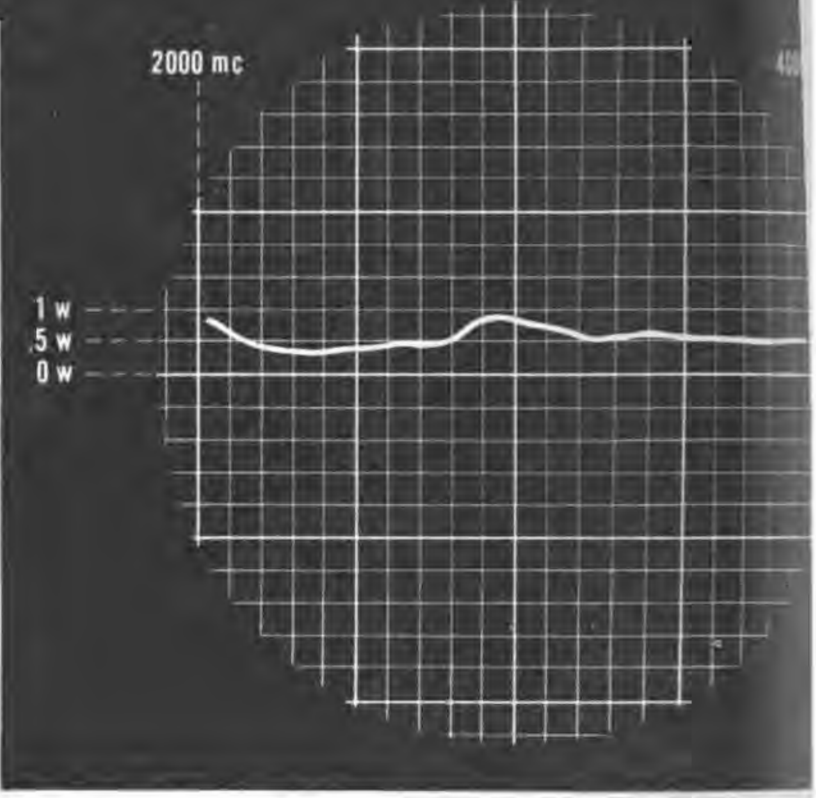
At Massachusetts Institute of Technology, a 704 installed in the new Karl Taylor Compton Memorial Laboratories is the first of its type to be used wholly for teaching and basic research. Made available by IBM, the machine will be shared by other New England colleges and universities for research and education in computing techniques.

North American Aviation, Inc., has three 704's in operation in Los Angeles to accommodate the company's accelerated research and development program in the areas of supersonic aircraft, missiles and rocket engine design.

A 704 at the Livermore site of the University of California Radiation Laboratory, operated by the University for the Atomic Energy Commission, is working on basic science and on classified problems connected with nuclear weapons development.

With these varied applications, the 704 Data Processing Machine has demonstrated its versatility. When the satellite is launched and useful information is provided to trackers and observers around the world, the computer will establish its value to science in the conquest of space.

**ABOVE:** the GL-6917 voltage-tunable magnetron is extremely small and compact—only ⅝" high and less than ¾" in diameter. **BELOW:** complete cavity and magnet assembly for the GL-6917 has been developed to assist equipment manufacturers.



▲ Observe from the scope presentation above (actual photograph made with a production GL-6917 on test) how power over the entire 2000-mc tuning range is substantially constant, varying only .5 w. Because tube frequency, with voltage-tunable magnetrons, is a linear function of anode voltage, an r-f signal can be tuned at will to any frequency in a wide spectrum.

# New GL-6917 voltage-tunable magnetron combines wide-range tuning, steady output, dependability!

General Electric's GL-6917 voltage-tunable magnetron—first of a new series in development—offers to designers of military and other microwave equipment a simple, efficient means of changing output frequency rapidly with no important reduction in signal power.

The tube is a major breakthrough in circumventing enemy radar-jamming and in other counter-measure work. Also, the GL-6917 finds direct application in missile tracking and other telemetering . . . . . in air navigation . . . . . broadband test equipment . . . . microwave communications generally.

Construction is extra-rugged. Fundamentally compact and sturdy, the GL-6917 is a hard-solder type and is metal-ceramic for even greater strength. The tube is designed to operate unpressurized up to 60,000 feet altitude.

General Electric has developed a special cavity and magnet assembly for the GL-6917, to assist designers in applying the tube to equipment on the boards. For full information on Type GL-6917 and accessories, call your regional G-E power-tube representative! *Power Tube Department, General Electric Company, Schenectady 5, New York.*

*Progress Is Our Most Important Product*

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9545-6481-1

# SIGNAL·GRAM

## — GOVERNMENT —

ETSTAR" SHINES America's first jet utility transport—the 10-passenger Lockheed rcraft Corporation "JetStar"—successfully completed its maiden flight in September Edwards Air Force Base, California. Setting a new record of 34 weeks from start design to first flight, the 500-mph plane was developed specifically to meet Air rce requirements for a small, multi-purpose jet transport capable of performing a de variety of missions economically.

WEATHER SERVICE MOVES TO SCOTT AFB IN SPRING Headquarters, USAF, has directed t the Washington, D.C. headquarters of the world-wide Air Weather Service will ve to Scott AFB, Illinois, during April, May and June of 1958. Other Air Force its involved in the move from Andrews AFB to Scott AFB are the Military Air ansport Service, headquarters of the Airways and Air Communications Service, and e 9th Weather group. Facilities vacated at Andrews AFB, just outside Washington, C., will be used by the Air Research and Development Command, currently located in ltimore, Maryland.

UTOMATIC PHONE SYSTEM What is believed to be the first electronically controlled utomatic telephone exchange, eliminating the standard busy signal, has just begun perating at headquarters of British Telecommunications Research, Ltd., in London. he unit employs the "magnetic drum" storage technique and has an exceptionally high witching speed. If you call a number that is busy, you hang up and when the called umber becomes free, exchange will automatically ring both calling and called subcribers. The work is jointly sponsored by Automatic Telephone and Electric Co., td., and British Insulated Callenders Cables, Ltd.

ADIATION DETECTORS TESTED A new network of radiation detectors is being used in anks, balloons and underground by Army scientists at the current Nevada atomic ests to measure the amount of radiation following an atomic explosion. Developed t the U.S. Army Signal Engineering Labs., Fort Monmouth, N. J., the new equipment eeps a continuous record of radiation hazards in the test area after a blast. The nformation is stored in well-protected underground recorders until the area can be ntered safely. Results of these new tests may provide vital information on atomic attlefield tactics and for use by civil defense officials in planning against posible enemy nuclear attack.

ONTRACTS: ARMY: Hallamore Division, Siegler Corp., closed circuit television systems o monitor rocket engine and missile testing, $300,000; Republic Aviation Corp., ombat surveillance systems with aerial drones capable of operating in any weather, 4,700,000; Philco Corp., radio relay units, $10,000,000; Electronics Corp. of merica, infrared detecting sets, $487,657; Georgia Tech Research Institute, combat urveillance radar, $832,236; Dubrow Development Co., single sideband converters, 59,975; Admiral Corporation, receiver-transmitters for helicopters, $3,469,000. AVY: General Electric Co., development of a handling and launching system for ALOS, $5,000,000; Radio Corporation of America, research and development study of an ltra-high-speed electronic computing system ("Project Lightning"), $1,500,000; estinghouse Electric Corp., production of shipboard and aerial electronic equipent, $19,000,000; Federal Television Corp., airplane direction-finding equipment, 1,093,107; Cook Electric Company, design and construction of a completely mobile issile instrumentation and control system, $2,250,000; General Precision Lab., nc., closed circuit TV system, $52,576. AIR FORCE: Fairchild Graphic Equipment, nc., subsidiary of Fairchild Camera and Instrument Corporation, design and development of electronic printing rectifier, $246,000; Laboratory for Electronics, Inc., anufacture of APN/105, self-contained airborne Doppler radar navigation systems, 4,500,000; Sperry Gyroscope Company, production of "very advanced" airborne radar ystems, $3,984,700; Boeing Airplane Company, quantity production of BOMARC groundo-air guided missile, $139,315,000; Stromberg Carlson Co., central timing system, 114,548; International Business Machines Corp., SAGE data processing equipment, 2,723,916; Avco Manufacturing Corp., radar systems, $6,242,874.

"AMPLITRON" AIDS VITAL DEFENSE RADARS Development of a uniquely designed new electron tube, known as the "amplitron," that combines the best features of existing r dar boosters and at the same time doubles their efficiency has been announced by the Army. The 10-pound tube is capable of boosting the energy output of a radar's basic signal by as much as 8 to 14 times. The tube, developed by the US Army Sign Engineering Laboratories and the Raytheon Manufacturing Company, makes possible lighter, more compact and versatile radar sets.

AERIAL GAS STATIONS ADVERTISE THEIR LOCATIONS Inflight refueling of Air Force plan anywhere in the world now is a routine operation largely because of an airborne "homing beacon" developed jointly by the Air Research and Development Command, Wri Air Development Center and Sperry Gyroscope Company. The high powered radar beaco makes it possible for fuel-hungry airplanes to rendezvous with flying tankers day or night, or in any kind of weather. The exact location of scheduled tanker plane can be pinpointed from hundreds of miles away.

## — INDUSTRY —

CABLE FEE TV SYSTEM The nation's first cable theatre system went into test operati in Bartlesville, Oklahoma, in September. The system, called "Telemovies," is owned by Video Independent Theatres, Inc., of Oklahoma City. General Precision Laborato engineered and equipped the studio origination equipment. Telemovies ties a local theatre to home television sets via cable hookups. For a subscription of $9.50 a month, viewers will be able to see 30 movies a month, including 13 first-run movie This system is not toll TV, but an experiment in merchandising to rejuvenate movie interest.

GROUND-AIR ROAD SHOW The M. P. Odell Company and General Precision Laboratory, Incorporated, have joined forces to present the first ground-air road show and exhib in the electronics industry, featuring the introduction of the first aircraft to house a complete installation of closed-circuit TV for the demonstration of airbor television. The two-day ground phase of the demonstration, which is open to the public, will appear in five cities, including Cincinnati, Dayton, Cleveland, Detroi and Pittsburgh, between October 21 and November 7.

NON-EXCLUSIVE LICENSING CONTRACT FOR COMPUTERS Radio Corporation of America and International Business Machines Corporation recently signed a non-exclusive agreement exchanging licenses under their respective patents for electronic computers and other data-processing machines. Under the agreement, both RCA and IBM will have th right to use each other's patents in their electronic computers and other data-proc essing machines, and each company retains the right to license applicants under its own patents. In a joint statement, the presidents of the companies said: "This arrangement enables the widest possible competition between our companies without the risks of infringing each other's patents."

ELECTRONIC "BRAIN" TO JOIN TRAVELERS INSURANCE COMPANY Radio Corporation of America will install the nation's first commercial network installation of integrated electronic "brain" systems for the main office of the Travelers Insurance Company in Hartford, Connecticut. The network will contain four separate RCA Bizmac electroni data processing systems, which will be integrated through a unit, similar to a telephone exchange. The Travelers installation will represent the nation's largest integrated electronic data processing system under one roof. Installation will start early next year and the overall system is expected to be completed by 1963.

MARTIN COOLING METHOD The Martin Company, Baltimore, Md., recently disclosed an "evaporating cooling technique" which its thermal engineers called a "breakthrough" in the protection of electronic components, enhancing their reliability in both airplanes and missiles at speeds up to Mach 5 and temperatures up to 800 degrees F. The system would reduce the weight of a manned craft by 661 lbs. when traveling at Mach 3. Martin's modular concept is said to open up the possibility of remote location of the electronic equipment since the cooling system is self-contained.

ELECTRIC WRIST WATCH An electric wrist watch that recharges its own battery has been invented by Loren F. Jones, manager of RCA's business machine marketing department at Camden, N. J. His newly patented watch is run by an electric motor, powered by a tiny storage battery. The wearer's random wrist movements wind a small spring. The spring, when released from time to time, sends surges of current through the battery. According to the inventor, the battery should last for a number of years.

COLOR TV DEBUT IN CUBA The first color television station outside the United States will go on the air, using RCA equipment, on October 24 in Havana, Cuba. The station will be headed by Gaspar Pumarejo, a pioneer in black-and-white television in Cuba. Initial plans call for a twenty-hour long color program schedule each day built exclusively around films, repeating a basic two-hour film program ten times, inserting fresh news and other items. Filmed news and other features will be flown to Havana daily from New York, Miami, Mexico City and Madrid.

(Continued on p

U. S. Army Photo

Experimental rocket being launched from tower at DOFL's Maryland test facility.

# ELECTRONIC AMMUNITION THAT "THINKS" IS DEVELOPED AT ARMY'S DIAMOND ORDNANCE FUZE LABORATORIES

Since 1940, scientists and engineers at Diamond Ordnance Fuze Laboratories, with their industrial contractor counterparts, have made important contributions to electronic ordnance. These include the proximity fuze, greatly improved fuzes for antitank and other special ammunition, and, more recently, fuzing systems for guided missiles. Other basic results of DOFL's research and development teams are new electronic systems which increase the accuracy of measurement of distance, velocity and direction, new electronic and mechanical control systems, and new and radical components and materials. DOFL's main laboratory is in Washington, D. C., and it maintains an extensive test facility at Blossom Point, Maryland. Over 1400 scientists, engineers, technicians, and supporting personnel work in these centers.

Electronic ordnance was born in World War II. Ammunition of this type, a DOFL specialty, senses the presence, distance, and direction of a target and causes the warhead to function at the instant when it will inflict the most damage. Electronic control can be compared to having a sharpshooter in every piece of ammunition. The accurate effect is devastating.

Many advances in ruggedness and miniaturization, pioneered by DOFL, are contributing significantly to peacetime technology. Typical industrial products which sprang from ordnance programs are printed electronic circuits, tough and tiny electronic tubes, and rigid mounting of components in solid plastic blocks. These valuable by-products have contributed heavily to the ability of DOFL's industrial teammates to design safer, smaller, and better components.

This is one of a series of ads on the technical activities of the Department of Defense.

**FORD INSTRUMENT CO.**
DIVISION OF SPERRY RAND CORPORATION
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**ENGINEERS** of unusual abilities can find a future at FORD INSTRUMENT CO. Write for information.

Class of technicians at Ford Instrument is instructed on techniques to be employed in assembling equipment for Army Ordnance project.

# — GENERAL —

GOLFING ELECTRONICALLY While testifying at the FCC's 890mc hearings, Daniel E. Noble, a vice president of Motorola, Inc., outlined a possibility that would enable the duffer to sit back at the clubhouse and watch his perfect score flashed back. He said a motorized cart would carry radar, computers and servo-mechanisms so that it would be remotely controlled and follow the ball about the course. It could cal late the range, direction angle and velocity, complete the shot,and radio the resul back to an automatic scoreboard. Mr. Noble was not advocating spectrum space for this nor does he recommend this for the present.

TALKING TO THE MOON United States Naval scientists of the Naval Research Laboratory in Washington, D. C., have announced that they have succeeded in using the moon as radio relay station for round-trip transmission of voice messages. This scientific breakthrough, regarded as the most significant discovery made by radar, followed six years of experiments.

NEW ELECTRONIC "SEA HIGHWAYS" The first chains of the Bendix Decca Navigator system installed by the Pacific Division of the Bendix Aviation Corporation on the North American continent, have been officially opened in Canada. The system, an American invention used for years in European waters, is a low frequency radio position-finding device that can be operated either automatically or manually to provide a continuous "map" of a ship's course and heading. The chains, covering an area of one million square miles, will form a navigational "key" to some of the most heavily traveled waters in the world--by transatlantic lines to private yachts.

NEW HELICOPTER SERVICE The first emergency shipment to be transported by helicopter left the Westinghouse East Pittsburgh plant's new rooftop heliport recently. The load was rushed to the Greater Pittsburgh airport for shipment aboard an airliner. The new helicopter service, which includes an eight-passenger vehicle, was inaugurated to provide fast emergency replacement parts service to customers. The "whirlybirds" can handle freight shipments up to 500 pounds.

ANALOG COMPUTING CENTER IN BELGIUM Belgian Minister of Foreign Trade, Henri Fayat, and C. L. Adamson, Vice President of Electronic Associates Inc., Long Branch, N. J., recently officially opened the U.S. firm's first overseas operation, the European Computation Center in Brussels. The Center is equipped with two expanded analog computer systems and provides education to engineers in analog computer techniques, consultation service and rental time on the Center's machinery.

HOW TYPHOONS ARE NAMED In the Pacific ocean, typhoons are identified by girls' names, as are their counterparts, the hurricanes, in the Atlantic ocean. Four sets of names are used in a continuous fixed sequence, without regard to the calendar year or season. The first typhoon in the Pacific during each season is assigned the name directly following the last name used during the previous season. When all 84 names have been used, the list is repeated, starting with "Alice," the first name in the first set.

DISCOVERY OF "HIGHER" SUN ENERGY A 3500 mile per hour Aerobee-Hi research rocket launched recently at Holloman Air Development Center, New Mexico, reached a new 120-mile record height for chemical ejection experiment vehicles. This gave "conclusive proof" to officials of the Air Force Cambridge Research Center's Geophysical Research Directorate that there is a reservoir of stored solar energy at much higher altitudes than previously believed possible. This discovery indicates the feasibility of developing rockets which will obtain their own propulsion energy from the stored sunlight around them.

CONVENTION CALENDAR HIGHLIGHTS

OCTOBER 24-25—The Fourth Annual Computer Applications Symposium, sponsored by Armour Research Foundation, will be held in the Morrison Hotel, Chicago. New computers and applications, and advances in automatic coding will be stressed in invited papers, panel sessions and discussion.

OCTOBER 28-30—"Electronics in the Jet Air Age" will be the theme of the Fourth Annual East Coast Conference on Aeronautical and Navigational Electronics held by the IRE at the Fifth Regiment Armory, Baltimore, Maryland.

NOVEMBER 11-13—EIA is sponsoring its Radio Fall Meeting at the King Edward Hotel in Toronto, Canada. 500 top engineers and managers in the entertainment, radio and television fields are expected to attend.

NOVEMBER 11-13—Recognizing the growing importance of the South in the electronics industry, the Third Annual IRE Instrumentation Conference will be held in Atlanta, Georgia. The conference theme will be "Instrumentation for Data Handling."

NOVEMBER 13-15—The American Standards Association will sponsor their Eighth National Conference on Standards at the St. Francis Hotel in San Francisco, California. Eleven sessions are planned, including more than 50 speakers.

# ERFA *

by Major B. W. Filipski, USAF
Air Command & Staff College
Maxwell A.F.B., Alabama

## *European Radio Frequency Agency

a view of NATO's cooperative capability

THE ORGANIZATION OF ERFA (EUROPEAN RADIO Frequency Agency), a cooperative venture of the North Atlantic Treaty nations of Europe, was born of necessity to pool effectively a vital resource differing greatly from earth commodities such as coal or iron. This common world resource is radio frequency spectrum which, to the non-technical and uninitiated, is as free as air with no marketable assets, but which, in reality, is a critically vital resource of all nations.

Several factors distinguish radio spectrum from previously known types of resources and serve as background for discussing ERFA. (1) Various portions of the radio spectrum have radically different propagation characteristics. A portion effective for night transmission may be useless for daytime use; those ideal for the North may be worthless for tropical communications. (2) In spite of the "oneness" of this world resource, each nation has sovereign rights to the entire spectrum. (3) Once a transmission encroaches upon another nation's use of that same frequency, equitable adjustments must be made. The sovereign nations belong to the International Tele-communications Union (ITU), which establishes rules and regulations governing radio frequency allocations and regulation of frequency assignments. (4) World War II presented new problems for the ITU, due to progress in telecommunications and electronics together with the expansion of civil and military air capacity. In 1947, the ITU agreed to allocations of exclusive bands for aeronautical services. Portions of the bands allocated to other services consequently had to be compressed. Meanwhile, nations engaged in post-war economic resurgence, defense commitments, and future expansion planning were dependent upon more radio communications and consequently were requiring expansion in those very portions already compressed. (5) An international accounting system became a necessity. The ITU devised a plan whereby radio assignments conforming with Radio Regulations would be recorded by the International Frequency Registration Board.

These, then, are the general limitations of the radio frequency spectrum and the purpose for the international control body, the ITU.

Two years after the North Atlantic Treaty was signed, the NATO nations moved for the creation of a military shield. General of the Armies Dwight D. Eisenhower, Supreme Allied Commander in Europe (SACEUR), arrived in Paris, January 1951, and created the Supreme Headquarters Allied Powers, Europe (SHAPE). The Standing Group, NATO's top policy making body, established ERFA to serve SACEUR in negotiating for and managing radio frequencies. SHAPE'S area of responsibility extends from Norway's North Cape to the Caucasus in Eastern Turkey. Within this area are 12 member nations of NATO, each exercising authority over the radio spectrum. SHAPE, itself, became another competing "nation" for portions of the already overcrowded spectrum. Thus, ERFA provided the vehicle for close coordination with non-military frequency control bodies of NATO together with other international and national military commands within SACEUR's area of responsibility.

ERFA prepares and maintains technical arrangements for coordination of radio frequencies, advises nations when civil circuits may adversely affect military circuits and recommends alternate frequencies by consulting a consolidated up-to-date list of current radio frequency assignments of NATO nations and European military commands.

The Agency is composed of a Committee and a Radio Frequency Bureau. The Committee has military representatives from each NATO country, one from SHAPE, and a Chairman and Secretary in an international capacity. The Radio Frequency Bureau is an international secretariat composed of radio engineers, translators, together with security, secretarial and administrative personnel. Directed by the Chairman, it carries out decisions made by the Committee.

### *Master Radio Frequency List*

Vitally necessary to ERFA was the procurement of radio frequency records from all NATO nations. Schooled in practicality, the smaller nations were reluctant to give up this valuable data without safeguards and evidence of equitable cooperation. The Chairman's preparation of a method of checks and balances acceptable to the entire Committee is regarded as one of ERFA's most significant accomplishments. Today, the Master Radio Frequency List of ERFA numbers over 150,000 up-to-date entries—the world's second largest international list.

In February 1953, a combination of hurricane winds

*(Continued on page 32)*


EARTH SATELLITE!

# *project* FOUR WHEELS

*Signal Staff Report*

Lightweight, compact, mobile air traffic control towers and communications facilities that can be flown into disaster areas or forward air strips and quickly put into operation are now being delivered to the Air Force by Craig Systems, Incorporated, Danvers, Massachusetts. The over-all system, called Project "Four-Wheels," is composed of a series of individual self-contained facilities and is designed to provide the military with improved tactical and fixed air traffic control and base communications facilities. This communication-air navigation unit is capable of performing a squadron's mission in the space of a house trailer, with the mobility of a field command post.

The project was sponsored and developed by AACS (Airways and Air Communications Service) in Rome Air Development Center in conjunction with Craig Systems, Incorporated, prime contractor. This requirement for a mobile communications system was recognized by AACS during support of the Korean operation. Now AACS in Europe has passed another milestone in its long and colorful history. Project "Four-Wheels" became a reality on the European Continent and will soon be ready for deployment in support of maneuvers, exercises or emergencies.

### *Means for Mobility*

The required mobility is obtained through the installation of selected items of communications and Navaids equipment in trailer vans which can perform the same functions as a permanent airport installation with the strategic advantage of being easily towed or flown by C-119 or other cargo aircraft to forward areas and quickly put into operation. To satisfy the mobility, air lift and shock isolation requirements for the amount of equipment involved, a special lightweight, insulated trailer was developed by Craig.

Features of the van trailer include a detachable undercarriage for aircraft loading with a four-wheel, single-axle, coil spring shock abso ing suspension system. For equ ment reliability, a special inter shock isolation frame was devis The components of the project clude a control tower, radio beac radio transmitting and receiv equipment, a communications cen and power units. Considerable l man engineering was designed i the individual facilities to provi for the most efficient layout of co ponents and reduce operator fatig These facilities are capable of bei operational in one hour from delive to a forward base by a crew of fo men.

### *Component Characteristics*

One important feature of the un is the self-contained combination a conditioner, heater, and dehumidifi which has a collective protector remove atomic, biological and chem cal contamination from the air.

All of the units, measuring 13 fe long, eight feet wide and seven fe high, are so designed that they ca

**LEFT . . . mobile control tower which performs same function as permanent airport installation. ABOVE . . . one step in loading Van V-83/M into C-119 aircraft. RIGHT . . . interior of control central AN/MRN-12.**

used *independently* in any com-nation so as to provide either com-*ete airport* facilities or any part at may be required.

*Air Traffic* Control Central, desigted the AN/MRN-12, is a prefabriated control tower consisting of a n with a retractable tinted glass me. The observation dome is fitted ith special glass panels to prevent gging and icing to give the operor 360-degree visibility. The AN/RN-12 provides three Very High requency (VHF) receive-transmit annels, three Ultra High Frequency HF) receive-transmit channels, one igh Frequency (HF) receive chanel, one Low Frequency (LF) reive channel, visual signaling equipent, wind and altimeter equipment nd two operation positions with rminal equipment for telephone nd local wire communications.

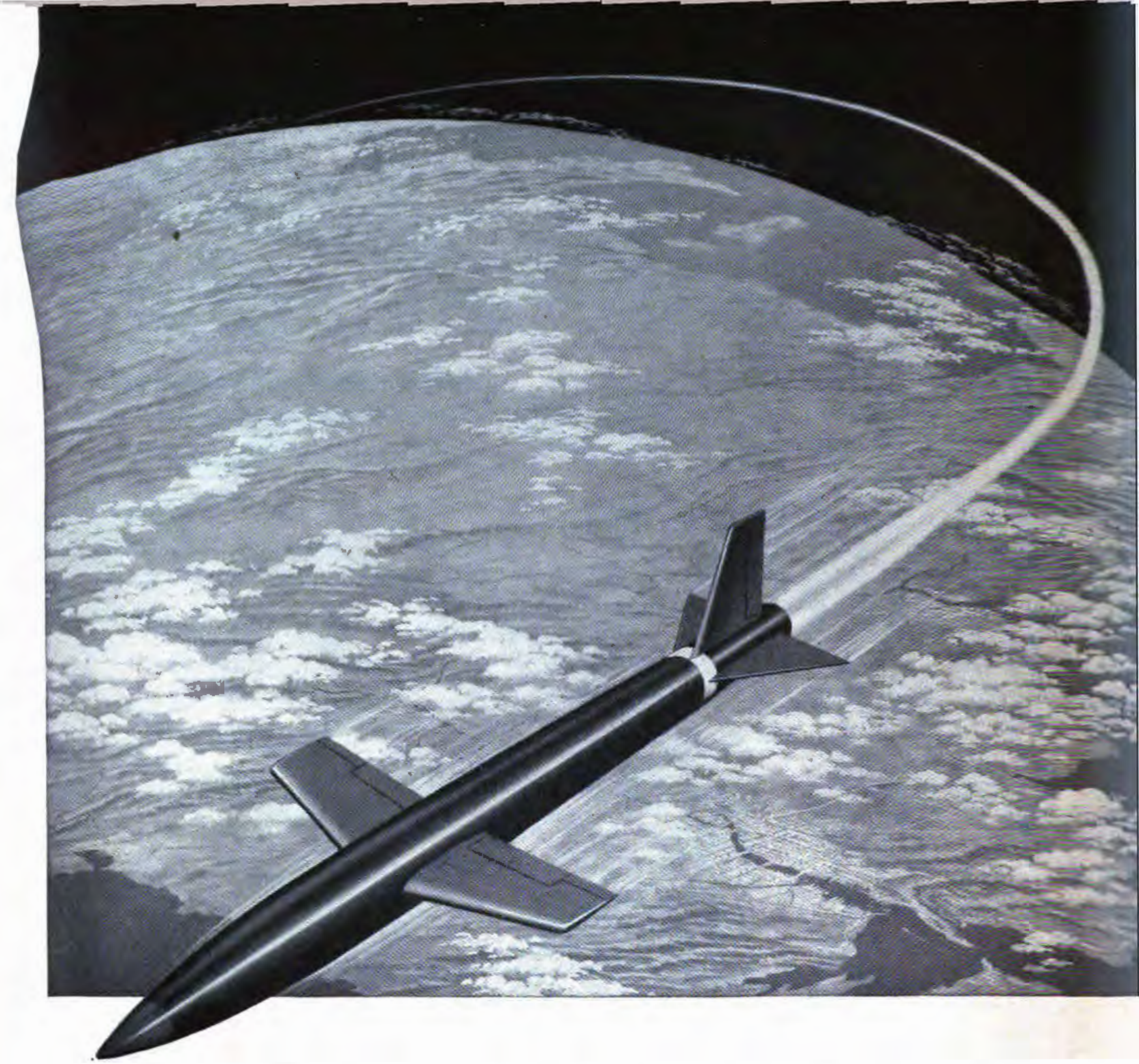
At the operator's finger tips is a onsole with instruments to give him adio communications with aircraft aking off and landing, as well as ith base operational facilities. A econd position holds approach conrol equipment and the CGA opertor, when off the air, can act as witchboard operator for incoming alls.

Other equipment includes a low frequency radio beacon designed for continuous operation from a mobile site. It provides speech amplifiers for beacon operation and voice transmission. A radio transmitting set is designed to complement the receiving sets which together support the Central Office-Teletypewriter, by providing medium range, point-to-point and ground to air communications.

### *Source of Energy*

Power for all of this equipment is provided by 10KW generators mounted on two-wheel, 1½ ton trailer chassis of a new design. Each piece of mobile equipment uses two generators, one for primary power and the other as stand-by.

The Four-Wheels equipment now provides the military with communications and navigation facilities in completely packaged form that is readily adaptable for lengthy storage or for prepositioning at air bases and capable of rapid activation without further requirements for additional components or equipment. The arrival of Four-Wheels equipment in Europe, enables the AACS to fully support USAF and NATO Air Forces in any location and on extremely short notice.



# We build electronic "BRAINS" for guided missiles

A missile's accuracy in reaching its target depends upon the reliability of precision electronic controls.

From the very beginning, scientists and engineers of the International Telephone and Telegraph Corporation have been at work on guided missile systems, applying world-wide experience and a score of special skills.

FEDERAL TELECOMMUNICATION LABORATORIES and FARNSWORTH ELECTRONICS COMPANY, both divisions of IT&T, are deeply engaged in research, development, and manufacture of missile guidance and precision remote control systems . . . contributing to the conception and operation of such missiles as the Terrier, Talos, Sparrow, Meteor, Rascal, and Bomarc.

Missile guidance is one more field in which the creative engineering and the integrated facilities of IT&T are developing new concepts in electronics and telecommunications.

IT&T

**INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, 67 Broad Street, New York 4, N.Y.**

# LESSONS FROM SIGNAL CORPS HISTORY

*a book review*

### by Dr. George P. Bush, Emeritus Professor, American University

MANY READERS WILL RECALL that he first volume of the official history f the Signal Corps in World War I, *The Emergency*, by Dulany Terett, was concerned with events which ranspired between the world wars, oncluding on the theme of Pearl Harbor. This second volume, *The Test*, egins with Pearl Harbor and is conerned with the dramatic events of he next eighteen months. The third volume, now in preparation, will conclude the story. This history is one in the series entitled *United States Army In World War II*, a series which is under the general editorial supervision of the Office of the Chief of Military History, Department of the Army.

Comprehensiveness is a relative matter. One may take a comprehensive look at Signal Corps training activities or at any of the other many facets of Signal Corps activity. Or, one may look beyond to take a comprehensive view of the total Signal Corps effort. Or looking still further, one may see the technical services in their several relationships. Thus it is with the present volume that we are able to get a clear and comprehensive picture of what the Signal Corps did during a particular critical period. Moreover, it gives us many of the overtones and innuendos which are all a part of the life of both men and organizations. One reads *The Test* as though there were unfolding before him for the first time the *reasons* which underlay so many of the intricate activities of this involved period of eighteen months of World War II, when so much was at stake.

## *With Value Judgments*

The four authors deserve great credit for the skill manifested in their endeavors to portray interestingly and factually the events of the period and to bring out their meaning and importance. The authors are George Raynor Thompson, Dixie R. Harris, Pauline M. Oakes and Dulany Terrett. Their source material was voluminous and much of it expressed in language that was official and highly technical. This reviewer is particularly pleased with the candid expression of value judgments so soon after the events which gave rise to them.

Examining the book more specifically, one notes that it is chronological in treatment. In fact, each of the sixteen chapters covers both a topic and a stated time period. Three principal topics are covered: research and development, training and supply, together with their many interrelationships being woven in and out of the several chapters. In addition, there is a chapter on Alaska communications, one on photographic activities, one on global communications and two on the North African field situation.

The authors have cleverly brought out the drama which lay behind certain factual reports. Beginning with the first chapter, even the first sentence, one sees the drama of Pearl Harbor in its earliest stages. From those first words, "At four o'clock on the morning of 7 December 1941, . . ." and on through the book to the last chapter which depicts an organizational crisis, there is drama for those who either read it straight or those who read between the lines. This history is alive. Here is depicted a relatively small technical service, charged with very important responsibilities to the whole army, starved over the years for the funds with which to do an adequate job, suddenly burgeoning outward and upward like a small A-bomb blast. The statistics scarcely tell the story properly. During these critical eighteen months, the officers increased from 3,000 to 27,000 while the enlisted men went from 48,000 to 287.000. At the same time, other Signal Corps activities were growing at an equal tempo. During June 1942, the Signal Corps "was accepting every two weeks as much signal equipment as the amount procured during the entire course of World War I." It is difficult to realize that such a tempo was reached only seven months after Pearl Harbor.

Reserach and development activities were vital to the improvement of signal comunications. Signal Corps engineers brought forth a constant stream of better radio, radar, telephonic, telegraphic, photo and other technical equipment to meet the Army's world-wide needs. In particular, frequency-modulated (FM) radio sets were refined and mounted in the tanks to give Armor better communications and a revitalized role of action. Airborne radar flourished in this period and was particularly useful in air-to-surface vessel use. Gun-laying radar (the SCR-584) was another 1942 achievement of great usefulness to troops. In the telephonic area, wires and cables were improved along with circuit and terminal equipment.

## *Lesson in Administration*

The dual responsibility of the Signal Corps is brought out in various ways. Not only is it a supply and technical service, but it is also a combat arm, training and furnishing troops. In this respect, it resembles the Corps of Engineers. This duality of function increases the contacts with higher command and thus causes liaison to be more difficult. The Chief Signal Officer's "public relations" thus became very important to him and required great skill in satisfying the demands made by many superiors. For example, General Somervell, the Chief of Army Service Forces, took over in March 1943 the seven supply services (including the Signal Corps) and a year later announced that henceforth they would be known as the technical services. The contacts between General Olmstead and General Somervell were never harmonious and deteriorated rapidly in early 1943. By June 1943, General Olmstead had retired. A careful reading of this episode as recorded in Chapter XVI can be a potent lesson in administration, par-

*Signal Corps (Cont.)*

ticularly as related to such principles as organizational structure, delegation of authority and responsibility, unity of command, and, particularly, a continuous reconsideration of all matters pertaining to the organization as a part of regular operations.

A very significant sentence appears on page 23: "But M Day had remained unidentified, and the events of war now differed from the plans." So it always is from war to war. The best laid plans fail to match the new situation. The answer lies not in foregoing the planning function, but rather in improving it. And improvement can be made, in part at least, by a careful evaluation of the book which is under review and others like it. *The Test* abounds with the lessons of Signal Corps history. Many of these lessons were caused either by ignorance of certain basic principles or by forgetfulness or complacency. It is here that history can be a constant reminder—not that history will repeat itself, but that basic principles tend to endure. An analogy is found in the case of the *Report of the Chief Signal Officer* (1919), a 547-page document published about one year subsequent to the armistice of World War I. This report was, in effect, the Signal Corps "history" of World War I. Such as it was, this document served in a variety of ways to point constantly to the truism that "The Past is Prologue."

It is in this respect that those presently in the Signal Corps are in debt to the authors of *The Test*. No one knows how timely the publishing such a history may be. Here is book of great potential usefulness well as of readable current intere

Copies of *The Signal Corps: The Test* (1957) and of *The Signal Corps: The Emergency* (1956) may be ordered by members of AFCEA at a special price of $4.05 and $3.15, respectively, through the Book Service, AFCEA, 1624 Eye St. N.W., Washington, D. C., or directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., at $4.50 and $3.50, respectively.

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*ERFA (Continued from page 26)*

and full moon tides smashed the dikes of Holland. With waves tearing 40 miles inland, an old enemy was cloaking one sixth of the nation with disaster. NATO military forces were dispatched for assistance and immediately, ERFA was requested to furnish necessary radio frequencies for the required communications. Acting under agreed plans, ERFA selected frequencies from the List which provided the most effective channels of communication. Prior users were notified and ceased their operations in favor of those required in Holland. Isolated areas were soon connected by radio communications links so that rescue and rehabilitation work proceeded with great speed. Thus, ERFA provided another proof of NATO's cooperative capability for a non-military purpose.

By June 1953, this Agency of NATO was gaining strength, flexibility and striking mobility. New responsibilities were handed to its competent Chairman and representatives. Almost on the heels of the transfer to ERFA of the problems involved in Very High Frequency (VHF) assignments, another allied problem was demanding attention. Ultra High Frequency (UHF) was gaining recognition by naval, land and air forces as a valual new portion of the spectrum. Necessarily, the proble of UHF allocations and assignments also devolved ERFA. After the forming of a VHF/UHF Panel, an location plan was eventually drawn up for dividing t UHF band between the three services. But even mo outstanding was the agreement to permit ERFA's Rad Frequency Bureau to act as the central control for c ordinating, recording and recommending common en neering criteria in the UHF band for 15 nations.

In the success of a cooperative venture, leadership often taken for granted. The Committee's accompli ments were the result of combining 15 competent, in vidualistic and nationally proud representatives whe subordination to a common purpose and technical co petence enabled them to stimulate cooperative reacti in the Agency to fit the international situation.

Without doubt, ERFA has contributed to the cohesi strength of NATO. Cooperative control of the rad spectrum became a supplement to sovereign contr within NATO. An example of effective management a provisioning, ERFA is tangible evidence of obtainab success in international cooperation.

# AFCEA Group Members

## Communications—Electronics—Photography

*ed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their bership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the elec-ics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.*

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- American Telephone & Telegraph Co.
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- Ampex Corp.
- Amphenol Electronics Corp.
- Anaconda Wire & Cable Co.
- A. R. F. Products, Inc.
- Arnold Engineering Co.
- Atlas Precision Products Co.
- Automatic Electric Co.
- Automatic Electric Sales Corp.
- Automatic Telephone & Electric Co., Ltd.
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- Barry Controls, Inc.
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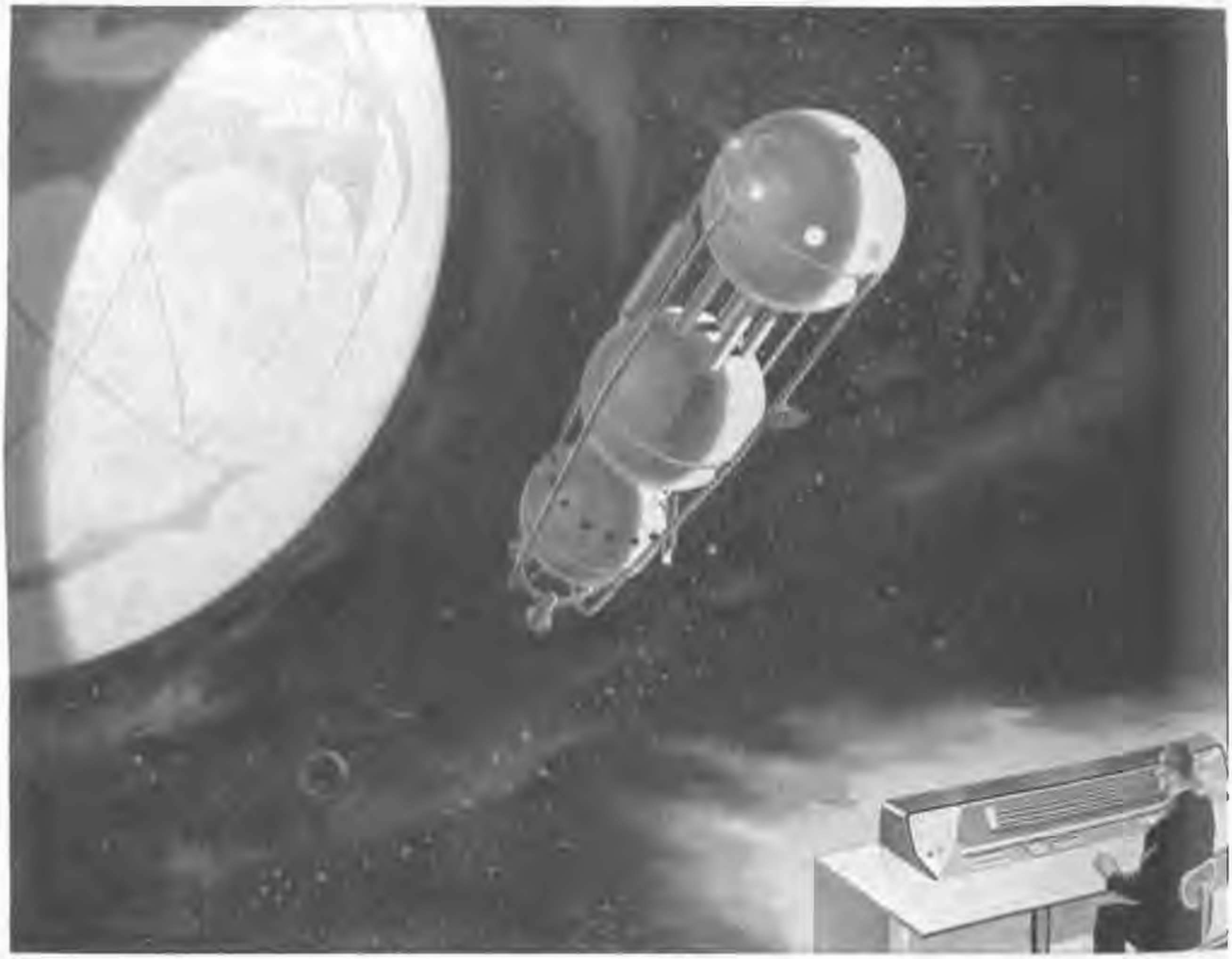

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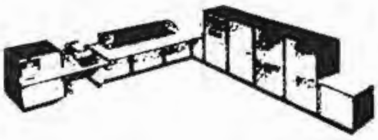

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SG57-4

# Chapter News

*San Francisco*—Rear Admiral Frederick R. Furth, USN (Ret.), National President of the AFCEA, is shown addressing the San Francisco Chapter. At the head table, left to right are: C. L. Wickstrom of the Pacific Telephone and Telegraph Company and a past president of the Chapter; Admiral Furth; Commander S. N. Barton, president of the Chapter; Admiral Logan McKee, Inspector General, Bureau of Ships, and Admiral H. E. Haven, USN (Ret.).

### *tlanta*

The chapter's schedule of meetings s been set up as follows: September , November 19, January 21, March and May 13.

These dinner-meetings will be held the Fort McPherson Officers' Club. ny AFCEA members from other eas who will be in Atlanta on any the above dates are welcome to at nd.

### *altimore*

A program on shipboard guided missles. conducted by Capt. Leslie M. lack, U. S. Navy, Bureau of Ordnance, avy Systems Director, Surface Weaons Systems, was scheduled for the hapter's opening meeting of the fall eason on September 17th.

### *ayton-Wright*

The chapter has instituted the office executive vice president to facilitate dministration of its affairs, with Col. B. Rippere appointed to this post or 1957-58.

The following have been named to he board of directors: Lt. Col. W. D. ones; M. O. Davis, Dayton Air Force epot; William Klein, Gruen Watch o.; L. D. Sullivan, General Electric o.; George Meyer, Westinghouse Electric Corp.; Col. Forrest G. Allen, Hqrs. RDC; Willis K. Sutton, Summers yroscope Co.; Walter Bass; R. J. McIlrath, Raytheon Manufacturing Co.; Lt. Col. G. R. Kraus; Byron K. Boettcher, Avco Manufacturing Corp., Crosley Div.; H. C. Blackburn, Sylvania Electric Products, Inc.; Paul Clark, RCA; Harold Hollister.

### *Fort Monmouth*

Halsey F. Hubbard of the U. S. Army Signal Equipment Support Agency has succeeded to the presidency of the chapter due to the transfer of Col. Robert B. Tomlinson. Other officer appointments have been made as follows: first vice president—Col. Alvin L. Burke, to replace Mr. Hubbard; treasurer—Margaret Manuel, USASESA, to replace Esther Ipri who resigned.

Committee chairmen for the various phases of chapter activity have also been designated for the current year. They are: membership—Col. Robert P. Haffa, USASEL; meetings—William J. Laverick, USASEL; industrial relations—Dr. Robert Meijer, Bendix Aviation Corp., Red Bank Div.; reserve affairs—Lt. Col. John E. Jenista, USASESA; public relations—J. Peter Hoffman, Office of Technical Information, Fort Monmouth; financial—George Trad, Trad Electronics Corp.; reception—Thomas Schlitz, TSS.

In addition, a new committee has been set up for the development of scientific manpower, with Arthur Adamson of Electronics Associates, Inc., as its chairman.

The chapter has inaugurated a monthly news letter, known as the "AFCEA Orbit," which will be sent to the members of the Fort Monmouth Chapter and other interested persons. Its purpose will be to "promote friendship and good will among the members" and to carry items of general and chapter interest.

### *New York*

A dinner-meeting at the New York Naval Shipyard on September 18th marked the resumption of chapter activities after the summer recess.

Report of the meeting, which included a tour of the shipyard's material laboratories, will appear in the next issue.

### *Pittsburgh*

The chapter opened its fall season on September 19th with its traditional picnic-outing. Held at North Park Lodge, the members and guests enjoyed the recreational facilities of the park, which included golf and fishing, and a fried chicken dinner. An added attraction was the distribution of door prizes.

### *Rocky Mountain*

A picnic on August 17th highlighted the chapter's summer activity. Members and their families, chalking up an attendance of 125, enjoyed the customary picnic fare and an all-day program of events scheduled for all age groups. By its success, the picnic was established as an annual event.

### *San Francisco*

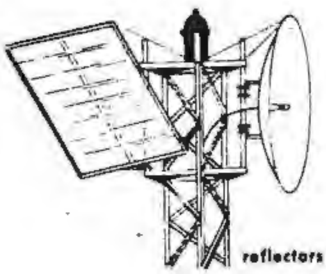
Admiral F. R. Furth, National President of the AFCEA, was guest of honor at an informal dinner party given at the Fort Scott Officers' Club in San Francisco on August 12th. Some fifty members and guests were present.

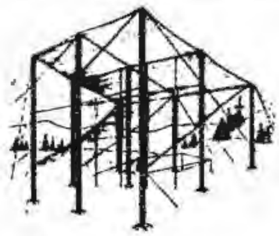
Special guests of the chapter were Adm. Logan McKee, Inspector General, Bureau of Ships, and Adm. H. E. Haven, USN (Ret.). Also present was Capt. W. B. Goulett, USN (Ret.), new Executive Vice President of the Association.

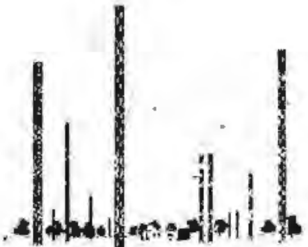
President Furth reported on the current status of the association and reviewed plans for its further growth in size and influence. He also conducted a question and answer session on local chapter problems.

### *Scott-St.Louis*

In answer to requests for a summer activity, the chapter arranged an excursion on the Mississippi River aboard the S. S. Admiral on August 17th. Members and their families boarded the boat at St. Louis and enjoyed an after-







noon filled with entertainment. Faci ties of the boat included a carniv and a Kiddieland.

### South Carolina

At a meeting of the Board of Dire tors on August 22nd, committee a pointments were made and the vacan in the office of first vice president w filled.

The committee chairmen are: me bership—William Schachte, Charlest Naval Shipyard; program and public —William F. Reilly, Charleston Na Shipyard; finance—J. E. Butterwor Southern Bell Telephone and Telegra Co.

William O. Kiger, Southern B Telephone and Telegraph Co., w elected first vice president to succe W. Thomas Edwards who had be transferred. Mr. Kiger and Col. H bert N. Sturdivant, second vice pre dent, were named chapter represen tives on the National Council.

Program plans were discussed f the year, and September 19th w scheduled for the opening meeting.

### Tinker-Oklahoma City

The dates of the 1957-58 series meetings have been set as follow September 19, October 17, Novemb 14, December 13, January 16, Feb ary 20, March 20, April 17 and May

The committee making the arran ments for the year's programs consi of John Mercer, Lt. Col. Richard Amann, William A. Kitchen and H Doolittle.

## New Group Member

The AFCEA has recently welcome two new group members, Federal Tel communication Laboratories, Divisio of West Coast Laboratories, San Fe nando, California, and Autonetics, D vision of North American Aviatio Inc., Downey, California.

Federal Telecommunication Lab which deals in electronic research an development, has named the followin company representatives in AFCEA P. R. Adams, Director, West Coa Labs; R. T. Cowden, Director, Customer Relations; J. E. Bower, Admini trative Manager; C. T. Clark, Senio Member, Technical Staff; W. S. Cha kin, Director, Wire Communication Lab.

Autonetics, which is concerned primarily with the research, developmen and manufacture of electromechanica products, has named the following company representatives in AFCEA: S. W Horrocks, Ass't. General Manager; R M. Ashby, Chief Engineer; N. F. Parker, Ass't. Chief Engineer; B. P. DuMar Manager, Contracts & Proposals; J. Emmi, Factory Manager; D. G. Soergel, Applications Manager; M. H. Suggs, Director, Quality Control; C. R. Raftery Material Director; D. S. Grant, Custnmer Relations Coordinator; K. Anderson, Director, Public Relations.

GUN FIRE CONTROL SYSTEMS
GUIDED MISSILES
ANALOG COMPUTERS
SERVO MECHANISMS
ASURING INSTRUMENTS
ONTRAVES
TALIANA

# ITEMS OF INTEREST

## From Government, Industry and the Services

### Bell's Pocket Receiver

The Bell Telephone Company of Pennsylvania is experimenting with a personal signaling service, described as somewhat of an extension to the conventional telephone bell.

Utilizing a small, transistorized radio-receiving set, the system is tuned to a fixed frequency and operates over a range of a few miles. When clipped to a belt or inside of a pocket, the receiver is capable of informing a person of an important message at his home or office.

When the message arrives at an office, the signaling operator is contacted and she "dials" the number of the desired receiver. Voice-frequency pulses go out over the radio channel to activate four reeds in the set. The reeds trigger an oscillator and a tone sounds, alerting the person.

The system in the test area of Allentown-Bethlehem is capable of handling about 3000 customers. The sets are rented.

### Nuclear Power For Missiles

The use of nuclear power to propel missiles of the future is under serious investigation by Lockheed Missile Systems division scientists.

The nuclear propulsion studies will be further advanced with a powerful new atom smasher, which has gone into use at the Lockheed nuclear laboratory. This is one of the facilities of the missile division's research and development center located in Stanford University's Industrial Park at Palo Alto, Calif.

The three-million-volt Van de Graaff positive ion accelerator is the largest such device in use within the aircraft industry and the first of its type on the West coast.

Dr. R. D. Moffat, who will be in charge of the machine's operation, explained that it can produce nuclear radiation under controlled conditions which permit great accuracy of measurement.

He said that the ion beam emerging from the accelerating tube consists of high velocity hydrogen or helium nuclei which interact with the atomic nuclei of the target material. These processes will be studied in order to understand better the structure of the target nuclei and the nature of its interaction with the ion beam.

Investigation will cover the fields of nuclear structure, reactor design, radiation shielding design and material damage, among others.

### Flight Utilizes Silvercel

Telemetering and data-recording equipment used in Major David G. Simons' recent record-breaking, 32-hour, 100,000-foot balloon flight utilized silver-zinc batteries.

Called Yardney Silvercel batteries and produced by Yardney Electric Corp., New York, N. Y., they make use of a silver-zinc couple. This is said to be up to five times more powerful than elements in other batteries. High energy ratio enables them to be as small as one-fifth the size and one-sixth the weight of batteries of comparable ampere-hour capacity.

One of these batteries accidentally fell 30,000 feet when a parachute to which it was attached failed to open after being released from a research balloon during a previous test. Not only did it survive the crash with only minor damage to its outer plastic casing, but, after recasing, the battery was placed immediately into service again.

### Automatic Landing

Combining radio and radar, an automatic system has been developed that is capable of landing a fighter plane aboard an aircraft carrier. A Navy F3D jet has made repeated landings on the *Antietam*, operating in the Gulf of Mexico.

The system takes over from the pilot while the aircraft still is some distance from touchdown on a carrier deck. Radar locates the plane and determines its altitude and location with relation to the deck. An electronic computer does the rest, sending the necessary course corrections to an automatic pilot which directs the airplane into the desired flight path.

When the system "locks on" to the craft, the pilot immediately relinquishes control and rides virtually as a passenger.

If the carrier deck is not in the proper position for a safe landing, the system automatically gives pilot a "wave-off" and the plane flown around the landing pattern another attempt.

In addition to over-all accura the *Antietam* operations are eval ing the system with relation to lo tudinal and lateral dispersion of landings.

Previous to its actual use abo the carrier, the device had lan various types of military and c mercial aircraft more than 1800 ti during development and testing at Niagara Falls, N. Y. airport and military installations.

The landing system was develo by Bell Aircraft Corporation, Buffalo, N. Y., under contract w the Navy's Bureau of Ships.

### British Develop Deccafax

A new communication syste which does not require the aid o television camera to transmit pictu has been developed by Decca Rad Ltd., of London.

Called Deccafex, the system p vides instant exchange of informati by vision and sound between int connected points in a closed circ television layout.

According to the manufacturer. present the development is capal of sending pictures and sound up 2000 yards. The system is based a new application of television ope ating principles.

Consisting of two "master" uni connected by coaxial cables, the sy tem's speech and vision directions a reversed by a single switch. Pictur are transmitted by placing transpa encies on the screen of the sendin unit, by using 35-mm slides or eve by writing the information with chinagraph pencil on the face of th tube itself.

Ordinary television receivers, whil still able to perform as before, can b used to receive sound and picture from the master unit.

Aside from the commercial potential, the manufacturers believe th system also will meet the requirements of airports, air traffic control centers road and rail terminals, where a mass of incoming information must be collected and broken down for distribution.

## ms-Clarke Joins
## ro Corp.

Nems-Clarke, Inc., electronic manu- cturers of Silver Spring, Maryland, cently became an operating division Vitro Corporation of America. ie Maryland firm will be known as ems-Clarke Company and Mr. Allen Clarke remains as president.

Mr. Clarke stated that the new affili- ion will result in expanded manu- cturing and development activity. reorganization of the development horatory is in process to broaden e base of the company's proprietary oducts. While some changes in rsonnel would be necessary in or- r to accomplish this reorganization, Ir. Clarke further stated such nanges would be kept to a minimum.

The company expects to greatly ex- and its development activity for the reation of new proprietary products n the fields of telemetry, medical lectronics, photographic instrumen- ation and communications equip- nent.

## adiation Detectors

Army scientists in Nevada have used a new network of detectors to measure the amount of radiation following an atomic explosion. Tanks, balloons and underground positions serve as stations for the tests.

Developed at the U. S. Army Signal Engineering Laboratories, Fort Monmouth, New Jersey, the equipment keeps a continuous record of radiation hazards in the test area after a blast. The information is stored in well protected underground recorders until the section can be entered safely.

One type of spotter being used is designed to "pop up" from the ground like a periscope to compute the radiation at various distances from the blast. The instrument is kept underground as protection from the atomic shock wave. A split second after detonation, an automatic air gun jolts the detector into position. Remaining above ground for hours, it keeps a running account of fall-out.

A similar probe has been installed in a Sherman Tank to determine how close to the explosion a vehicle can be without danger to its crew.

A third set of instruments is attached to a balloon tethered at 1000 feet. The balloon burns instantly from the nuclear heat flash, but instruments have time to send readings through coaxial links to the recorders.

The scientists hope to ascertain under what conditions attacking troops can move into a section after striking with atomic artillery.

## Daystrom Forms Avionics

Daystrom, Inc., has announced a major reorganization of certain subsidiaries into an Avionics Group for development and manufacture of complete electronic systems for the guidance and control of missiles and aircraft.

Involved in the move are Daystrom Pacific Corp., Santa Monica, Calif., which manufactures gyroscopes, potentiometers and other miniature electronic equipment; Daystrom Transicoil Corp., Worcester, Pa., which produces servo-mechanisms; Daystrom Instrument Division, Archbald, Pa., which manufactures electronic computer equipment and precision subassemblies; the Aircraft Instruments Division of Weston Electrical Instrument Corp., Newark, N. J., which will supply specialized equipment to the new group; and special research and development facilities at Poughkeepsie, N. Y.

Commenting on the activities of the new group, Thomas Roy Jones, president, said, "The Daystrom Avionics Group will offer a single source for guidance and control systems and also has the necessary tools and facilities for the fabrication and assembly of all other missile components."

## Names In The News

**Thompson H. Mitchell**, President, RCA Communications, Inc., has been appointed general manager of the organization's Telecommunications Division. Mr. Mitchell will direct the integration of communication and broadcasting activities of the former Commercial Electronic Products group with RCA Communications, Inc.

**Lt. Colonel Kenneth E. Shiflet** has been named Chief of Technical Liaison in the Office of the Chief Signal Officer. He succeeds **Lt. Colonel L. J. Fishkin** who was recently appointed Special Assistant to the Chief Signal Officer.

**Dr. Irving Langmuir**, world-famous scientist, died at Falmouth, Mass. He was 76 years old. The Nobel-prize winning scientist was on the staff of the General Electric Research Laboratory from 1909 until his retirement in 1950. During his career at G.E., Dr. Langmuir's work was estimated to have saved the public nearly one billion dollars per year in electric light bills. In addition, he helped establish modern radio and television broadcasting.

(*Continued on page* 42)

**Dr. John N. Mrgudich,** Director of Human Resources, and **Joseph Weinstein,** mathematics consultant at Evans Signal Laboratory, have been awarded fellowships in the Secretary of the Army's Research and Study Program.

**Loren E. Gaither** has peen appointed Director of Communications Engineering for Philco Corporation's Government and Industrial Division. Mr. Gaither, who retired from the Army Signal Corps in 1955, was Director of Government and Industrial Engineering for the Magnavox Company.

**Captain E. N. Dingley, Jr.** (USNR-Inactive), a member of AFCEA and formerly Chief Communications Engineer of the National Security Agency, recently retired. He has accepted a position as a staff research engineer with Electronic Communications, Inc., St. Petersburg, Fla.

**Brig. Gen. Albert F. Cassevant,** now Director, Procurement Division, Office of the Deputy Chief of Staff for Logistics, has been designated to serve as Commandant of the U.S. Army Signal School at Fort Monmouth, N. J. He succeeds **Brig. Gen. Stuart S. Hoff.**

**Colonel William E. Jennings** was recently named the First Army Signal Officer, succeeding **Colonel C. B. Brown,** who retired from service. Colonel Jennings was Deputy Signal Officer.

# Highlights from WESCON

***This section is devoted to some of the items and events which comprised the Western Electronic Show and Convention held in San Francisco, August 20-23, 1957.***

Precision transistorized timing instrumentation components were exhibited by the ***Electronic Engineering Company*** of California. The components are part of a completely transistorized system which was designed and developed by the company for the Air Force's Missile Range at Patrick Air Force Base.

A lightweight, underwater camera enclosure, designed to operate at depths up to 1200 feet, was introduced for the first time by the ***Hallamore Electronics Co.,*** division of The Siegler Corporation, Anaheim, Calif.

A completely transistorized combat computer for the U.S. Army was described by John Terzian, an engineer of ***Sylvania Electric Products, Inc.*** Called MOBIDIC, the computer will solve prohlems in a variety of fields including logistics, combat surveillance, scientific or analytic computation such as in traffic control and artillery target assignment.

An operating display of the "Indicoder" binary decoding tube was shown at the ***Stromberg-Carlson*** exhibit. When a group of such tubes is used in combination, they will form an electronic display board which can keep current, detailed information on scores of aircraft in the vicinity of an airport.

The first power tetrode in the electronics industry was unveiled by the ***Semiconductor Products Division of Minneapolis-Honeywell.*** Because this new type transistor faithfully reproduces input signals, it is expected to be used in the manufacture of high fidelity equipment.

The ***Anatran Division of Endevco Corporation,*** Pasadena, Cal., demonstrated a unique digital stepmotor that rotates in steps of 180° in response to voltage pulse inputs.

***Electro-Mec Laboratory, Inc.,*** Long Island City, N. Y., showed the first shaft-to-digit encoder designed for airborne use.

***Intercontinental Dynamics Corp.,*** Englewood, N. J., exhibited a low frequency noise generat which provides an electrical noi output for performance simulation servos and other mechanical devic

***B J Electronics, Borg-Warn Corp.,*** Santa Ana, Calif., exhibit the model 82 signal generator seri which is designed for general labor tory work and rugged field applic tions where high frequency, free fro the adverse effects of environment extremes, is required.

***Jennings Radio Manufacturin Corp.,*** San Jose, Calif., has pr duced a new type of relay for u under severe environmental cond tions (e.g. missiles and aircraft) well as in other electrical application The contacts of the new relay are i a vacuum surrounded by a sturd stacked ceramic enclosure.

A new traveling wave tube weig ing only two ounces has been deve oped at ***Geisler Laboratories,*** Menl Park, Calif. It is believed to be th lightest traveling wave tube to dat and does not require a capsule sinc the tube forms its own.

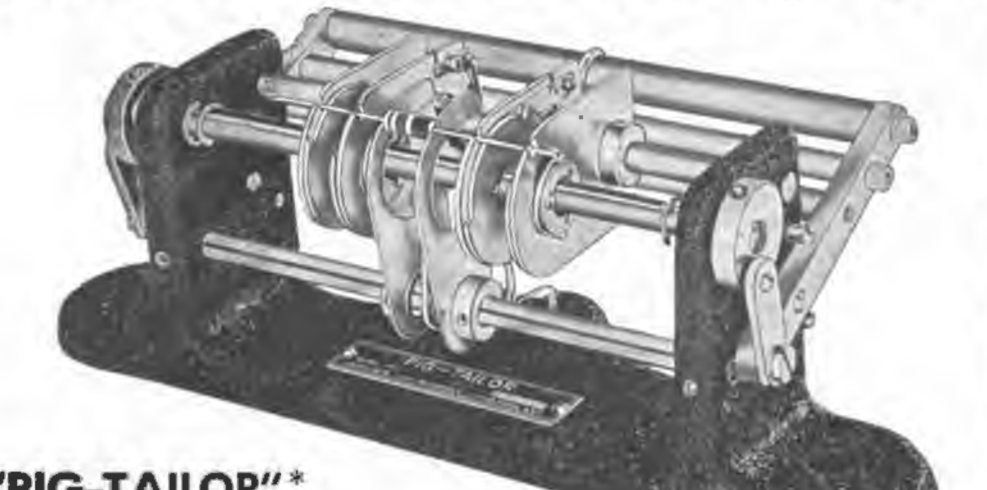
Visitors to the ***Texas Instrument Incorporated,*** display witnessed th actual growing of large single crys tals—from which semiconductor de vices are made. A regular productio crystal growing machine was set u to demonstrate the process.

The ***Hewlett-Packard Company*** Palo Alto, Calif., announced a new instrument. The —hp— 560A Digital Recorder, the result of more than five years of research, is used to record the answers displayed on an electronic counter or counters.

The ***Aeronautical Division of the Robertshaw-Fulton Controls Company,*** Anaheim, Calif., exhibited a new liquid level switch for control of critical fuel levels in missiles and supersonic aircraft.

The ***General Electric Company*** unveiled its new 85-watt silicon power transistor publicly for the first time. The new transistor is thought to have the highest power rating of any high temperature transistor available.

# PROVEN-on the assembly line!



**"PIG-TAILOR"*** T.M.

*For PREPARATION of axial lead components*

**PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"**

# "PIG-TAILORING"

***. . . a revolutionary new mechanical process for higher roduction at lower costs. Fastest PREPARATION and ASSEMBLY f Resistors, Capacitors, Diodes and all other axial lead mponents for TERMINAL BOARDS, PRINTED CIRCUITS and INIATURIZED ASSEMBLIES.***

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time 'rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

**"SPIN-PIN"*** T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

*Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-10P*

**BRUNO-NEW YORK INDUSTRIES CORPORATION**

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET • NEW YORK 1, N. Y.

# NEW PRODUCTS FROM INDUSTRY

## *Stethoscope Shuts Off Unwanted Sounds*

Airsonic, Ltd., of London, England, now offers a new stethoscope, said to be the first of its kind, which allows the doctor to shut out unwanted sounds and yet amplify those which are desired.

Since all sounds have a certain frequency, the device is designed with 2 controls that permit only a particular frequency to be carried to the ear pieces. A doctor, for example, can thus listen to the heart of a patient confined in an iron lung while the lung is still operating.

Suspended from the doctor's neck is a compact 18-oz. box containing the brain of the instrument. Two sets of ear pieces can be used simultaneously with a connected tape recorder and a loud-speaker. This feature provides a valuable aid for teaching purposes. Used with the stethoscope, the microphone conveys only the sounds from the source with which it is in contact.

## *New Mullard "510" Amplifier Kit*

Featuring the addition of a separate pre-amplifier and control unit, together with the incorporating in the power amplifier of an output transformer operating under distributed load conditions, a new version of the Mullard "510" high fidelity amplifier kit has been announced by Mullard, Ltd., Torrington Place, London, Eng.

Both power amplifier and preamplifier units use up-to-date printed circuit techniques, and an accompanying instruction booklet enables easy, accurate assembly.

A 5-position selector gives a choice of inputs: LP and 45-r.p.m. discs; 78-r.p.m. discs; compensated tape; radio, and microphone. Separate bass and treble controls give, respectively, continuous variations in level from 10db at 40 cs, and 15db at 10 kcs.

Believed to provide exceptionally high performance, the power amplifier has a rated peak output of 10 watts, with a total harmonic distortion of only 0.1%. Frequency response is flat within 1db from 10 cs to 30 kcs. A salient feature lies in the amplifier's large margin of feedback stability, allowing for a diversity of loudspeaker and enclosure design, and affording flexibility in the remote siting of the loudspeaker from the amplifier.

## *Transistorized Telephone Receiver-Amplifier Aids Impaired Hearing*

Development of a single-stage transistorized telephone receiver-amplifier which increases the level of incoming speech signals, thus offering particular aid to those with impaired hearing, has been announced by Stromberg-Carlson of Rochester, N. Y.

The compact device, enclosed in a molded plastic case measuring 4 x 2¾ x 1¼ inches, can be installed with any standard telephone, whether desk or wall-mounted.

An adjoining 4-conductor 3-foot cable, coupled to the points where the receiver is normally connected, is sufficient to put the unit into operation. When the handset is removed from the hookswitch, the device is immediately energized.

## *Ultrasonic Surgery*

A new medical technique, called "neurosonic surgery," is now possible through the development of precision ultrasonic focusing instruments, recently designed by Professor Fry and associates of the University of Illinois, and now available from Invengineering, Inc., Belmar, N. J.

The first human brain surgery using the new ultrasonic apparatus is scheduled to be performed this month at the University of Iowa. Professor Fry believes ultrasonic techniques have further application in the destroying of bone tumors and cancerous cells in addition to the exploration of the central nervous system.

During the human brain surgery, deep lesions are formed in the brain which sever fiber tracts without damaging intervening tissues or destroying blood vessels. This procedure is said to represent considerable advance in technique. Dosage at 1 megacycle is delivered for 1 to 3 seconds. Larger lesions are possible by positioning the focal spot successively in a number of locations.

The positioning system is motor driven and controlled from an instrument panel. Supported by steel I-beams, it holds a demountable X-ray tube for determining proper location of the head. Exposure duration is set up on a series of dials reading directly in decimal notation. The sound level is set up by reading the deflection of a pointer on a single meter.

## *Recordak Engineering Drawing System*

Recently developed by Recor
Corp., 415 Madison Ave., New Y
17, N. Y., a subsidiary of Eastm
Kodak Co., a new card system of
ing engineering drawings, using 35
microfilm images mounted in ap
ture cards, is claimed to offer gr
savings of time and cost in the fil
of and reference to drawings and e
nomical distribution of necessary
per reproductions.

While working on new desig
engineers have ready reference to t
drawings on the Recordak Reader
the drafting board. Consequent
time and cost of reference paper co
ies is eliminated. Required fili
clerks are fewer and equipment spa
is 95% reduced.

Original drawings are microfilm
and processed, and then can eith
be mounted on a tabulating apertu
card for use in electronic sorti
machines or on a plain file card
manual filing. Duplicate sets of car
can be made economically for qui
dispersion to other plants.

From these aperture cards, full
reduced-size drawings can be repr
duced for manufacturing or bid pu
poses at great savings in paper cost
shipping costs and time. It is sai
one Government agency, now engage
in this method, is saving an estimate
$500,000 annually.

## *New Amplifier Klystron Tube*

A new, wide-tuning-range klystro
amplifier tube, having internal reso
nant cavity circuits capable of tunin
from 1700-2400 megacycles, has bee
announced by Varian Associates o
Palo Alto, Calif.

Known as the VA-800, the new tube
is one of a line of high-power, high-
gain, low-noise CW power tubes de-
livering 10kw and 1kw of power
for tropospheric communication serv-
ice in the frequency range from 37
mc to 8500 mc.

RF connections to the new VA-800
are merely an input line with less than
1 watt of drive power and an output
line to carry 10,000 watts of rf power
to the antenna. All resonant circuits
are an internal part of the tube, and
can be tuned readily to any spot in
the 1700-2400 mc band. No other
adjustments are said to be required
for continual optimum operation.

### quid Levels Measured · Remote Storage Tanks

"*Data-Gage*," a new transistorized ctronic system claimed to measure ; *liquid* level in any of 100 re- otely located storage tanks with ac- *racy* of performance, reliability d automatic self-checking, has *en* developed by Texas Instruments, c., Dallas 9, Texas.

Major components of the system e a receiver console, field selector it and liquid level gauge embody- g a *float* of completely new de- gn. Either the entire system may installed at the tank site, or a re- iver console may be installed at a mote office any distance away.

On a single system, liquid depth 64 feet in each tank may be meas- red with a claimed accuracy of 1/16 ch.

Desiring to monitor a specific ank, the operator dials and is con- ected through the field selector unit o the liquid level gauge on that par- icular tank. A dynamic mechanical urface finder is activated and the lata is telemetered to the receiver onsole where it appears in lighted umerals. No wires enter the tank and installation requires no halt of operation.

### The Automatic Chemist

The Titromatic Analyser, an apparatus said to perform the work of two skilled chemists in the continuous analysis of a chemical process during manufacture, is now available from the Instrument Div. of Robertshaw-Fulton Controls Co., 2 West 45th St., New York 36, N. Y.

With the apparatus connected to the main plant stream, a measured quantity of the solution being manufactured is fed to a reaction vessel at regular intervals. After dilution with water, titration with a standard reagent begins and continues until the solution has been completely neutralized.

The amount of reagent used is determined by an "electric eye" that finds the level of the reagent and then records the volume used on a recorder chart. Thus, this continuous record enables instant detection of variations in the plant stream and use of corrective measures. Meanwhile, the reaction vessel is emptying itself and the whole process starts again.

Composed of two separate units—one chemical and the other the electronic control—the apparatus is designed to operate continually and the time cycle of a titration can be varied from once every 3 minutes to once every half hour.

### Moving Target Simulator

A precision piece of test equipment, designated the "moving target simulator," has been recently developed by Aircraft Armaments, Inc., of Cockeysville, Md., for the purposes of checking radar range tracking circuits, of calibrating radar range marker circuits, and of performing other tests on either K or Ku-band radar equipment.

The simulator provides a microwave return signal with pulse characteristics identical to that of the transmitted radar signal. The return signal may be adjusted to have a continuously varying range, and then used to check the radar range tracking circuits. However, it is said the unit will also provide a series of fixed range echo pulses of extreme accuracy for calibration of radar range markers. The unit may be connected to the radar set directly through a directional coupler, or may be used with a pick-up horn antenna.

A transit case offers convenient portability of the unit and its required accessories. However, the simulator may be mounted in a standard relay rack for laboratory use.

### Ultrasonic Cleaner

Designed for industrial cleaning of small precision parts, a portable, lightweight, ultrasonic cleaner, Glennite Model U-621, has been announced by the Vibro-Ceramics Division of Gulton Industries, Inc., Metuchen, N. J.

In as little as 5 seconds, it is said the U-621 can clean small metal parts, glass and ceramic, such as electromechanical instruments, small aircraft instruments, watch parts, small diameter tubing, and delicate research and medical instruments.

A further application exists in the chemical industry for the agitation of liquids and for experimental processing such as emulsification and demulsification.

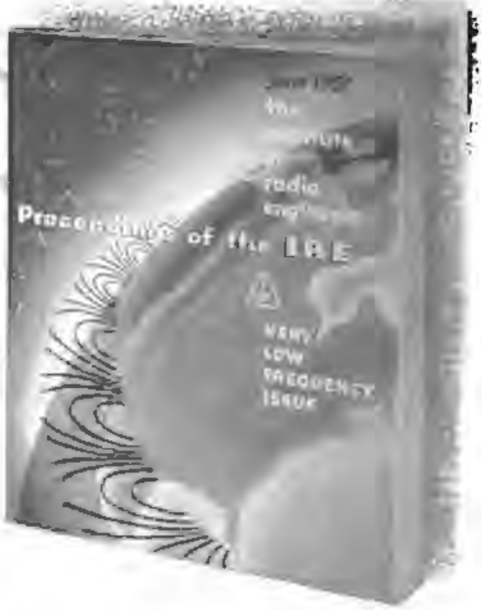
### New Beam Power Amplifier

Production of an audio beam power amplifier, claimed to provide maximum reliability in high ambient temperatures, has been announced by Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Designated "Type SN-2146B," the new tube, which makes use of the stacked ceramic construction, is capable of 4.5 watts power output under class A conditions. Designed primarily for military equipment manufacturers, the tube is said to offer greater resistance to heat, shock, vibration, altitude and humidity than types previously available.

## ABOUT VERY LOW FREQUENCY PROPAGATION!

Smaller antennas, lower transmitter power, and relative freedom from atmospheric noise are reasons behind our communication services' gradual migration to the upper end of the frequency spectrum. Lying fallow and awaiting rediscovery has been the very low frequency band below 30 kc.



Now, because VLF offers a reliable means of communicating over vast global distances, there is a marked revival of interest. It is now known that VLF has highly stable propagation characteristics which make it possible to transmit data to distant points with unusual fidelity and precision. Whe greater accuracy is required, such as very lon range radio navigation systems and internation transmission of frequency standards, VLF promis to open doors to many new and important uses.

## *June Proceedings of the IRE gives you the facts about VL*

This year, the Boulder Laboratories of the National Bureau of Standards and the IR Professional Group on Antennas and Propagation co-sponsored a Symposium at Bou der, Colorado, on the propagation of very low frequency radio waves. From th papers given at this important meeting the editors of *Proceedings* have chosen thos of broadest interest for publication in the June, 1957, issue.

Typical of the service offered members of IRE is this VLF report — to be used no and referred to for years to come. If you are not a member of *The Institute of Radi Engineers* be sure to reserve a copy of the June *Proceedings of the IRE*, today!

## *Partial Contents of this VLF Issue:*

- **"A Technique for the Rapid Analysis of Whistlers,"** by J. K. Grierson, Defense Reserve Board, Ottawa, Ontario, Canada.
- **"VLF Radiation from Lightning Strokes,"** by E. L. Hill, School of Physics, University of Minnesota.
- **"Some Recent Measurements of Atmospheric Noise in Canada,"** by C. A. McKerrow, Defense Reserve Board, Ottawa, Ontario, Canada.
- **"Intercontinental Frequency Comparison by Very Low Frequency Radio Transmission,"** by J. A. Pierce, Croft Laboratory, Harvard.
- **"The Mode Theory of VLF Ionospheric Propagation for Finite Ground Conductivity,"** by James R. Wait, National Bureau of Standards, Boulder, Colorado.
- **"The Geometrical Optics of VLF Sky Wave Propagation,"** by J. R. Wait & A. Murphy, National Bureau of Standards, Boulder, Colorado.
- **"Characteristics of Atmospheric Noise from 1 to 100 Kc/s,"** by A. D. Watt & E. L. Maxwell, National Bureau of Standards, Boulder, Colorado.
- **"The Present State of Knowledge Concerning the Lower Ionosphere,"** by A. H. Waynick, The Pennsylvania State University.
- **"Noise Investigation at VLF by the National Bureau of Standards,"** by W. Q. Crichlow, National Bureau of Standards, Boulder, Colorado.
- **"Reflection at a Shapely-Bounded Ionosphere,"** by I. W. Yebroff, Stanford University.
- **"The Attenuation Versus Frequency Characteristics of VLF Radio Waves,"** by J. R. Wait, National Bureau of Standards, Boulder, Colorado.
- **"The Waveguide Mode Theory of the Propagation of VLF Radio Waves,"** by K. G. Budden, University of Cambridge, England.

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# Books

***IANDBOOK OF PIEZOELECTRIC CRYSTALS FOR RADIO EQUIPMENT DESIGNERS, PB 111586R, by J. P. Buchanan. OTS, U.S. Department of Commerce, Washington 25, D. C. 702 pages, $7.00.***

Recently released to industry as a uide for designers of military elecronic devices, Mr. Buchanan's manal is a revised edition of the Air 'orce handbook of the same title ssued in 1954.

Presenting a comprehensive exmination of piezoelectric control of adio frequencies, the manual inludes background material, circuit heory, components data and all inormation essential to the application f piezoelectric crystal oscillators.

In addition to a 430-page division iven to general coverage, other secions discuss application of crystal mit, holders and ovens recommended or use in equipment of new design.

The illustrated volume also inludes a bibliography containing ome 900 entries together with a list f manufacturers.

***'RINCIPLES OF ELECTRIC AND MAGNETIC CIRCUITS, by Warren B. Boast, Ph.D. Harper & Brothers, New York. 369 pages, $5.50.***

Dr. Boast's second edition, like the irst, is designed to give a full comrehension of electric and magnetic ircuits to the undergraduate student.

However, the section treating elecric energy sources has brought the ext up to date relative to improvenents in solar sources. In Part IV a presentation of the methods of lectric network analysis), sections ave been expanded to include disussion and further examples on sitations involving voltage sources in ircuits where a direct application of asic principles would render the ciruits indeterminable of solution.

In addition, a more exact mathenatical treatment of the combination f the compensation theorem and the uperposition principle is offered. Alhough the English units of magnetic otential gradient and flux density re emphasized, the rationalized MKS stem of units is also employed.

More than 300 problems are proided the student for testing his bility to apply theory.

***ACOUSTICAL ENGINEERING, by Harry F. Olson. D. Van Nostrand Co., Inc., Princeton, N. J. 718 pages, $13.50.***

For radio, TV, sound motion picture and recording engineers, architects and musicians, this newly enlarged edition makes available the most up-to-date information in modern acoustic science, and offers complete working methods covering the entire field of acoustical engineering.

In addition to the most recent developments in underwater acoustics, ultrasonics, architectural considerations and new musical instruments, the two new chapters treat sound reproducing systems and communications systems.

Since reducing a vibrating system to the analogous electrical network has been found a valuable tool in an analysis of that system, there is made throughout the volume a logical use of analogies between electrical, mechanical and acoustical systems. Detailed presentations of theory and practice are given concerning important transducers, and the material on speech, music and hearing correlates objective and subjective acoustics.

***"LIFE" PHOTOGRAPHERS—THEIR CAREERS AND FAVORITE PICTURES, by Stanley Rayfield. Doubleday & Co., Inc., New York 22, N.Y. 89 pages, 14" x 10½", case-bound, coated stock, $5.00.***

In compiling this unique anthology concerning 40 *Life* photographers, Stanley Rayfield has traced the careers and specialties of the entire *Life* photographic staff, from the original four in 1936 to the youngest, who was just 6 years old when the picture magazine was born.

Rather than giving a definitive record of any one photographer's work, a demonstration of individual approaches to picture-making and photo-journalism is offered and illustrated with 228 black-and-white photographs. *Life* photographers "hope that out of the thousands of negatives they shoot will come a truly great picture once in a while and many of them have pictures that are a permanent contribution to photography. Today the editors look at ½ million pictures a year to find the 10,000 they will print. The odds 'against' a picture running in *Life* are about 50 to 1."

Of special interest to those interested in photography is a section of the book on *Life* photographic technique and equipment.

***UNDERSTANDING HI-FI CIRCUITS, by Norman H. Crowhurst. Gernsback Library, Inc., New York 11, N.Y. 224 pages; $2.90—paper-bound edition, $5.00—hard-bound edition.***

Although assessing high-fidelity performance is generally regarded a matter of taste, its circuitry is completely scientific. With the rapid progress in the science of audio circuitry during the last decade, there has arisen, however, some confusion in the evaluation of the variety of circuits available.

For the engineer, technician, musician or layman, Mr. Crowhurst has endeavored to divide the whole audio or high fidelity system into sections, explaining pertinent technical points that lend themselves easily to confusion, such as, output stages, matching, equalization, speaker crossovers, volume and tone controls.

The concept of proper integration of parts, considering the system as a whole, is presented to reveal as invalid the idea that the best result is obtained merely by a grouping of all the "best" parts.

In most sections there are at least two approaches—one simple and one complex. Additional consideration of such circumstances as budget, taste in programs, critical listening habits, etc., permits the reader to make his own particular compromise.

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# SIGNAL

November 1957

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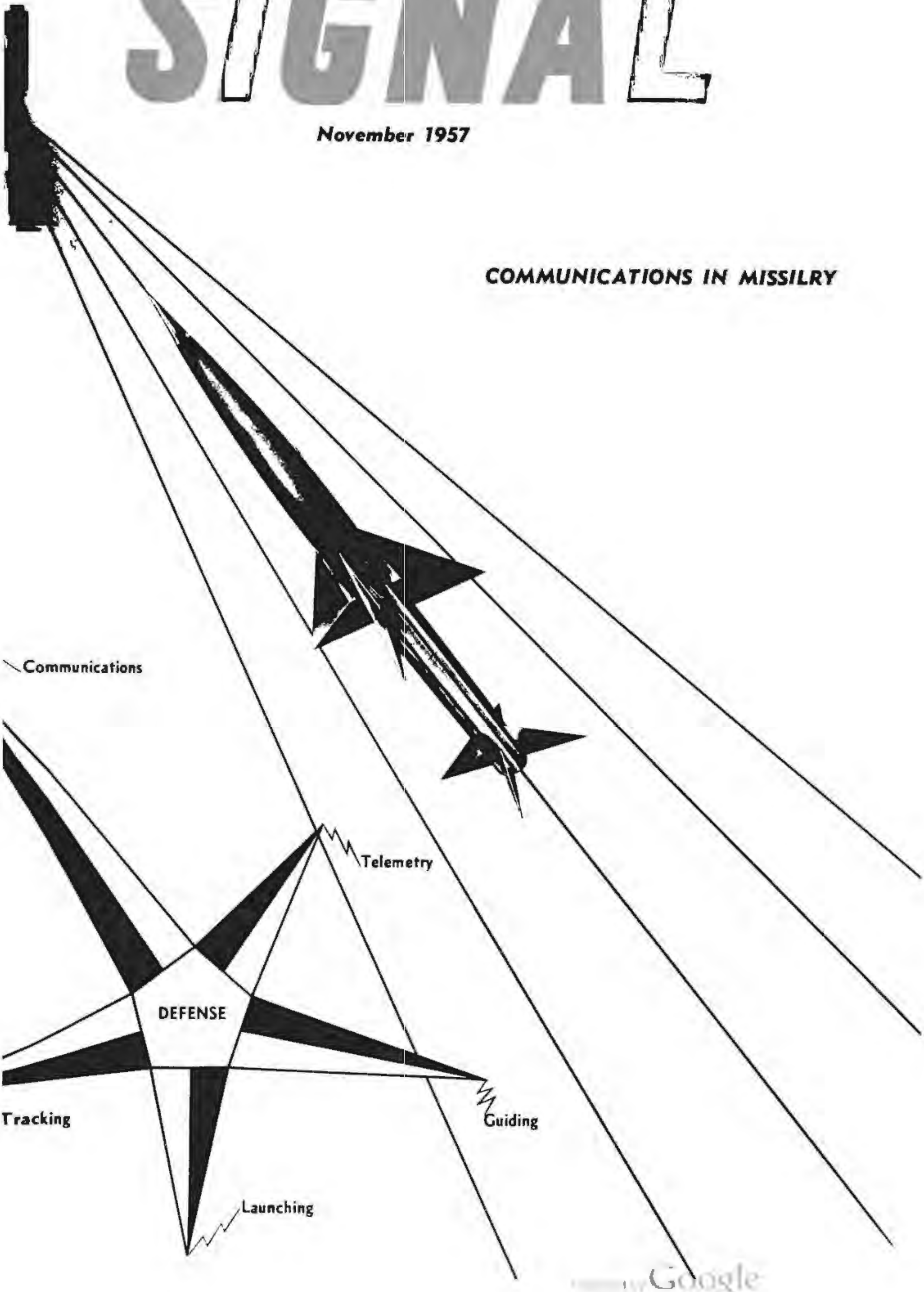

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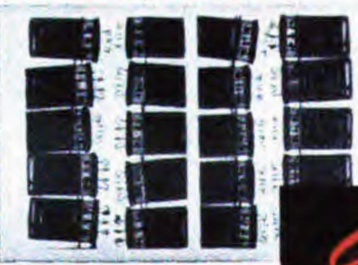
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# SIGNAL

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**Journal of the Armed Forces Communications and Electronics Association**

**VOLUME XII** **NOVEMBER 1957** **NUMBER 3**

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### COVER

*The missile on the cover is the Sperry Sparrow I. Admiral Arleigh Burke, Chief of Naval Operations, credited "years of intensive development by the Bureau of Aeronautics and Naval Air Missile Test Center and Sperry for the readiness of the Fleet with this air-to-air missile system." See page 13 for a first release story on the design, development and production of a complete missile system. The cover illustration by the Editor portrays the importance of electronics to defense in this epoch of missilry.*

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# *From the President*

In my last message, I spoke of the possibilities of creating a greater interest at our chapter meetings by discussing timely subjects and events relating to our national welfare. I also hinted at the importance of being alert to the problems of balancing heavy industrial requirements against the needs of an expanding economy. In short, I was saying that the future of America depends upon how well we as a Nation utilize our economic resources in advancing our national objectives.

This is a process known as economic mobilization. Its phraseology is meaningful and carries a dynamic connotation which is profoundly important to all of us in the communications and electronics field. It is the responsibility of our citizens and our industrial organizations to plan, cooperate, control and coordinate the transformation of the Nation's productivity from a peace time economy to an emergency status. In this age when time has been reduced from days to minutes, it is necessary to prepare the blue prints for tomorrow's eventualities now if we are to support our defense requirements at home and abroad and, at the same time, maintain a progressive day-to-day civilian economic balance. This must be done in concert with our peace time responsibilities to assist our allies and to help them in developing a stable economic posture. This transformation does not fall upon industrial management alone, and neither is it a spontaneous evolution. It must be sparked and directed by the Federal Government, for this is the law of the land. The point to remember is that we should see to it that action is taken now to prepare against the day of reckoning, so that our organizations for national security have the means to provide for the defense of our Nation, and to win quickly and as economically as possible should a war be thrust upon us. This is our challenge, since ultimate success or failure of national mobilization, and the operation of the economy before and after mobilization, depends to a maximum degree upon the people.

Perhaps President Eisenhower, in his State of the Union message on February 2nd, 1953, has provided us with the foundation on which to build for our future security when he said, "Our problem is to achieve adequate military strength within the limits of endurable strain upon our economy." . . . "To amass military power without regard to our economic capacity would be to defend ourselves against one kind of disaster by inviting another." . . . "We must effectively integrate our armament programs and place them in such careful relation to our industrial facilities that we assure the best use of our manpower and our materials. To have peace and security, we need above all to be strong and alert; we need unified effort."

The next point I would like to make relates to the importance of bringing new blood into the chapter organizations. It is my unshakable conviction that each chapter can benefit materially by electing to chapter offices each year young executives representing the various industries in the communications, electronics and photographic fields, together with engineers, educators and scientists working on research and development, and other dynamic leaders within the community. A constant change within the chapter organization assures new ideas, but even more, provides a means for making the Armed Forces Communications and Electronics Association and its official publication, SIGNAL, known to a greater number of people.

With the appointment of a new Executive Vice President at national headquarters, who will devote much of his time to the furtherance of closer association with the chapters and the expansion of our association, and with the publication of a top-flight monthly magazine, SIGNAL, we have every reason to believe there will be a steady and progressive growth in the months ahead. This growth can be stimulated by bringing new men into the chapter organization and by a little effort on the part of our present members in encouraging new membership among their friends.

*Frederick R. Furth*

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By means of a transistorized circuit and the new RCA half-inch Vidicon, the "Telemite" actually surpasses standard Vidicon-type industrial TV cameras in sensitivity. It produces clear, contrasty pictures with a scene illumination of 10-foot candles or less.

The "Telemite" operates with up to 200 feet of cable between it and the control monitor, and this distance can be further extended by using a repeater amplifier. This is the first TV camera to employ photoelectric sensitivity control, which provides automatic adaptation to widely varying scene illumination.

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# electronics in NEW WEAPON SYSTEMS

WIDESPREAD ANXIETY APPEARS TO exist in the electronics industry. Aircraft manufacturers gradually are encroaching on the electronics and communications field.

The general scramble throughout industry for trained engineers and skilled technicians, especially those with backgrounds and schooling in the relatively new field of electronics, is popularly taken for unmistakable evidence of this trend.

Thus needless but quite natural rivalries and resentments between the electronics and aviation industries are springing up as the aircraft and missile designers have come to rely increasingly upon electronic components to make possible the performance demanded of modern day weapon systems.

Yet many of these same rivalries and resentments are rooted in the misunderstanding of why the aircraft and missile makers are so concerned with developing their electronic capability. This capability must be developed if we are to take necessary cognizance of the evergrowing role electronics can play in our offensive and defensive military planning.

The building of a capable electronics engineering staff by an aircraft or missile manufacturer is just as legitimate and necessary as the development of a staff of competent propulsion engineers. In order to design advanced manned and unmanned aerial weapons, we have to have maximum competence in propulsion engineering. But this does not mean we manufacture engines or that we intend to in the future.

By now, everyone must be familiar with the truly formidable technical production problems created by the swift advent of supersonic and hypersonic aerial vehicles, both manned and unmanned. We are indeed straining at the leashes of scientific knowledge in many areas—in metallurgy, in high-altitude physics, in the behavior of materials and electrical components at elevated temperatures, in the so-called exotic fuels and their related propulsion problems—to name just a few of our trouble spots.

We cannot afford to minimize the difficulty of any of these problems. However, in the development of present day weapons to meet present day threats, and in the planning and designing of tomorrow's weapons to counter tomorrow's threats, we have one dominant responsibility. This responsibility underlies everything we produce or plan to produce for the military services, and for the civilian market as well. It is summed up in the word "reliability."

Not too many years ago, in aerial weapons, for example, reliability centered on three factors: a relatively slow airplane, the courageous man who flew it, and the guns he was given to aim and shoot with his own hands and eyes, or the bombs his aircraft was equipped to drop on military targets. Reliability was only as good as the human in the cockpit was skillful in manipulating the equipment he was given—only as good as the judgment he was capable of applying to each combat situation.

Today, this is no longer quite true and with the passing of each year, the reliability task is becoming less and less simple. Today, we are flying interceptor aircraft that can travel faster than sound and automatically can fire their rocket and guided missile armament at enemy targets our pilots may not actually have seen.

### By Rear Admiral Charles F. Horne U. S. Navy (Ret.)

One of the country's most active electronic executives, Admiral Horne is a Division Manager of Convair Pomona (California), a Division of General Dynamics Corporation. Graduating from the Naval Academy in [illegible], he became one of the pioneers in the application of electronic concepts in the U. S. Navy and subsequently Deputy Chief of Naval Communications. He was also a former [illegible] of the Civil Aeronautics Administration.

Bombardiers, too, could destroy or extensively damage targets obscured by weather or darkness. Supersonic guided missiles, equipped with electronic devices that help the weapon seek, find and knock down a fast-moving target regardless of visibility, can be launched from land, sea and air.

All of these sophisticated and complex weapons are useful militarily only to the degree that they—and the even more complex launching and directing systems of which they are just a part—can be relied upon to stop or impair the effectiveness of an enemy attack or accomplish the military objectives of our own retaliatory forces.

Seldom is there a weapon in today's military arsenal that is not a part of a larger and even more complicated system—an equipment complex created to detect, track and counter any enemy threat from the air or to cope with a surface attack launched from ground or ocean.

At many points in these complex systems, the human is still the vital decision-making, judgment-exercising element, but in a far different way than in the old dog-fighting aerial combat sense of World Wars I and II. Whenever an "either or" decision must be made, whenever a "now or later" judgment becomes necessary, we as yet have devised no substitute for the human brain.

Nevertheless, the employment of that human judgment is reduced almost to futility if any of the critical components of a complex weapon system fails to function properly. And in truth, there are today many combat situations in which human judgment alone no longer can be relied upon for the rapid calculations and motions made necessary by the very high speeds at which our modern aerial weapons are traveling. Increasingly, we find ourselves relying more and more upon the tools that electronics have given us—high-speed but compact computers, radar and other circuits that can sense the presence of a target not visible to human eyes, devices that move control surfaces far faster and with infinitely greater sensitivity than human hands or feet, gyros that are not subject to vertigo or the disorienting pressures of high G forces induced by acute maneuvers at high speeds.

Thus, not only are our individual weapons themselves more complex today than they were a decade ago, but they also perform effectively only in relation to the other segments of the weapon system of which they are the punch-delivering part.

To an aircraft or missile manufacturer such as Convair Division of General Dynamics Corporation, this means three primary things. . . .

1. He must design components in terms of the whole weapon system. Each must be intimately related to the limitations of the others in the system, trailing neither too far behind the technological levels of the other elements nor leading too far ahead.

2. If the weapon system is to function effectively throughout, the designer must make it relatively simple to maintain, and the training and skill levels demanded of the men responsible for maintenance of all its individual elements in operational use obviously must fall far below those of the men who designed and developed those elements for production.

3. He must so design and develop the system that it is producible by present-day shop standards. True, in many areas of the aircraft and missile industry, shop technology is far advanced over that of other less exacting industries. The aircraft-missile industry works to far closer tolerances and the components it creates and purchases from other suppliers must be not only much more precise in performance but also much more rugged than are the products with which all of us are familiar in our daily lives—our automobiles, TV sets, radios, automatic appliances and the like.

Granting the validity of these basic industrial principles, it can be seen that to remain competitive with other manufacturers and to continue to provide the kind of advance product planning that is dictated by modern military technology, we as an aircraft and missile manufacturer have had to develop our weapon system design and management capability. Going hand-in-hand with this is the increasing necessity to design for maintainability, and to keep fabricating techniques and the employment of revolutionary new materials and processes consonant with the design sophistication of all the weapon system elements.

### *Military Procurements*

Today, as a weapon system designer, an aircraft-missile manufacturer such as Convair must devote a large part of its engineering, research and development effort to the electronic aspects of the systems on the company's drawing boards. Only six years ago, electronics accounted for only 6.1 per cent of the U.S. Air Force's aircraft and related procurement. Yet in fiscal 1957, this percentage had climbed to 17.3 per cent, or 1.4 billion dollars o[illegible]4 billions spent for aircra[illegible] relate products. And in the p[illegible]ent o other than aircraft and [illegible] equipment, electronic and c[illegible]icatio devices accounted for [illegible]than 7 per cent of USAF purch[illegible]In fisc 1956-57. In the first [illegible]f fisc 1957, approximately 367 [illegible]on do lars were spent by the D[illegible]ment Defense for procurement [illegible]electro ics and communication[illegible]and 3 million during the c[illegible]pondi period of fiscal 1956. T[illegible] figu exclude electronic and [illegible]unic tion equipment installed [illegible]tegr components of aircraft, [illegible] vehi cles, artillery, missiles, [illegible]s a other equipment.

The three Services sp[illegible]ost 3 billions for aircraft pro[illegible]ent the first half of fiscal 1[illegible] almo 300 millions more than in the san period a year ago. For missiles t three Services spent slightly mo than 850 millions, compared wi about 445 millions in the first ha of fiscal 1956.

While there are strong indicatio that future military procurement w be pared down, it would be foolhar to predict any decline in the propo tion of outlay that will be devoted electronics and related electric equipment in our future aircraft an missile procurement.

Obviously, at Convair-Pomon where our primary concern is desig development and production guided missiles for the U.S. Navy, w must employ electronic and rada engineers who are just as capable a are the other specialists required b our product—in aerodynamics, stru tures, mechanics, hydraulics, pne matics, metallurgy, chemistry, an the host of other scientific discipline represented in our engineering de sign, test and production rosters.

In fact, if any one thing distin guishes our type of business from the of consumer manufacturing, it is th depth of engineering force we are re quired to maintain and to develop As weapon designers, we have to hav capability in all of the engineering areas affecting our products, not jus in a selected few.

If the weapons are to functio properly, we must have good electron ics men at the outset of the desig phase. Electronics are an integra and often determining design factor not a superimposed accessory added after the aircraft or missile is created. All the missile or aircraft elements must dovetail into a single working whole.

It should be equally obvious that no aircraft or missile producer would

(*Continued on page* 10)

*U. S. Army photo.*

**Aerial drone being launched in test at Fort Huachuca. Remotely controlled by van equipment, it serves as a "flying camera" to spot enemy movements and installations.**

# U. S. ARMY SIGNAL CORPS DEVELOPS ELECTRONICS FOR ATOMIC-AGE AT FORT HUACHUCA PROVING GROUND

Fort Huachuca, once a sleepy cavalry post, has come of age in the last few years. When the United States Army Electronic Proving Ground was established here in early 1954, this mile-high post was set upon a new trail marked by electron tubes, transistors, radar antennae, and television cameras.

Nestled against the base of the rugged Huachuca mountains about 100 miles south of Tuscon, its 70,000 plus acres are a beehive of electronic activity under United States Army Signal Corps direction. The many types of different terrain are ideal for the testing of electronic equipment.

Nearly 5,000 military personnel and approximately 2,000 civilian employees, many of them highly skilled scientists, are engaged in work at the Proving Ground.

The new look in defense is placing heavier burdens on the United States Army Signal Corps. This, of course, means more communications with new doctrines suited for employment in atomic war. The Combat Development Department at the Proving Ground has been experimenting along these lines. A new area system of battlefield communication designed to meet the threat of mass destruction from nuclear attack is now in the planning stages.

Meanwhile, the Signal Communications Department is conducting tests on both standard and experimental United States Army Signal Corps equipment to determine their future with the new look in defense. Under atomic attack, the use of extensive wires will not be practical. More radio communication is the answer, but ways to put more channels on radio frequency must be found.

With the spread-out of troops under atomic attack, increased surveillance of combat areas is a necessity. The Combat Surveillance Department of USAEPG is presently developing and testing a surveillance system with devices on the ground and in the air to bring reconnaissance and fire control information to the field commander.

Another important Proving Ground product is the "Flying Camera." A high speed camera is mounted in the fuselage of a remote-controlled drone aircraft. The aircraft is launched into the air by means of jet assist. When its mission is completed, the drone parachutes to the ground near the original launching site. Its up-to-the-minute pictures are developed, and the troops proceed to hit the pin-pointed areas of resistance.

* * *

These are just a few of the many projects under way at Fort Huachuca, helping to keep our country's military offense and defense the world's best.

This is one of a series of ads on the technical activities of the Department of Defense.

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**Engineers at Ford Instrument check out drone control system for United States Army project.**

want to undertake the costly and highly specialized assembly-line production of all the electrical and "black box" components in a given weapon or weapon system if he could readily obtain these components from companies having a long and capable production experience in these fields. He would not do this anymore than he would undertake the production of specialized machine tools that his plant might require for a particular manufacturing task.

Sometimes, however, because he cannot reasonably obtain elsewhere the close-tolerance, high-precision devices on which the performance and reliability of his missile depend, at a price within allowable limits, the aircraft-missile manufacturer is compelled to design and produce the components himself.

But it is also a matter of Convair policy that, wherever possible, the production of these components—and in many cases the detailed design work also—is subcontracted to established competent electronics manufacturers or manufacturing in other fields. The procurement of "black boxes" normally goes outside the missile-aircraft industry, unless the missile-maker's quality, tolerance or durability requirements are so rigid as to be beyond the available capabilities of the electronics' manufacturers.

Convair, in short, is not only a producer and designer of airframes for aircraft and missiles but also is responsible for seeing that the electronic, hydraulic, pneumatic and all other systems are integrated satisfactorily and reliably into these airframes.

A good reason why the aircraft-missile industry's requirements are so much more exacting—and therefore sometimes exceed the capacity of some of the electronics industry to produce missile and aircraft components—is that these high-performance weapons subject their components to vibrations, G forces and environmental conditions much more severe than those to which the electronic industry normally has been accustomed.

The Convair Terrier missile, for instance, contains only specially processed and reliable vacuum tubes. These were developed by the electron tube manufacturers to meet our special requirements for components of unusually high quality. To install such tubes in an ordinary television circuit would be a wasteful luxury, but to install less reliable and lower-quality tubes in the Terrier would tremendously increase the likelihood of missile malfunctioning and would increase the total cost.

Potentiometers are another example of Convair's extraordinary needs. We build some of our own and had to develop our own precision manufacturing techniques for this when it proved impractical to obtain fully adequate potentiometers from our suppliers. We intend to get out of the potentiometer business as soon as it is possible.

To eliminate circuit failures or missile malfunctioning caused by vibration, we are developing a method of encasing electrical harnesses and connectors solidly in plastic by an injection molding process. We had to develop correlary fluoroscopic inspection procedures to assure fail-safe harnesses and plugs. Inspection of these assemblies after potting in plastic proved impractical by other means.

Soldering is one of the large manufacturing operations at Convair-Pomona. One and a half million direct manhours are spent on soldering alone. Each missile has approximately 8,000 soldered joints. More than 60 per cent of these joints cannot be adapted to automated printed circuitry, but we intend in the near future to produce 40 per cent of the Terrier's circuits semi-automatically. To accomplish this, we had to develop our own new techniques of etching and automatically soldering our printed circuits. Better reliability was one of the most compelling reasons why we turned to semi-automatic circuitry production for the Terrier missile. We could not obtain the quality we needed elsewhere or by other methods at prices we could afford to pay.

With the advent of new and faster missiles, we are likely to encounter temperatures so high we can't use conventional solders and must develop really high-temperature materials for this purpose.

### *Electronics Concerns*

In the hypersonic missiles of the future, 65 per cent of our development effort at Convair-Pomona will be electronic engineering, with the remaining 35 per cent apportioned among structural, mechanical and hydraulic engineering.

At Convair-Pomona, 56 per cent of the engineers on our payroll today are concerned in some way with electronics. At Convair's other missile division—Convair-Astronautics at San Diego, California, where the Atlas Intercontinental Ballistic Missile is in pilot production, the proportion is 20%.

At Convair-SanDiego, where aircraft is the dominant product, approximately 25 per cent of the qualified engineers are working in electronics. More than half of these ar engaged in research and developmen and the remainder are scattere throughout the division's other acti ities.

To broaden its electronic base an to diversify its corporate structur Convair's parent corporation, Gener Dynamics, in June 1955, acquire and merged with Stromberg-Carlso Company, one of the Country's lea ing producers of telecommunication sound equipment and military an industrial electronics. Stromberg a great addition to our family and fine organization, but this does n change the need for, or the use o electronics people at Pomona or S Diego.

Electronics is truly becoming o of the most dominant—if not t single most important—aspect of o industrial output. No forward-loo ing company engaged in productio of weapons for the military today ca overlook the development of its ele tronics systems engineering capabi ities to the maximum and still ho to remain in the competition; whethe the parent company carries an ai frame and/or electronics label. th needs for successful weapons syste development for our Country are th same.

The anxiety I mentioned in th opening paragraph is largely unwa ranted. Much of the concern has bee generated by defense spending redu tion and a feeling of panic that ha resulted. I do not believe, for e ample, that the aircraft industry i tends to get into the electronic par business. Actually, the aircraft an electronics industries have much mor in common than do some of the othe major basic industries that hav entered the electronics and the missiles fields in the past ten years.

In conclusion, I would like to reiterate one major premise. Those o us in the airframe-electronics industr must work together to strengthen ou capabilities to produce these weapons systems. We must maintain hig standards of reliability and at the same time we must build these standards within a framework of low cos production. As I have already stated we at Convair-Pomona are not interested in doing all our own electronic design and production if we can find a suitable subcontractor who can do the job within our high quality control and performance standards.

This then is our challenge. Let us unite the aircraft and electronics elements and meet this challenge together. Let us pull together a "associates".

# the New South and SOUTHERN BELL

**by HARVEY G. BOOTH**
**Vice President**
**Public Relations,**
**Southern Bell**
**Telephone & Telegraph Co.**

THE SOUTH OF THE STORY BOOKS is no more. Forever "gone with the *wind*" is King Cotton and the picturesque mode of life he nurtured.

Plantations have given way to factories; forest lands have been transformed into housing subdivisions, and farm-to-market roads have been widened into super highways busy with commerce.

The South is changed and changing. It is in a period of transition which began on the eve of World War II and which has no end in sight.

Like the rest of the Nation, the Dixie states are growing. But the South's advancement appears to be of a different sort from the change occurring generally throughout the United States during these times of great population growth and prosperity.

Perhaps the best way to describe it is to say that the South is experiencing not just growth as such. It is not merely increasing in the things it already had. The growth is not simply the addition of more people, more factories, more production. The transition in the South is a growth in quality more than quantity, a growth that has roots deep in human progress as well as material progress.

The significant factor in the South's evolution is one of upgrading. There has been a substantial increase in income per capita. There is better education per capita. And, most important, there is a higher standard of living.

All people in Southern Bell Telephone and Telegraph Company—whatever their jobs—are interested in and affected by the South's metamorphosis. From it has come a continuing demand for more telephone service. It means more calls to handle, more applications for new service, more installations and changes, more construction work, more capital to raise and invest.

Just how much has the telephone business been growing in the South?

At the beginning of 1946, Southern Bell had 1,863,204 telephones in service in the nine states where it operates—Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee. Now, a little more than 11½ years later, there are approximately 5,590,000 in operation.

This gain represents an increase of about 3,727,000 telephones just since the end of the war, a growth of 200 per cent. Among the other Bell System companies in other parts of the Nation, taken altogether, there has been a 119.3 per cent increase in telephones over the same period.

To describe the growth in another way: the company now has three times as many telephones in service as it had 11½ years ago. And the gain over the past 5½ years alone exceeds the total number of telephones in service upon the company's 65th anniversary in 1944.

The company's growth has been far more than had been forecast earlier for the nine states. In fact, advance estimates of economic growth for almost all businesses in the South since the war have been far too conservative, and economists continually have had to raise their sights about Dixie during the last decade.

It is doubtful any prophet could have predicted the expressed desire or "demand" for telephones that has occurred in this postwar expansion. Yet Southern Bell has taken care of 99.4 per cent of all applications for service which have come to it during this period. At the present time about 61 per cent of the households in areas served by Southern Bell have telephones. At the beginning of 1946 only about 31 per cent had telephones. The demand still is continuing at a heavy pace.

To provide facilities for this continued and unprecedented increase in telephones, Southern Bell expects to spend, during this year alone, over $1,000,000 each working day in constructing telephone facilities, or a total of almost $300,000,000.

Southern Bell now operates 1,082 exchanges in a territory that covers 50 per cent of the land area of nine states. Through these exchanges on an average business day this year, telephone users are placing an average of over 34,780,000 local telephone calls and almost 919,000 long distance calls.

To operate its vast communications network, Southern Bell employs about 70,500 persons. In contrast, 11½ years ago, the company had 36,731 persons on its payroll.

At the present time, 90 per cent of the telephones in the Southern Bell area are dial-operated. And almost 56 per cent of the long distance calls originating in Southern Bell exchanges are dialed directly by operators.

In December of this year two cities—DeLand, Florida and Waycross, Georgia—are scheduled to begin use of customer direct distance dialing, for which equipment now is being installed. These will be the first Southern Bell exchanges to have the service. Meanwhile, over one-third of Southern Bell telephones use the "2-5" numbering system, designed to fit into the nationwide plan for direct distance dialing.

Just as Southern Bell has benefited from the progress in the South, it has contributed to that progress. This year the company will pay an estimated $285,000,000 in wages. And taxes to be paid to local, state and federal governments will amount to about $137,235,000. In addition, the economy of the area has been affected favorably by the company's phenomenal construction program which has resulted in the expenditure of over $2,000,000,000 since the end of 1945.

Despite all the changes in the area's economy, the people of the South feel that the region has not yet reached a state of full development and that there are possibilities of still further growth.

Southern Bell has complete faith in the South and its dynamic growth and potential. And the company hopes to be able in the years ahead to continue providing in full measure the telephone service to help in that progress.

* * *

# Transmitter klystrons for microwave communications

10-watt SRL-7 series
reflex oscillator klystrons for 1700-193
1850-2100, 1930-2160, 2160-2400 mc

| | | | | | |
|---|---|---|---|---|---|
| | | [illegible] | SRL-7C | SRL-7G | [illegible] |
| | Frequency Range | 1700-[illegible]30 mc | 1850-2100 mc | 1930-2160 mc | [illegible] |
| **SRL-7 SPECIFICATIONS** | Output Power | 7-10 w | 7-10 w | [illegible] | [illegible] |
| | Modulation Bandwidth | 20 mc | 20 mc | [illegible] | [illegible] |
| | Modulation Sensitivity | 63 kc/v | 70 kc/v | [illegible] | [illegible] |

Designed primarily for telephone, teletype, telegraph and TV transmitting applications, the Sperry SRL-7 series reflex klystrons are also ideal for laboratory use in test equipment and bench oscillators. Important features include extended service life running into thousands of hours, outstanding ease of modulation, and single-screw tuning. Now in large-scale production, SRL-7 series klystrons are ready for immediate delivery. Phone or write your nearest Sperry district office for data sheets on these tubes and other Sperry klystrons for other purposes.

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Television transmission

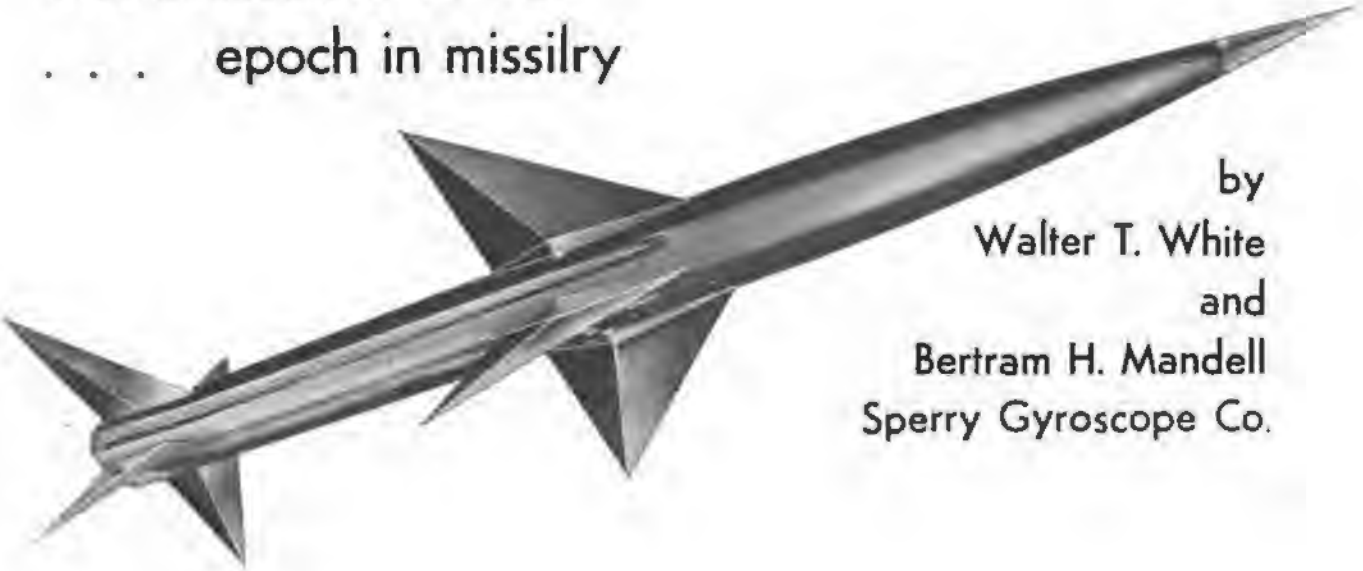
Microwave relay

Flow control

Battlefield communications

# SPARROW I

## . . . epoch in missilry



by
Walter T. White
and
Bertram H. Mandell
Sperry Gyroscope Co.

FIRST AIR-TO-AIR GUIDED MISSILE IN the Nation's arsenal, the Sperry Sparrow I already had reached an advanced status before it was officially announced by the Department of Defense early in 1954. The announcement came after seven years of development by the Navy's Bureau of Aeronautics and Sperry Gyroscope Company. Admiral Arleigh Burke, Chief of Naval Operations, credited "years of intensive development by the Bureau of Aeronautics and Naval Air Missile Test Center, and Sperry for the readiness of the Fleet with this air-to-air missile system."

### *Developments and Elements*

Commenting on the vastness of the technical subjects which had to be mastered in early guided missile development, Rear Admiral John E. Clark, Director of the Navy's Guided Missile Division, has said that "perhaps never in the history of human endeavor had man embarked on a program of such magnitude with so little to base his efforts on. . . . In ten short years, our scientists and engineers had produced guided missiles of amazing performance and reliability." A case in point, the Sparrow I program had to include not only design, development and production of a "bird" consistent with the Navy's peculiar problems of shipboard use, but guidance and test equipments, training of ground and air crews, and the construction and operation of a plant specifically for missile production—all without precedents.

More than 100 prototype missiles had been constructed and critically test-flown between 1948 and 1951, including air launchings from Navy aircraft as early as 1949. Evolutionary models, these missiles were the forerunners of the production Sparrow I missiles now in service with the Sixth and Seventh Fleets of the U. S. Navy. Behind the initial, terse announcement of the first air-to-air missile system, is a pioneering project that began in 1946, when the Sperry Gyroscope Company was authorized to initiate a study program for the development of an air-to-air guided missile capable of intercepting bomber aircraft.

Also involved were preliminary studies and resulting choice of the radar guidance system, missile guidance system and missile aerodynamic configuration. The objective of the Sperry Sparrow I Weapon System was to defend carrier task forces from attack by enemy aircraft through the use of beam-riding guided missiles launched from carrier-based fighters. The probability of attack on Naval forces by high-speed aircraft carrying guided missiles, as well as conventional armament, made necessary the development of this defensive weapon which is capable of relatively long range operation and which has exceptionally high single-shot probability of kill. The major operating elements of this weapon system are: (1) An aircraft carrier which serves as a mobile base and directs a fighter to the vicinity of the target; (2) The fighter squadron; (3) The missile carried by the fighter; (4) The fighter fire control system which indicates the course to be followed by the fighter; (5) The fighter radar set which transmits the beam which guides the missile, and which furnishes data to the fire control system for determining the course to be followed by the launching aircraft.

In addition to these operational elements, other items essential to system operation, such as test equipment, maintenance bases, logistical support and personnel training programs, are parts of the Sparrow I Weapon System.

### *Components*

A major element of the Weapon System, the Sparrow I is a supersonic air-to-air, beam rider type of guided missile. The missile consists of a fuze and warhead, a source of hydraulic and electrical stored energy, a guidance system and a rocket motor, all packaged in an 8-inch diameter, 12½-foot cylindrical body with a pointed ogival nose. The arrangement of wings and tail fins is a cruiform configuration and provides for missile maneuverability in any direction without the necessity of banking the airframe for a turn, as with

*The first air-to-air missile in the Nation's arsenal, the Sparrow I has seen service with the Navy's Sixth and Seventh Fleets. Until now, the only information re-*

conventional aircraft. The assembled missile weighs about 300 pounds.

### Arming The Fighter

The Sparrow I is carried externally under the wings of jet fighter aircraft. The fighter is equipped with airborne guidance radar and is armed with four missiles. These jet aircraft operate from both carriers and shore bases and are effective at all operational altitudes against high-speed jet bombers, fighters and certain missiles.

In tactical flight operations, enemy aircraft are picked up by the airborne radar and Sparrow I missiles are launched by the fighter and controlled by a guidance system that "looks through clouds" and places the missile squarely on the target.

### Guidance And Control System

The guidance and control system provides the capability for the missile to alter its flight path and intercept an evasive target. Elements of the system function as the brains, nerves and muscles of the guided missile. The initial flight path for Sparrow I is controlled by inertial elements which include both accelerometers and gyroscopes. The later phase of flight for Sparrow I is controlled by beam signals, and the missile follows the axis of the radar beam to the target.

The principal elements of the guidance and control system are:

(a) Multi-axis gyroscopes and accelerometers.
(b) Missile antenna and receiver for detecting the intelligence in the guidance beam.
(c) Missile computing circuits to shape the signals to obtain precise and stable beam riding.
(d) Servomechanisms for positioning the wings of the missile as required for maneuvering in flight.

These elements are packaged in a number of unitized separate assemblies in order to facilitate manufacture, test and field servicing. Both the mechanical and the electronic components are packaged to form complete functional assemblies. This greatly facilitates the preparation of specifications on a logical basis for each element, and it simplifies system checkout and maintenance for the missile.

Extensive flight tests have shown that the complete assembly is highly reliable under the rugged environmental conditions of missile launching and flight.

### Power Supplies

The power supplies for Sparrow I include battery sources for electrical energy and a high-pressure hydraulic accumulator for the mechanical energy required to position the wings. Both supplies are designed with adequate capacity to furnish the energy required for the duration of the flight of the missile.

### Sparrow I Rocket Motor

The rocket motor is the source of energy which provides the thrust that gives the missile the velocity increment over its launching speed. Thrust on the missile in the forward direction results from the reaction of the hot gases ejected at high velocity.

The motor is packaged to form a smooth cylinder that is a section of the missile's body. It consists of three major components; namely, the case, the propellant grain and the igniter assembly. The case is a thin-walled metal cylinder with an attachment mechanism to the forward section of the missile, and with a nozzle which directs the high-velocity gases aft. The high-energy propellant uses solid concentric grains with a plastic base which burn uniformly, and thereby gives a steady thrust to the missile. The chemical composition of the grain provides an oxidizing agent, and therefore, burning rate essentially is independent of altitude.

The igniter assembly fits into the forward section of the motor and is triggered by an electrical impulse. The grain of the motor is fired in a fraction of a second by action of the igniter and a large uniform thrust is generated immediately.

### Warhead System For Sparrow I

The purpose of the warhead system is to provide the maximum probability of kill when the Sparrow I intercepts the target. The kill must be positive and immediate in order to eliminate the possibility of a crippled enemy aircraft completing its bombing run before crashing into the sea. With this as an objective, a significant part of the missile's weight an volume is allocated to this payload

The warhead assembly for Spa row I includes three major element namely,

(a) The safety and arming mec anism which provides positi safety of life for ground, shi board and flight personnel u der all conditions of enviro ment and handling.
(b) The fuze which detonates th warhead at target interce tion.
(c) The warhead which includ an igniter and explosive a sembly which, when detona ed, will kill the target.

### Flight Of Sparrow I

The Sparrow I missile is launche when the pilot of the fighter aircra closes the firing switch. This actio sends to the missile an electrical puls which ignites the rocket motor. Th resultant thrust propels the missil forward relative to the launchin rack and the missile quickly attains speed significantly greater than tha of the carrying aircraft. By moto burnout, which occurs within second after launching, the missile's velocit is twice to three times the speed o sound. This is in excess of 1500 mile per hour. When attacking an enem target, the missile either is launche singly or several missiles are launche rapidly in sequence.

In flight, the missile has the capa bility of altering its path by deflecting control surfaces. Initially afte launching, the trajectory of Sparrow I is controlled by inertial guidance. In the later phase of flight, the wing of the missile deflect in response to guidance signals from the radar beam which is pointed at the target. Accordingly, it is said that the missile "rides the beam" and Sparrow I is classified as a "beam rider" missile. Because the guidance beam is positioned precisely in the direction from the launching aircraft to the target, the missile is guided along a trajectory which leads to an interception even under evasive action. The accuracy and reliability of Sparrow I in flight has been proven by hundreds of instrumented launchings where precise observations were recorded.

For the production of the Sparrow I missile, Sperry Farragut Company, Division of Sperry Rand Corporation, *leased by the Navy has been quite general. This article is the first to be cleared by the Navy on the design, development and production of a complete missile system.*

as organized in June 1951, to build, quip and operate a naval industrial eserve aircraft plant for the Navy's ureau of Aeronautics.

The plant, fully air-conditioned nd including an electrostatic air-ltering system, consists of an enlosed factory, laboratory, service nd office areas totaling 537,000 quare feet.

The factory was laid out essentially n a production flow basis with raw naterials and purchased parts reeived at one end of the factory floor nd finished products shipped from he opposite end of the building.

### *Missile Manufacture*

Sparrow I production by the Sperry Farragut Company, at Bristol, Tennessee, consists of the manufacture, inclusive of factory test, of the complete guidance and control section, electrical and hydraulic power assemblies, and the airframe of the missile. The rocket motor, fuze and warhead, which comprised the balance of the missile configuration, is procured by the Navy directly from other prime contractors for eventual assembly to guidance and control, and power sections at naval field installations or aboard ship.

Factory layout provides for a purchased material holding and checking area inside the plant. From this area, entire lots are routed to adjacent incoming material quality control stations for inspection and test. Completely equipped mechanical inspection, electrical test, and materials testing laboratories in the plant varified conformance of incoming material with purchase specifications.

The detail parts of the missile include not only commercially available items such as hardware, resistors, capacitors and tubes, but also many parts designed specifically for Sparrow I. Accordingly, the machine tools and production equipment in the plant are devoted largely to the manufacture of the special detail parts. The fabrication of these parts involved machining of castings and forgings, turning, and sheet metal work.

To facilitate operations on the major categories of machining work, two principal machining areas were established. These are designated, respectively, as the "casting line" and the "turning line." The sheet metal shop handled the relatively small volume of punch press and sheet metal extrusion work required for missile parts.

Airframe shells are machined in a special area that is tooled to handle the relatively larger aluminum and magnesium castings and extrusions from which the control and hydraulic power sections of the airframe are fabricated.

Although the majority of transformers required for the missile are sub-contracted to capable manufacturers in this field, a critical group of transformers is manufactured in the plant, as are all required special coils and gyroscope stators.

### *Assembly, Inspection And Test*

Purchased and manufactured detail parts are released from stores to the assembly lines and areas in quantities and types compatible with the block of missiles to be manufactured. Manual assembly lines and areas are established for distinctive types of work, i.e., electrical assembly, wire preparation, transformers and coils, assembly of gyroscopes and hydraulic assembly. Within the electrical assembly area, separate lines are established for the production of individual units, such as servo amplifiers and guidance amplifiers.

Gyroscopic and hydraulic assembly, inspection, and test operations are conducted in "super-clean" enclosed areas established exclusively for such work.

Final missile assembly is effectively keyed to the receipt of components from the respective lines and areas. To this extent, all component assembly lines served as "feeders" for the final missile assembly line and components are stocked at the latter line rather than in a separate storeroom. Overhead materials-handling equipment is employed to facilitate final missile assembly and delivery to and from system test.

Final missile production testing is conducted on all missiles in a sequence which provided for both static and dynamic performance checks before, during and after exposure to simulated firing shock and flight vibration. Several missiles from each month's production are selected for comprehensive environmental tests following the initial factory acceptance tests. These "samples" are subjected to altitude, temperature, and vibration tests in the plant's environmental laboratory. Additionally, missiles are also selected each month for air launching at the Naval Air Missile Test Center and achievement of a specified high reliability and accuracy is a further condition of final acceptance of production output.

### *Reliability And Quality Control*

Missile reliability engineering and production quality control efforts are closely coordinated to provide an effective system of factory and field failure reporting and analysis.

The quality control policies and practices employed in the production of Sparrow I missiles directly reflected management's keen awareness of the quality requirements which are essential in the production of reliable guided missiles. In recognition of the severe environmental conditions and unusually high reliability requirements in a guided missile, purchased functional components, such as potentiometers, resistors, capacitors, and relays, are 100% tested to specifications before acceptance for product use. Electron tubes are 100% microscopically and electrically tested before and after a combined burn-in and vibration cycle.

To insure uniform and efficient checking for conformance with specifications, all inspection and test operations are performed in accordance with detailed check lists and procedures. Continuous direct liaison between inspection and manufacturing supervision, as well as weekly summary reports, assured prompt action to correct below standard workmanship trends.

The Sparrow I marks an epoch in missilry. The system represents a major accomplishment in guided missiles by the U.S. Navy and Sperry. Significant steps in the program include conception and design of the missile and its guidance system, prototype missile manufacture and successful flight test, construction and operation of a plant specifically for missile production, and service evaluation and acceptance of the production Sparrow I Weapon System.

The major objectives of the project have been to achieve an effective weapon system with an accurate and reliable missile designed to be manu-

(*Continued on page* 51)

# To voice the world's newest submersibles

The shipboard and battle-announcing needs of a submarine pose problems that just "standard" equipment can't meet.

*Exceptional ruggedness* is required, both to withstand shock and to resist heat, humidity, and salt moisture.

*Power* must be adequate, yet compressed into the smallest possible space.

*Dependability* is relative to such factors as cruise distances never before attempted by underwater craft.

An example of products meeting such problems is found in the announcing equipment aboard the atomic-powered *Nautilus* and *Seawolf*, built by our associate division, Electric Boat, and "voiced" by Stromberg-Carlson. Here standard components were re-designed to the special conditions involved. On the *Nautilus*, to date, our equipment has logged more than 60,000 nautical miles without difficulty of any sort.

Similar equipments also serve the land and air arms of our country's military forces and give evidence of equal dependability under the special conditions for which they were designed.

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Editor's Note:

*The quality control standards, as established by Captain Richards in this article, have received recognition from the U. S. Air Force and are now in use by the National Security Agency, Strategic Air Command and the Air Materiel Command. Recently Captain Richards received special commendation for his work from Headquarters, Airways and Communications Service.*

# QUALITY CONTROL *of the* STRATCOM SYSTEM

**by Captain Maxwell J. Richards, USAF**
**Headquarters AACS,DCS Comm.**
**Andrews Air Force Base**

[illegible]E MORE ACCURATE NAME STRATCOM, WHICH HAS [illegible]ed the familiar term GLOBECOM, stands for the [illegible]d States Air Force Strategic Communications Sys-[illegible] It consists of interconnected Air Force radio sta-[illegible], leased or allocated long haul wire and radio chan-[illegible] terminal equipment, relay facilities, communications [illegible]rs, cryptographic centers, etc. It does not normally [illegible]de internal, tactical and special-purpose communica-[illegible] systems of the various commands below the major [illegible]mand level.

Actually, the STRATCOM System is the United States Air Force point-to-point, long-haul communications pipeline. It is composed of several integral parts such as the USAF Communications Network (AIRCOMNET), which provides a system for passing official teletypewriter traffic in support of USAF air operations on a global scale; the USAF Air Operations Network (AIROPNET), which provides a system for passing flight service and other aircraft movement messages between selected locations; Weather Teletypewriter and Facsimile Networks and others. Headquarters USAF determines and modifies the structure of the STRATCOM System on the basis of USAF operational requirements; however, Airways and Air Communications Service (AACS) is responsible for engineering, installing, operating and maintaining the system.

The STRATCOM System encompasses both the voice and the printed information media. Quality control of the STRATCOM voice system is relatively simple since the landlines are engineered four-wire circuits. These circuits arrive at each STRATCOM single sideband C-3 Control Terminal at —9 db and the single sideband equipment is quality controlled by use of the signal-to-noise ratios illustrated in figure 1 (page 18).

The STRATCOM printed information system is quality controlled through the technique of total distortion measurements. For example, it is the objective of AACS to have a teletypewriter signal arrive at receiving tributary stations with not more than 10% total distortion, regardless of the type of transmission path or the point of origin.

*(Continued on page* 19)

| SIGNAL TO NOISE RATIO | MERIT RATING | GRADE OF PERFORMANCE | ACTION REQUIRED |
|---|---|---|---|
| Above +25 db | M-5 | Excellent | None. |
| +21 db to +25 db | M-4 | Good | None. |
| +16 db to +20 db | M-3 | Marginal | Constant attention by technical control; investigate potential sources of trouble. |
| + 5 db to +15 db | M-2 | Poor | Channel not usable for customer-to-customer transmission; investigate sources of trouble and transfer channel to maintenance where applicable. |
| Below +5 db | M-1 | Unusable | Channel not usable for customer-to-customer transmission; investigate sources of trouble and transfer channel to maintenance where applicable. |

Figure 1. Quality Standard for Single Sideband Radiotelephone Service.

| TYPE OF OPERATION | TOTAL DISTORTION OF INCOMING SIGNAL FROM DISTANT END | ACTION REQUIRED |
|---|---|---|
| Relay-to Relay and Relay-to-Tributary Station. | Less than 5% | Circuit acceptable; no action required. |
| | Between 5% and 10% | Marginal; monitoring required. |
| | Above 10% | Seize circuit if constant for two minutes; investigate transmission path and equipment. |
| Tributary to First Relay Having a CTCF. | Less than 10% | Circuit acceptable; no action required. |
| | Between 10% and 25% | Marginal; constant monitoring required. |
| | Above 25% | Seize circuit if constant for two minutes; investigate transmission path and equipment. Source of trouble must be eliminated prior to restoring circuit to traffic. |

Figure 2. Quality Control Standard for Non-Cryptographic and Off-Line Cryptographic Operation.

| DISTANCE | TOTAL DISTORTION OF INCOMING SIGNAL | ACTION REQUIRED |
|---|---|---|
| FROM POINT OF ORIGIN TO DISTANT RECEIVING STATION | Less than 5% | Circuit acceptable; no action required. |
| | Between 5% and 10% | Marginal; constant monitoring required. |
| | Above 10% | Seize circuit if distortion is constant for two minutes; investigate transmission path and equipment. Source of trouble must be eliminated prior to restoring circuit to traffic. |

Figure 3. Quality Control Standard for On-Line Cryptographic and Transceiver Data Link Operation.

| TYPE OF DISTORTION | TYPE OF EQUIPMENT | QUALITY STANDARD | |
|---|---|---|---|
| | | TRANS-MITTING TOLERANCE | RECEIVING TOLERANC |
| BIAS | Transmitter-Distributor TT-21 or XD-86 class and the AN/TCC-1, AN/FGC-38 and AN/FGC-39 class | 3% | |
| Switched Combination produced by the 119C1 | Page Printers and Reperforators | | 30 to 35 |
| Bias (Transmit) Switched Combination produced by the 119C1 (Receive) | Crypto Devices (SSM-3, SSM-33, TT-160/-FG, etc.) | 3% | 25 to 30 |
| Total | Relays | 3% | |
| Fortuitous* | Electronic Devices | 3% | |
| Fortuitous* | VF Carrier Channels | 3% | |
| Fortuitous* | Keyboards of M-15, M-19, or M-28 | 4% | |
| Fortuitous* | Transmitter-Distributor TT-21 or XD-86 class and the AN/TGC-1. AN/FGC-38, and AN/FGC-39 Class | 3% | |

*This fortuitous distortion is the peak figure for a two-minute sample random keying.

Figure 4. In-Station Quality Standards.

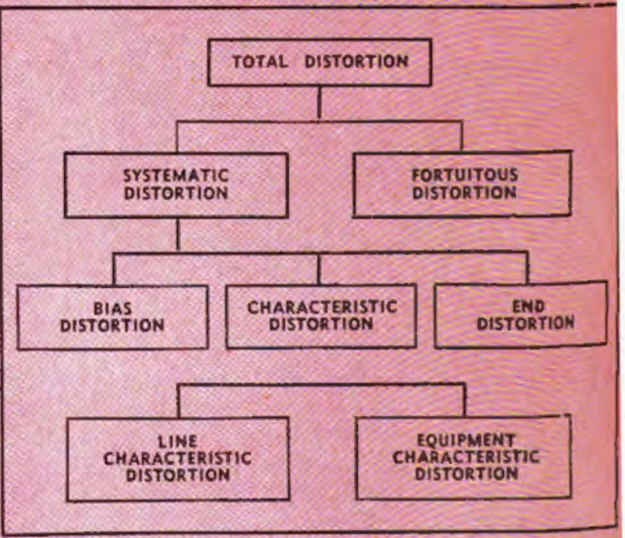

Figure 5. Components of Teletypewriter Distortion.

elay-to-relay operation within the STRATCOM System n meet this requirement today; however, many Air orce Tributary stations cannot. Figure 2 is a table of e quality standards used for clear text and off-line yptographic operation within the STRATCOM System. ince a signal from a tributary station is permitted to ar-ive at the first technical control point (CTCF)[1] with a aximum of 25% total distortion[2], it must be regenerated r reperforated before it is transmitted to either another ibutary or to the distant relay. This is necessary since e signal must arrive at the distant end at not more than 0% total distortion. Although 25% total distortion ar-iving from a tributary is acceptable for clear text and ff-line cryptographic operation, it is not acceptable for ither on-line cryptographic or transceiver data link IDP Integrated Data Processing) radio transmission. On-ne cryptographic equipment and transceiver data link quipment will not stay in "set" when the total distortion n radio circuits exceeds 10%; therefore, Figure 3 is the ir Force standard for these two techniques.

The quality standard illustrated in Figure 2 is used by ll STRATCOM technical controllers as the quality standard or all off-line and clear text traffic arriving at their sta-ion. However, these controllers also use in-station stand-rds which are illustrated by Figure 4. These in-station tandards are used when a technical controller looks back nto his own STRATCOM relay equipment. If the equip-nent being tested exceeds the limits prescribed in Figure 4, it is defective and is not used for traffic.

Although AACS bases its printed information quality ontrol standard on total distortion, an understanding of he components of total distortion is essential in order to nterpret the STRATCOM System performance. This requirement becomes apparent when the STRATCOM techni-al controllers determine trouble locations on transmis-ion paths used for transceiver data link and on-line cryp-ographic operation. Figure 5 illustrates the components of teletypewriter distortion as used by AACS; the terms used in this figure are defined below.

**Total Distortion**: The total of all forms of signal distortion is cumulative and is known as total distortion. A signal having marking bias (all marks lengthened and all spaces shortened) in one link of a teletypewriter transmission system and spacing bias (all spaces lengthened and all marks shortened) in another portion of the system could actually have less total distortion at the distant receiving point than at test points along the system due to the cancellation effects of bias distortion.

**Systematic Distortion**: The term systematic distortion is used to denote the periodic or constant distortion, such as bias or characteristic distortion, and is the direct opposite of fortuitous distortion.

**Fortuitous Distortion**: The random displacement, splitting and/or breaking up of the mark and space elements.

**Bias Distortion**: The *uniform* lengthening or shortening of the mark or space elements, one at the expense of the other.

**Characteristic Distortion**: The repetitive displacement or disruption peculiar to specific portions of a signal. There are two types of characteristic distortion; line characteristic distortion and equipment characteristic distortion.

**End Distortion**: A special type of telegraph signal distortion created for testing purposes. It has the effect of advancing or delaying the end of each marking impulse with respect to the beginning of the character cycle or the initial mark to space transition.

The test equipments used today to quality control the STRATCOM System are adequate but cumbersome. Although these equipments are also used in industry, their intent and design is to provide "after the fact" information. A technician today, using these test equipments, is always looking for the trouble after it occurred. This technique is obsolete in the jet age and in its place the Air Force is looking for "before the fact" information. Soon to be incorporated within the STRATCOM System are automatic telegraph distortion monitors and continuity signals recognizers. These electronic units will recognize marginal circuitry prior to its development into an out-of-service condition. In this way, the STRATCOM technical controllers will prevent the unnecessary chaos that accompanies an out-of-service condition. Dials on these distortion monitors will be set at the marginal value of the total distortions indicated in Figures 2 and 3, and alarms will sound when the STRATCOM circuitry degrades to these values. Thus, the STRATCOM System will be quality controlled electronically and will provide the technician with "before the fact" information.

---

[1] CTCF is the abbreviation for the Channel and Technical Control Facility which is the unit within a STRATCOM station that is charged with the responsibility of controlling the quality of the System.

[2] Twenty-four percent total distortion is the same as the Bell System coefficient 10.

# EFFICIENT SPECTRUM

ALMOST EVERY DAY THOSE OF US IN the electronics field learn of new devices and equipment that radiate electromagnetic energy. We also hear of increased power for radars and vast new high power communications systems. Taken together, these only intensify the already difficult problem of efficient spectrum utilization.

There is only one frequency spectrum, and it is literally bulging with users. From a military standpoint, (Figure 1, page 23), the Army signal system must be compatible with Air Force and Navy systems and at the same time, essential civilian requirements cannot be neglected. On top of this, the enemy can be counted on to provide both intentional and unintentional interference.

Modern warfare will require greatly increased emphasis on communications and non-communications systems. In the Field Army Area, increased requirements are generated by the present day needs for combat surveillance, for the conduct of electronic warfare, for many new types of radars, and for air navigation and traffic control. All these in turn generate a pyramid of additional communications requirements.

In a recent article entitled, "What Price Frequencies" (SIGNAL, January 1957), Major General Alvin L. Pachynski, USAF, very lucidly pointed out ". . . . the solution (to the problem of shortage of spectrum space) lies in the establishment of long term objectives rooted in technological progress and which, among other things, must take equipment obsolescence into account. The successful achievement of those long term goals is dependent on a joint awareness by all of us of the problem that exists today."

This problem is not lessening. It is increasing by leaps and bounds. Moreover, present concepts envision a great increase in the number of electronic devices concentrated in a relatively small area in support of a tactical and strategical operation, which could result in intolerable interference among equipments. Realizing this, the Chief of Research and Development, Office of the Chief of Staff, directed the Chief Signal Officer to conduct a study in order better to understand, measure and control the problem of electromagnetic spectrum crowding. The Chief Signal Officer directed the Commanding General of the U. S. Army Signal Engineering Laboratories at Fort Monmouth, N. J., to establish a project investigating this problem. This effort is known as Project MONMOUTH.

The first phase of Project MONMOUTH (now called Project MONMOUTH I) involved a theoretical study of the electronic complex, considering existing equipments deployed in a tactical situation. Project MONMOUTH I showed a considerable mutual interference problem and came up with recommendations to reduce this interference. This was during the summer of 1955.

With the magnitude of the present problem established, a second phase of the project was started. The objective of Project MONMOUTH II was to attempt to find ways to reduce the areas of interference among electronic equipments in the Army of the future. Considered were:

(1) Better frequency assignment techniques. (2) Optimum balance of frequency allocation versus tactical requirements of the equipments. (3) Communication network systems concepts (including time-sharing and common-user methods). (4) Appropriate methods of modulation. (5) Appropriate propagation techniques. (6) Methods for the design of equipments to result in non-self-jamming. (7) Other means to avoid or minimize mutual intereference.

To meet these objectives, the scope of this study was to:

(1) Survey and estimate systems requirements of the Army of the future. This task required determining the number of channels, distances between echelons, equipment density, employment by the using organization, weight and size limitations, and other limiting factors for the following sub-systems: Air navigation and traffic control, combat surveilla communications, countermeas and radar-IFF-missiles. Air Fo and Navy requirements also had be considered.

(2) Synthesize the individual systems into an over-all signal co plex that will be non-interfering. be taken into account were such ite as frequency allocation engineeri interference criteria, design limi tions for future equipments, types modulation, wave propagation limi tions, power requirements, and f quency assignment techniques co sidering density, location, and tac cal deployment of equipment.

(3) Evaluate the signal comp which has been devised for any fo seeable tactical situation. This quired analyzing it for non-interfe ence, feasibility, and applicability, order to present as comprehensive statement as possible for the natu degree, and seriousness of any inte ference and to recommend areas f future study.

A working group representing i dustry, universities, and Governme agencies, receiving technical and a ministrative guidance from USASE was divided into sub-groups to stud various aspects of the problem. The sub-groups set about the task of sy tematically proceeding from a d scription of future tactical concept for a field army to a detailed anal sis of the spectrum utilization prob lem.

The method of solution used i Project MONMOUTH II is shown i Figure 2 (page 23). The study star ed with certain facts shown as "Gi ens" which included information o tactical concepts of our own force and of enemy forces, and a knowl edge of environment in which the system would have to function. A detailed study was made of communications and non-communications requirements from the organizational and operational complex of the future Field Army. If one could listen in on the conversation of the group considering the operational requirements of a communications system, one would

# UTILIZATION

by
Brig Gen Earle F Cook,
Commanding General,
U S Army Signal
Engineering Laboratories,
Fort Monmouth New Jersey

ear such expressions as "need lines," call-minutes" and "link lengths." mportant areas of consideration in- luded traffic analyses, circuit loading nd the number of voice channels.

In the non-communications group, he sub-group considering the air avigation and traffic control require- ents discussed such functions as ithin army area air lifts, area cas- alty evacuation, aerial observation, lose support, and operational re- uirements in terms of volume of traffic, urgency, type of aircraft and distances to be covered. Other subgroups considered the operational requirements of their own sub-systems and made similar investigations and studies.

At this point in the solution, the systems concepts to satisfy the communications and non-communications requirements were considered. For communications, the pros and cons of area coverage radio relay and radio central systems, net systems, and point-to-point systems were developed. In choosing the system to match the desired service, no single concept completely satisfied the communications requirements of the future Field Army. Therefore, a number of systems capable of handling the communications requirements of the combat and support organizations were integrated.

The Systems Design Group concerned itself with the more basic, generalized phases of an integrated signal system, many of these aspects having been previously enumerated in the objectives of Project MONMOUTH II. The group was divided into sub-groups to consider various aspects of the problem, such as: propagation and systems, design limitations, interference criteria, field tests, spectrum allocation, and frequency assignment techniques.

Factors attendant to good systems design are interrelated. For example, it is difficult, if not impossible, to separate frequency stability from type of modulation, the type of modulation from the mode of wave propagation, and so on right down the line.

As an illustration of the types of studies conducted by these subgroups, let us look at what personnel concerned with propagation and systems investigated. Studied were such factors as: general propagation characteristics such as use of higher frequencies for short range transmissions and lower frequencies for long range transmissions; special modes of wave propagation such as ionospheric scatter, tropospheric scatter, and obstacle gain transmissions; and non-line-of-sight transmissions via irregular terrain propagation. Atmospheric noise, cosmic noise, and man-made indigenous noise, as it may be realized by our future field army, were studied to assess the effect on receiver sensitivity and power balances of systems to be exploited. Suitability of various types of modulation to the mode of propagation and system concepts were studied. Transmitter power and antenna characteristics required to provide the necessary degree of systems reliability over the distances desired were also established within the size and weight limits imposed by future tactics.

What we were after in the field of equipment design criteria was some future thinking on the state of the art. An example of this is the thinking on frequency stability, which becomes a very important factor in the selection of such things as the type of modulation and the bandwidth requirements or receivers. A transmitter output power spectrum was promoted which would be essentially a mirror image of the receiver characteristics. Also, receivers were assumed whose image response, spurious responses, and desensitization were many orders of magnitude better than the present state of the art. This would mean that transmitter filters, preferably integral with the output tube, would be required. Present design of receivers with r.f. bandwidths far in excess of the i.f. bandwidth could be greatly reduced by r.f. filtering or a selectivity which closely matched that of the i.f. response.

Narrow band modulation schemes received considerable attention in the tactical studies since they provide better receiver sensitivity, which permits a type of tactical equipment having lower transmitter radiated power. Associated with such studies are the forms in which intelligence should be presented, e.g., voice, teletype, facsimile, etc. Also important were methods attendant to a further reduction in the intelligence bandwidth associated with these types of intelligence presentations. The desired degree of security which should be provided in all systems at each level in the field army command was also considered. Improved crystal tolerance and frequency stability of the future will make the narrow band modulation schemes assume greater importance. This is so because the total bandwidth requirement will be decided by the bandwidth of the type of modulation being used instead of that required for frequency stability and crystal tolerance.

Thus, in general, we can say single side band rates high in spectrum economy; frequency modulation rates favorably in freedom from noise, re-use of channels, and use in motion; while pulse code modulation rates in re-use of channels freedom from noise, and repeater use.

The interference criteria to be used in conjunction with the mutual interference studies received considerable attention. Data on this subject are limited and such data as are available are useful only insofar as they provide laboratory type information, namely, the steady state condition. Nature very rarely lets the steady state exist and if she does, it is only for a limited time. All received electromagnetic transmissions between two fixed stations vary in field strength with time. If one or both terminals of a transmission circuit are vehicular, the variations are even more marked. In general, if one talks about the median received signal, both wanted and unwanted, there is associated around the median a fluctuation or distribution which is uncorrelated. Thus, if both wanted and

*making full use of good equipment design criteria, optimizing methods of spectrum allocation, and using realistic techniques of frequency assignments." — General Cook*

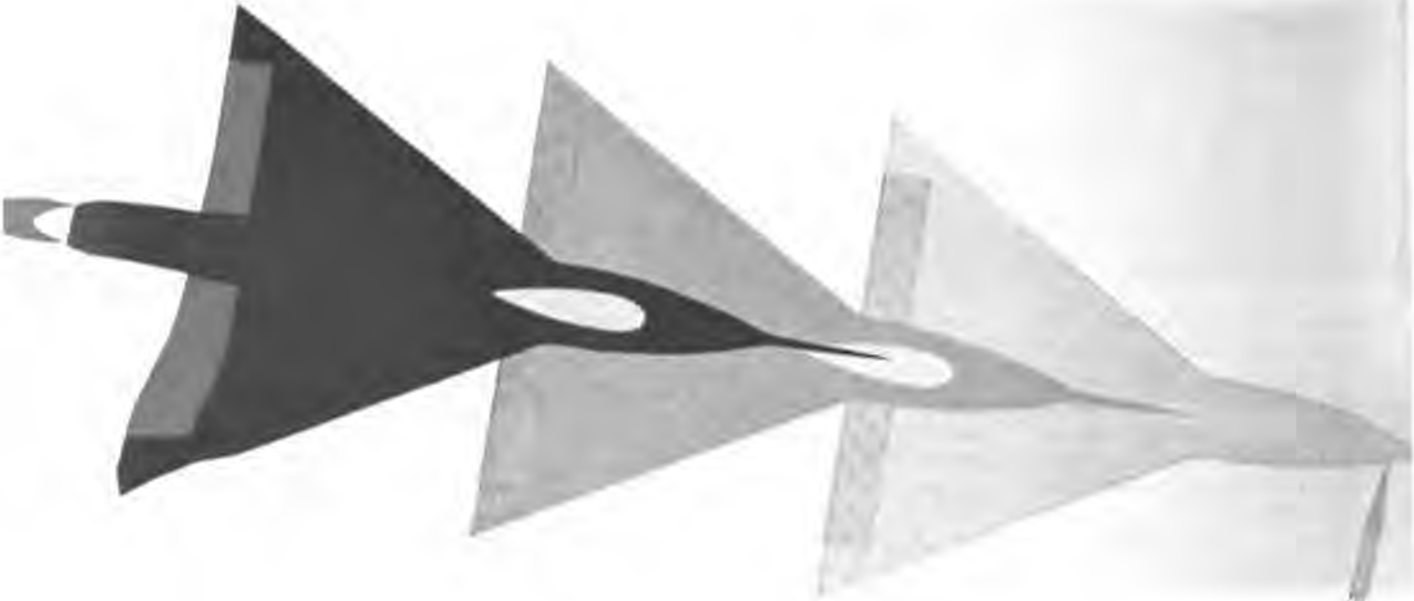

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Figure 1

unwanted signals had the same median value of received field strength, then when the unwanted fluctuated higher than the median, the wanted would be correspondingly lower than the median.

The type of modulation whether SSB, AM, FM, or pulse, wanted or unwanted, greatly influences the interference criteria to be used in interference studies. For example, the capture effect of FM is well known and therefore, a small over-riding unwanted signal at the front end of the receiver appears greatly enhanced at the output of the receiver.

Some tests were conducted of off-channel and far off-channel interference. Communications systems were located near radar systems and the interference effects with distance were noted, analyzed and made use of in the studies.

After the study of operational requirements and the various systems studies had been completed, the systems group was able to consider the spectrum allocation problems.

The useful frequency spectrum generally associated with radio waves, has been pushed higher in frequency with the advent of new tubes and equipments capable of exploring the complicated laws of wave propagation. Unfortunately, in the past, the need for a particular type of service precluded the full exploration of the wave propagation phenomenon associated with the higher frequency range. Allocation tables which are proposed at international conferences or at joint services boards are more of an expression of the need for spectrum space by a particular type of service than a choice based on firm technical considerations. This is true since at the time of preparation of these allocation tables a full understanding of the laws of nature as they affect wave propagation and systems was not available and is only now partially understood.

The equipment limitations imposed by tactical doctrine of our field army of the future legislate a frequency spectrum that is different from that prescribed for zone of interior, continental defense, or for that matter, commercial service. There is no reason to assume, for example, that because a commercial fixed-to-vehicular service is in a certain frequency band that the field army mobile-to-vehicular service should be in the same band. The constraints such as heights of antenna and transmitter power output, for example, are certainly vastly different for the two Services. The equipment constraints imposed by World War II field army tactics are certainly much different than those of future field armies. The frequency spectrum, then, has to be designed for the particular brand of service required by the tactical doctrine of our field army. This in turn dictates the constraints which will be imposed upon the electronic systems and equipments. In other words, changes in tactical doctrine of our field army, new systems and a more thorough understanding of wave propagation, will require a review and possibly a change in systems and equipment needs which in turn will require a frequency spectrum utilization review. Such a review can be made periodically or when important findings which effect frequency spectrum engineering take place.

Spectrum allocation of the various systems was made using a dynamic approach, i.e., fitting the allocation to the tactical operational requirements. It is at this point that the proposed systems to satisfy the tactical requirements and the system engineering criteria come into sharp focus. The full picture of the technical factors, tactical factors, and constraints imposed on the systems have been determined and it will be found that if the system is at all feasible, a highest frequency, an optimum frequency, and a lowest frequency allocation can be determined. This spectrum allocation comes about from the fact that when one imposes constraints on a system, the parameters of that system change. For example, antenna gain increases with frequency for a fixed size of an-

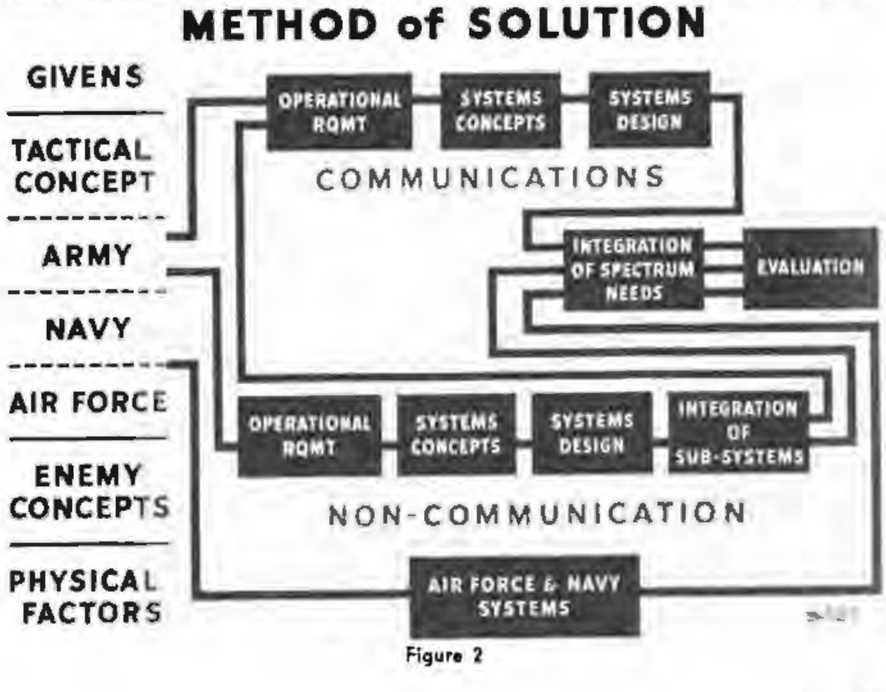


Figure 2

tenna; path attenuation over irregular terrain increases with frequency; man-made or indigenous noise decreases with frequency; the noise figure of a receiver increases with frequency, etc. The variations with frequency are not all linear or in the same direction and, after combining these relationships, the resultant will have a maximum, optimum, and minimum frequency allocation. All of this is dependent on the constraints not being too severe.

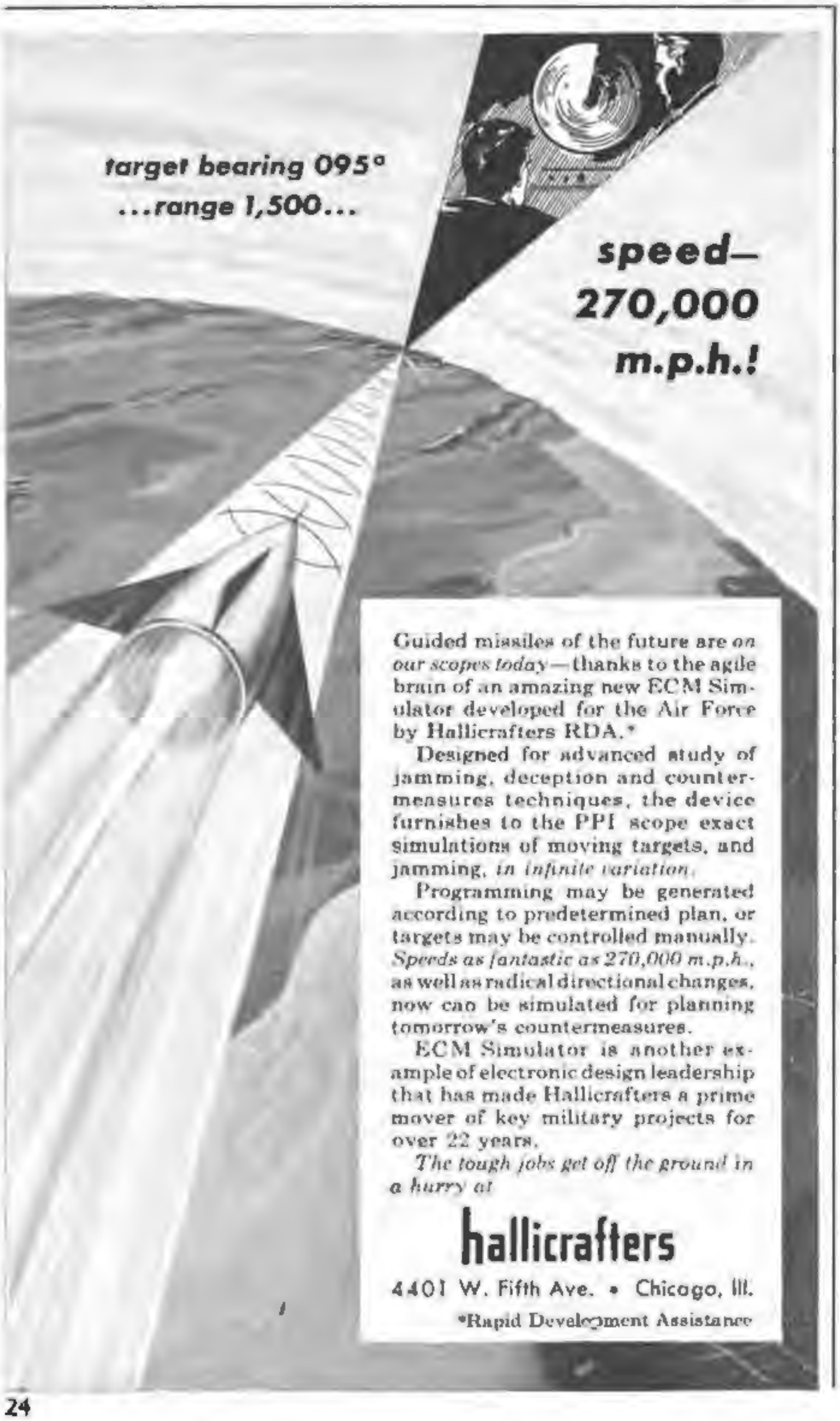
Techniques of frequency assignment in the future field army were devised in order to arrive at the number of r.f. channels which would be required to permit freedom of movement, say within a division area, of like equipments without inter and intra division interference. Based on equipment design criteria and propagation, frequency assignment to permit adjacent channel operation without interference was also considered. The total number of r.f. channels to do the required job in a future field army area with no interference or tolerable interference was arrived at, which, when multiplied by the r.f. channel spacing based on design limitations, provided the amount of frequency spectrum required to do the job. This is in sharp contrast to some previous practices of design in w the equipment was designed to over the entire band allocated f function, without density studies ing been made to see if that n spectrum was really required or a able. Thus, one finds that many ferent equipments cover the same quency spectrum or a large po of the same band. When these ec ments are made operational, the nal Officer in the field is require come up with frequency assign plans and techniques which wil sult in no interference or toler interference. Also, the attendant tuning range results in receiver formance figures which are n poorer than they might be if range were limited only to tha quired.

In this study, tuning of radars came a necessity. Radars for the time were assigned frequencies manner similar to communica practices. Thus, the amount of quency spectrum to fulfill a syst requirement was positioned in spectrum allocation along with o spectrum needs. Fortunately, on basis of design criteria well bey the state-of-the-art, the total spect requirements did not exceed available or useful portion of the e tromagnetic spectrum as far as field army of the future is concern Also, the spectrum requirements each system did not exceed its sp trum allocation. As a matter of f it was possible to provide gu bands between systems.

It should be remembered that t entire study was one of mutual int ference and therefore in no way dicates the amount of additional sp trum or even changes in systems p losophies that may result from el tronic countermeasures, enemy m tual interference, enemy counterme ures or counter-countermeasures— of which are the subject of the co tinuing Project MONMOUTH effort.

While Air Force and Navy Electr magnetic requirements were consi ered in these studies, much closer c ordination along the lines of fully i tegrated electronic systems requir ments mentioned in "What Price Fr quencies?" must be accomplished i order to realize the maximum in spec trum economy.

The signal complex for the futur field army will not suffer intolerabl *mutual* interference if thorough sys tems planning and engineering is con ducted by making full use of good equipment design criteria, optimizing methods of spectrum allocation and using realistic techniques of frequency assignment. • • • — • —



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Faster, simpler radar maintenance is the pay-off with the Sperry Combination Test Sets. One set does the job of three or more standard test units but requires one-quarter the space and weighs half as much! Here are the five functions each Sperry test set performs:

**POWER METER:** Directly measures average power of radar transmitter with accuracy of ± 1.0 db.

**FREQUENCY METER:** Indicates directly the frequency of both receiver and transmitter.

**SPECTRUM ANALYZER:** Accurately displays power vs. frequency spectrum of transmitter signals from single or multi-pulse systems. Display is stable at all pulse widths and repetition rates.

**SYNCHROSCOPE:** Simple general-purpose synchroscope functions as an "A" scope and displays radar video signals or similar wave forms—no need for auxiliary synchroscope.

**SIGNAL GENERATOR:** Accurately and directly calibrated output signal level is variable over complete range. Choice of pulse, frequency or external modulation.

With no additional equipment you can also measure transmitter peak power, repetition rate, transmitter pulse width, T.R. recovery time, duplexer losses, transmission line VSWR. Designed for tough operating conditions, these sets comply fully with military specification MIL-T-945A. Your nearest Sperry district office will gladly supply you with complete operating data.

Microline Model 570
16¾" L x 15¾" W x 15⅝" H

**COMPLETE LINE OF TEST SETS**

| Band | Microline* Model | Military Type | Frequency |
|---|---|---|---|
| L | 670 | | 400-450mc |
| S | 590B | UPM-44B | 2700-3500mc |
| C | 551A | SPM-5 | 5100-5900mc |
| X | 570 | UPM-32 | 8500-10500mc |
| K | 557 | | 23500-24500mc |
| V | 580A | UPM-14 | 34000-35600mc |

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DIVISION OF SPERRY RAND CORPORATION

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MANY FLIGHTS BETWEEN AIR TERMINAL points are made daily by military, commercial and civilian aircraft. Fundamental traffic data on the actual number of aircraft, in a given terminal area (under conditions of instrument flight regulations [IFR]) have been the subject of many studies. Data on actual air traffic control demands, based on studies of air traffic under visual flight regulations (VFR), are not thoroughly reliable. Therefore, it is believed that the increasing complexity of air traffic throughout the continental United States requires positive air traffic control to avoid mid-air collisions under both VFR and IFR conditions.

There are many agencies throughout the United States employing search-type radars which can be utilized to obtain the air traffic control required to save lives and dollars. Chief among these agencies are Army antiaircraft defense units with their radars now oriented only toward killing an enemy. The search-type radars of these units are not integral parts of antiaircraft weapons systems, but are essential for full utilization of these systems. Without the data from properly located operational extended range radar coverage radars, the tactical range capability of antiaircraft weapons systems would seriously decrease in proportion to the decrease in the approach altitude of aircraft. For example, if the approach altitude of an aircraft would decrease from 5000 to 1000 feet. radar coverage in range for any radar would decrease from 88 to 40 miles.

It is believed that air traffic growth since 1950 has increased at an average rate of about 10 percent per year —with commercial, military and private air traffic increasing proportionally. Applying this growth factor, one can readily visualize approximately 300 aircraft operating during one time period, within 150 miles of a large city like New York. The speed capabilities of such aircraft magnify the mid-air collision danger.

### *Air Traffic Control*

This article will point out the following: some of the fundamental problems involved in obtaining effective radar coverage; some radar facilities now available to resolve the air traffic problem, and the agency having the most utilization potential in resolving the air traffic problem—provided that such agencies are properly located. It is visualized that a national agency, whose sole responsibility is for air traffic control in the continental United States, will be established to collect and collate air traffic data furnished by various radar installations. It is further visualized that reporting radar installations will be connected to the central collecting agency by direct communications, and that air-ground-control communications are available to the central agency. Subordinate control agencies are to be located at major air terminal points.

Though it is appreciated that there are many other ways to approach the air traffic control problem, radar is presently considered the most efficient, and therefore, will be the subject of this article.

The present state of the radar art has certain inherent limitations which seriously affect efficient air traffic control. In order to fully understand these limitations, two of the most important have been selected to be discussed in their technical aspects. The first limitation causes faulty radar wave propagation which results in faulty radar data, and in some cases no data at all. The second is radar line of sight as limited by the curvature of the earth. These limitations can be understood best by comparing the propagation of radar waves to those of light:

(1) Light waves are refracted, or bent, when they pass from one medium to another having a different density. This fact accounts for the phenomenon known to desert travelers as a mirage. Thus, an oasis that is actually many miles away appears to be clearly above the horizon. What has happened it that light rays from the distant oasis have been bent around the earth's curvature. This effect may result when the atmosphere is not uniform and is subject to varying composition and density, causing the light rays to travel in a curved path instead of a straight line. Similarly, radar waves can behave in a like fashion. Both the optical and radar mirage are caused by the bending of waves away from a medium of low density into a medium of higher density. The degree of bending is expressed by the changes in *refractive index*. The atmosphere may provide a curved path by which radar waves may be bent around the earth's curvature; such a curved path for radar waves is called a *duct*. Atmospheric conditions of abnormal variation affect the operation of radar equipment on frequencies generally greater than 30 megacycles. In general, the higher the frequency the greater will be the possibilities of a duct causing erratic radar wave propagation effects. The question arises—what are the weather conditions that cause the creation of a duct and the resulting propagation peculiarities. It is well known that the earth's at
phere is subject to many variati
In general, both the temperature
the moisture content decrease gr
ally and almost uniformly.
height above the surface of the e
This is the standard condition.

when this condition occurs no duc
are formed and radar transmissio
is normal. However, normal atmo
pheric conditions may not be prese
at all times. In some cases, the tem
perature first may increase wi

ight and then begin to decrease. *his is referred to as temperature version.*

*(2)* The path followed by a light ive in traveling from one point another is called the optical line *sight between* the two points. The path followed by a radar wave, under standard atmospheric conditions, is called the radar line of sight between two points. For most purposes, optical lines of sight may be considered as straight lines. Radar lines of sight, except when they are vertical, curve downward as pointed out above. Therefore, under normal conditions, the volume of space which one radar can cover depends on the altitude of the points in space or aircraft to be covered above the curvature of the earth, plus physical obstructions. For example, assume that the average radius of the city of Philadelphia was 20 miles with no physical radar line of sight obstructions. It would require a minimum of six (search-type) radars, equally and properly spaced around the city, to provide a volume of radar coverage. This would cover 80 miles around the city for 1000-foot altitude points in space or aircraft above the earth's curvature. It should be noted that aircraft at speeds of 600 miles per hour would cover this straight line distance in 8 minutes. Eight minutes of air traffic control is not enough. Therefore, many search-type radars are required to resolve the critical air traffic problem in and around the cities of the continental United States.

[redacted]

Agencies which operate radars constantly throughout the United States are the Army, Navy, Air Force, Civil Aeronautics Administration (CAA) and certain radar development and production agencies. It is believed that this available source of radar equipment is adequate to resolve the air traffic problem, if properly organized and located on a national basis. It is assumed Air Force radars provide long range coverage for the air defense of the continental United States; Army radars, excluding radars that are integral parts of antiaircraft weapons systems, provide operational radar coverage which insures full utilization of antiaircraft weapons systems. Naval radars augment Air Force radars and provide radar coverage for Naval ships and installations, and finally, CAA radars are used in consonance with civil air traffic. These are adequate radar facilities to provide efficient air traffic control throughout the continental United States, provided they are properly located.

It can be reasonably assumed that the terminal points for the major portion of all United States air traffic coincides with a majority of the cities which Army antiaircraft units are defending. It is further assumed that the complete and continuous radar coverage required for full utilization of antiaircraft weapons systems is more than adequate for air traffic control when properly located throughout the range of these operational radar coverage radars surrounding these cities.

In order to best understand the radar coverage problem, one must assume that there is no radar line of sight obstruction above the earth's surface, and that each radar line of sight to points in space is limited by the curvature of the earth only. For example, take a piece of ordinary paper and place a pencil point in the center to represent a radar location. Then draw north-south and east-west lines through this point extending two inches in each direction. Center a dime over this point, inscribe its perimeter, and let the diameter of the dime represent 40 miles, the approximate diameter of a large city. It should be noted that the location of this radar in the center of the city would provide radar coverage only out to 20 miles beyond the perimeter of the city for points in space or aircraft at 1000-foot altitude due to the curvature of the earth only. Now place a point on the perimeter at each line intersection and inscribe perimeters for each point whose radii are equal to the diameter of the dime. These four circles indicate the radar coverage of points in space or aircraft at 1000-foot altitude for four radars located around the perimeter of the city. It should be noted that now the radar coverage has been extended to a maximum of 40 miles beyond the perimeter of the city at four points by utilizing four radars instead of one. Indefinite radar coverage in range, for 1000-foot altitude points in space or aircraft approach, can be attained by increasing both the number of radars and their emplacement distances from the center of the city.

### *Conclusion*

Finally, because of the precise, complete and continuous radar coverage required for full utilization of antiaircraft weapons systems, the presence of these operational radars, properly sited around air traffic terminal points, presents the greatest potential source for air traffic control around such cities. The other sources of radar coverage mentioned above neither possess, nor require, the precise, complete and continuous radar coverage capability that is required by antiaircraft weapons systems. Accordingly, individual antiaircraft defenses are capable of providing efficient air traffic information to a central collection and control agency without interference with the antiaircraft mission, and accentuating the much overlooked need for locating antiaircraft operational coverage radars at optimum locations.

# FALSE FACE

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**LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT**
**FRENCH ROAD, UTICA, NEW YORK**

**A DEPARTMENT IN THE DEFENSE ELECTRONICS DIVISIO**

## — GOVERNMENT —

PLANS FOR MISSILE SQUADRON The Air Force will form its first intercontinental missile squadron this year, but no missiles will be launched from operational sites "except in case of war," the announcement said. The unit will be ready to operate Snark weapons by the end of 1957. The squadron, assigned to the Strategic Air Command, will be based at a site to be announced later.

ENTERTAINMENT FOR ARMED FORCES The Armed Forces television is adding a five-transmitter network to furnish entertainment to U.S. troops of all services in South Korea and the surrounding area. With this addition, 17 remote sites will now have access to military television. The Armed Forces Radio-TV Service occasionally adds new radio outlets, and an up-to-date count shows 39 standard broadcast and 36 closed circuit stations, world-wide.

FCC AND PAY TV The FCC's ruling in September on experimentation with subscription television will be brought to the attention of Congress when it convenes in January. Meanwhile, the FCC has presented rulings providing for acceptance and consideration of applications for authority to conduct nationwide tests for a period of three years. Under the ruling, each pay-TV method meeting FCC requirements may be tested in a maximum of three cities which receive a minimum of four grade A commercial signals. Applications may be filed now, but will not be acted upon before March 1, 1958. The lengthy delay will give Congress an opportunity to study and evaluate this controversial matter.

MORE BUSINESS FOR SMALL BUSINESS Government contracts set aside for exclusive award to small business for Fiscal Year 1957 amounted to $744,335,298, almost 50% more than the 1956 figure of $497,678,432. The percentage of military prime contract procurement awarded to small business suppliers and nonprofit concerns was increased from 16.3% in the first half of Fiscal Year 1957 to 23.2% in the second half. This increase is attributable in part to the efforts of the Defense Department to offer small business greater opportunities to compete for military prime contracts, along with the Small Business Set-Aside Program conducted jointly by the Department of Defense and the Small Business Administration.

CONTRACTS: ARMY: W. L. Maxson Corp., production of missile components, $2,050,000; International Resistence Co., research and development in resistor design, $195,097; Gilfillan Brothers, Inc., target drone instruction and maintenance, $404,745; Stromberg-Carlson Co., manual telephone switchboards, $2,226,000. NAVY: Sperry Gyroscope Co., TALOS missile guidance systems, $47,000,000; Canoga Corp., four radar systems, $1,087,458; Hazeltine Corp., coder-decoder, $1,180,283; Burner-Hollomon Mfg. Corp., TERRIER missile handling equipment, $217,192; Admiral Corp., electronics equipment, $1,196,000. AIR FORCE: General Electric Co., over-the-horizon scatter communications equipment, $5,135,266; Federal Electric Corp., maintenance and operation of the "White Alice" communications system in Alaska, $2,630,000 and $15,022,365 (definitive); General Precision Laboratory, radar sets, spares, data, engineering services and reports, $1,600,000; Republic Aviation Corp., wind tunnel facility to test future missiles, rockets and manned aircraft, $1,200,000; Bendix Aviation Corp.. components for compass system, spare parts and ground support equipment, $1,532,639.

## — INDUSTRY —

U.S.-EUROPEAN TRANSATLANTIC TELEPHONE CABLE The American Telephone and Telegraph Company has launched a new enterprise with the signing of contracts with German and French agencies for construction of an undersea telephone cable system between this continent and Europe. The $40,000,000 cable system will consist of twin cables that will cross the Atlantic between Newfoundland and the Brittany peninsular in France. It will provide 36 voice circuits; 13 will terminate in France, 13 in Germany and the remaining 10 are reserved for other countries in Europe. Both cables are scheduled for service in late 1959.

(Continued on page 31)

90-FOOT PERISCOPE What is believed to be the world's longest periscope has been constructed by General Electric Company engineers and installed at the Atomic Energy Commisssion's National Reactor Testing Station. The 90-foot aluminum tube with an intricate mirror and lens system permits atomic workers to observe a "hot" nuclear reactor while in a shielded cubicle during development work on a nuclear propulsion system for aircraft.

"BLACK" SCREEN CATHODE TUBE A special black background screen for radar and other visual indicators, which eliminates limitations of such equipment under high surrounding light level conditions, has been developed by Allen B. Du Mont Laboratories, Inc. This is the first successful application of a black background directly to a phosphor film. The new screening technique allows electronic picture viewing under exceeding high ambient light conditions and is foreseen as having revolutionary future implications for television viewing.

MARKING ELECTRON TUBES A truly permanent-marking ink has been developed by Raytheon engineers and is in daily use in the production of important military miniature and subminiature types of electron tubes. This marking withstands all attempts to remove or destroy it short of actually grinding away the glass on which it appears.

ELECTRONIC TYPEWRITER PREDICTED TO TAKE DIRECT DICTATION Brig. General David Sarnoff, chairman of the Board of Radio Corporation of America, recently addressed the annual conference of the Life Office Management Association, an insurance group. He told them, "The business man of the future may well dictate his inter-office memos and personal letters to an electronic typewriter that will produce them phonetically in response to his voice."

## — GENERAL —

TESTING H-BOMBS ON THE MOON A University of Maryland scientist recently proposed the moon as a safe, remote site for testing hydrogen bombs. Dr. S. Fred Singer said it would be no greater technical problem to send an interplanetary ballistic missile 240,000 miles to the moon than to launch an intercontinental missile 5,000 miles. Dr. Singer presented his views in a paper prepared for the Congress of the International Astronautical Federation in Barcelona, Spain.

RUSSIAN SOLAR POWER Radio Moscow reported Russia has begun construction of the world's first full-scale solar power station in Armenia. The broadcast said 1,300 mirrors will reflect the sun's rays and bring water in a cauldron to boiling point, with the steam operating a turbine.

UNITED ENGINEERING CENTER The new United Engineering Center is to be erected between 47th and 38th Streets on United Nations Plaza, New York. Colonel C. E. Davies, building co-ordinator for the new Center, sailed in August for Europe where he will invite representatives of 13 Western European engineering societies to share facilities in the new Center.

"STRANGE CASE OF THE COSMIC RAYS" This was the title of the third program in the Bell System Science Series recently presented on television. This scientific detective story told about the chain of investigations that led to the identification of one of Nature's most baffling phenomena—cosmic rays. Film available from Bell.

ANNUAL SINGLE SIDEBAND DINNER This event will be held during the IRE Convention March 25, 1958, at the Hotel New Yorker. Tickets are $7.50 each and can be obtained by writing The Single Sideband Amateur Radio Assn., Inc.—261 Madison Ave.—N.Y. 16, N.Y. For any further information write Edwin Piller, Chairman, Publicity Committee, at the same address.

NATIONAL CONVENTION CALENDAR

NOVEMBER 18-21 The National Defense Transportation Association will meet at the Shoreham Hotel, Washington, D. C. The latest civilian concepts of "The Shape of Things to Come in Transportation and Logistics" will be presented by outstanding leaders in the transportation world.

DECEMBER 4-5 The Institute of Radio Engineers' Professional Group on Vehicular Communications will meet at the Hotel Statler in Washington, D. C. The conference theme is: "Meeting the Demands for Vehicular Communications?"

DECEMBER 9-13 "Computers with Deadlines to Meet" is the theme of the Eastern Joint Computer Conference and Exhibit to be held at the Sheraton Park Hotel, Washington, D. C. Sponsoring societies are the IRE, AIEE, and ACM. Non-members are cordially invited and may obtain further information by writing to: Mr. Richard T. Burroughs —Registration Chairman, 1957 E.J.C.C.—I.B.M. Corporation—1220 Nineteenth Street, N.W.—Washington, D. C.

EDITORIAL

# *Coordination: Research & Development*

A quarter of a century ago, American industry was spending $200 million a year on industrial research and development. Most of the results derived from this investment accrued to benefit business. Today, we have built up in America a powerful industrial capacity which receives its strength from research and development and technological know-how. Precisely, the progressive advancement in this field since the 1930's has contributed to our national and individual status. Research and development have grown tremendously to a point where we are spending in excess of $4 billion annually. No longer is it supported by individual industrial concerns alone. Rather, it has become an integral part of our national industrial might and extends throughout the length and breadth of our industrial effort to meet the present day challenges in both peace and war. Dynamic business initiative, labor and management leadership, and aggressive research and development have brought about a terrific change in our capacity to produce hard and soft goods and have prodigiously affected our standard of living.

Through research and development and technological know-how, management has the responsibility to provide the kind of products which best satisfy the present and future desires of Government and the people. Be this as it may, it is essentially important that careful consideration be given also to the question of critical raw materials, low cost, marketing, business expansion and the effects of increased production on our national economy. It would appear, then, that the real key to future successful industrial research requires an understanding of the problems of the people who use the final products.

We must not lose sight of the fact that those of us who are particularly interested in this blossoming electronics age occupy a first row orchestra seat in this $4 billion research and development business. To us is given the opportunity to plan wisely for tomorrow's prosperity in this vital segment of our industrial complex.

In planning for this new era, we must pause long enough to look back, evaluate and remember the growing pains as well as the accomplishment of the communications and electronics industries during the past few years. So far, the contributions of communications and electronics to our economic way of life have been nothing short of miraculous. This is just a beginning for, from here on out, these industries are destined to play a greater role in the scheme of things. We cannot afford to be complacent or bask in the sunshine of past glories. Through an interchange of knowledge and close coordination of ideas at our chapter meetings, and by expanding our membership so that every one of us in the communications, electronics and photography fields can benefit from the experience of others, we can contribute our share to the production of soft and hard goods to insure economic stability and a maximum degree of flexibility. In this way, we can add to the conservation of our natural resources, insure our industrial technology, strengthen our research and development and preserve our national security.

*The Editor*

# *the* BOMAC *story*

by

Richard J. Broderick
Treasurer
Bomac Laboratories, Inc.

**ABOVE:** Part of the spacious and spotless area devoted by Bomac to assembly of delicate electronic components.

**LEFT:** A pleasant setting for the production of microwave tubes, this modern plant houses 110,000 square feet of manufacturing space.

JUST TEN SHORT YEARS AGO, Bomac Laboratories, Inc., was two men—and its "laboratory" a small loft over a soft drink plant in Beverly, Massachusetts.

Today, Bomac employs over 700 people. Its beautiful, modern plant, nestled amid 35 meticulously landscaped acres adjacent to heavily traveled Route 128 in North Beverly, houses some 110,000 square feet of manufacturing space. In this pleasant setting, Bomac manufactures enough microwave tubes and components each year to gross more than $5,000,000.

For tomorrow, things look even brighter. Bomac has recently completed a new $1,000,000 plant which calls for an additional 200-400 employees.

In part, the Bomac story is a reflection of a bigger success story—the mushroom growth of the entire electronics industry in the years after World War II. But it is more, for it points up the fact that strange and wonderful things can still happen in this country when two men and an idea come together at the right time.

**This is another in the series of company articles in SIGNAL, describing the growth of the electronics industry.**

The two men were physicist Henry J. McCarthy, now Bomac's President, and production specialist Harold C. Booth, now Executive Vice President of the organization. In 1947, both were with Sylvania's Electronics Division—McCarthy as manager of engineering, and Booth as superintendent of the same division. Both men had a thorough grounding in electronics, and both had come up through the ranks. Their idea was simple and solid: to get into the growing electronics industry on the ground floor and serve it as specialists in the research, development and production of microwave tubes.

### *Utilizing Manpower*

It was a good time for a move—the industry was ripe for growth in the immediate post-war years. At the close of World War II, it was concentrated in a few large eastern companies, whose principal job was to produce the component models developed at Government supported research laboratories like M.I.T. and Columbia. When these companies turned back to their respective commercial fields at war's end, the industry was left with a large manpower pool of highly trained technicians who had no intentions of abandoning their newly developed skills. As a result, new companies began to spring up—companies whose size and ability to specialize gave them inherent competitive advantages in production quantities, quality, and price. The industry was off and running.

### *Skill and Specialization*

Booth and McCarthy added a half-dozen skilled employees and turned their attention to microwave TR and ATR tubes. It was a job that called for skill and specialization plus, for these are delicate tubes for a delicate job. They are primarily used as switching tubes for radar which performs the function of protecting sensitive receivers from the high power pulses of outgoing transmission signals. In a matter of millionths of a second, they must switch all the power of the outgoing signal to the an-

(*Continued on page* 35)

*A 1957 AFCEA Convention Presentation*

# Some Aspects Of Telegraphic Data Preparation and Transmission

***by William B. Blanton, Director, Planning, Plant & Systems, Western Union Telegraph Co.***

THE ENORMOUS GROWTH THAT IS TAKING PLACE IN THE ELECTRONIC generating, processing, and recording of data is making new demands on telegraphic communications. Because of the growing volume and the statistical nature of data, these demands stress economy and accuracy.

### *Preparation of Data for Transmission*

Accuracy in the telegraph transmission of data must start with the original preparation of the data in a character-coded form for introduction into the transmission system. If this is done from the storage of a machine, suitable electronic circuitry can be provided to insure accuracy. In most cases, however, human effort is required in transcribing from the original typewritten forms and reports. It is telegraph experience that human errors involved in this original transcription far outnumber subsequent equipment and line transmission errors. Unfortunately, they are the most difficult to detect.

One technique, which holds considerable promise for practically eliminating transcription errors, is electronic character sensing. In this technique, the characters in the original copy are photoelectrically sensed and recognized, and a punched tape is prepared automatically. Excellent results have already been obtained where strict controls can be applied to the original printed copy, but considerably more work remains to be done before the flexibility, economy and reliability are obtained that are needed in general telegraph applications.

System designers are constantly trying to achieve accuracy and economy in the transcription of data into a form suitable for transmission by transferring to machines as many of the fixed and repetitive functions as are economically and technically feasible. Telegraph equipments and techniques are widely applicable in this field. In many organizations, the mechanization of office paper work is being accomplished by maintaining files of prepunched tape containing fixed data and control code combinations. These tapes are used to prepare a printed document and a complete tape of each new transaction. It is necessary to insert by keyboard only the variable data pertaining to the particular transaction. The complete tape can be transmitted to other points in the organization for producing partial or complete tapes and printed copies. At these points, the new tapes can be used for processing the transaction further, any additional data that may be needed being added by keyboard.

Edge-punched cards which have the telegraph code punched along one edge of the card are also being used for the storage of data. The cards are more durable and are filed more easily than punched tape. At present, the cards are only punched, but plans are underway for equipments that will both punch and print the cards. Magnetic discs of the type used on dictating machines appear to have advantages where small amounts of data must be stored and selected at random for preparing documents. The discs are durable, have a fairly large storage capacity, can be filed along with the documents, and can readily be erased. Development work is now in progress on this type of equipment.

In some instances of transcribing data, the process is essentially that of entering variable data on one of a number of fixed forms. One way of merchandising this process is to provide for each type of form a removable program panel that will cause the fixed information to be entered automatically.

A prototype setup has been made, consisting of a telegraph page printer, a printer-perforator, a transmitter and a plug board apparatus, for off-line use in typing a printed form and at the same time preparing a printed perforated tape for use in further processing or transmission. The printer is provided with a carriage position register that indicates each of its 72 positions, and a line register that indicates each of 20 lines on the form. Sixteen diff ent line programs can be set up on the plug board.

At the top of Figure 1 is shown part of the printed form, a below is shown the tape produced. The line programs will cau the character or a combination of characters shown below the tap to be inserted automatically when the printer carriage arrives designated positions. By means of the line position register, a line program can be made effective at any desired line on the for Generally, several lines on a form will use the same progra Inserted characters may advance the printer carriage to the ne field on the form, or may convey any kind of fixed information. desired, characters may be punched in the tape only, for use further processing. The operator key-strokes only the variable formation, shown above the tapes, thus reducing the possibility human error.

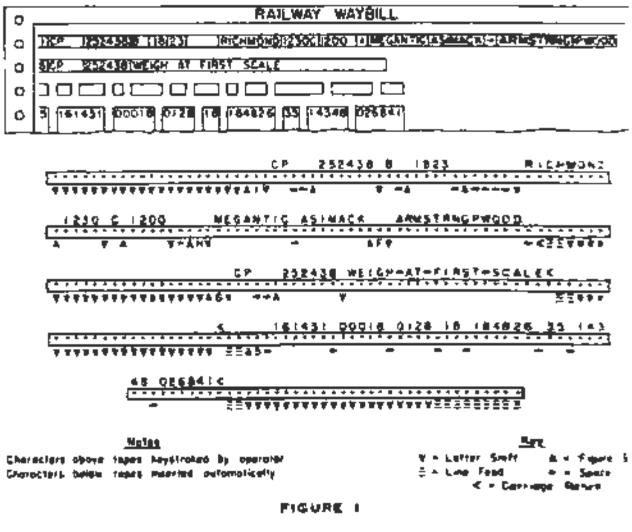

FIGURE 1

### *Line Facilities for Data Transmission*

Before the data processing revolution, telegraph transmissio was mostly of discrete messages, prepared by humans and read b humans. Telegraph transmitting and receiving equipments capabl of speeds of 65, 75, or 100 words per minute with the 5-level tel graph code were economically satisfactory for that traffic. Now with machines producing and consuming data in increasin amounts, there is a growing need for transmission facilities tha are economical for the bulk transmission of data. Usually this r quirement is expressed in terms of "high speed data transmission. In most cases, however, high speed is not the essential element bu rather is the generally accepted means of meeting the requir ments.

The 3-kc voice band is the vehicle for all of the trunk or long haul circuits in the present Western Union plant. Each of thes 3-kc bands is divided into two half-bands. Each half-band has useful spectrum from approximately two hundred and twenty-fiv to sixteen hundred and twenty-five cycles and is frequency-divide into 9 telegraph channels that are suitable for speeds up to 10 words per minute.

Since the half-voice band is available throughout its plant Western Union has turned its attention to the development of suit able terminal modulating and demodulating equipment for using

(*Continued on page 38*)

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these half-bands for the high-speed transmission of data. This work is nearing completion, and tests indicate that a signaling speed of about 400 cycles per second is practicable. In computer language, this is 800 bits per second, or somewhat more than ten times the signaling speed of a 100 word-per-minute telegraph channel.

In addition, plans are underway for providing a telegraph channel of about ⅙th voice band width, which will be suitable for a signaling speed of around 100 cycles per second, or 200 bits per second. Such a channel can be used by one IBM transceiver circuit operating at the rate of 11 cards per minute, or for the transmission of seven-level paper tape at the rate of 200 words per minute.

Western Union pioneered in the development and application of frequency modulation for telegraphy. Our trunk line plant comprising several million channel miles is operated by this method. As a result, we enjoy a unique resistance to errors due to changes in the transmission characteristics of the voice band and errors due to fortuitous interference.

Regenerative repeaters are not normally required even though several sections of carrier channels are operated in tandem. Therefore, 6, 7, and 8-level or even higher level data codes can readily be transmitted over line facilities that are in general use for 5-level code transmission.

### *Accuracy in Data Transmission*

Error detection and assuring accuracy in transmission is a problem that is not unique to long distance transmission of data. As is well known, computers and other data processing systems that transmit data within the same machine, and possibly to other machines a few feet away, are replete with error detecting arrangements. Transmission systems are subject to more extraneous interferences, but even if these were not present, it would be necessary to protect against equipment and component failures.

Many schemes have been devised for providing error detection. Almost invariably, these schemes require redundancy: that is, the transmission of more information than is necessary to convey the intelligence.

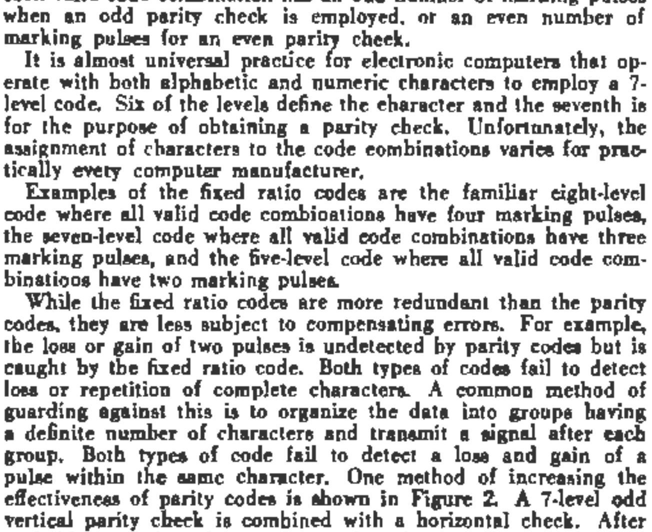
Examples of vertical checking codes in which the redundancy is individual to each character are the odd or even parity codes, and the codes having a fixed ratio of marking and spacing pulses. The parity codes may be 5, 6, 7, or 8-level codes, but in any case, each valid code combination has an odd number of marking pulses when an odd parity check is employed, or an even number of marking pulses for an even parity check.

It is almost universal practice for electronic computers that operate with both alphabetic and numeric characters to employ a 7-level code. Six of the levels define the character and the seventh is for the purpose of obtaining a parity check. Unfortunately, the assignment of characters to the code combinations varies for practically every computer manufacturer.

Examples of the fixed ratio codes are the familiar eight-level code where all valid code combinations have four marking pulses, the seven-level code where all valid code combinations have three marking pulses, and the five-level code where all valid code combinations have two marking pulses.

While the fixed ratio codes are more redundant than the parity codes, they are less subject to compensating errors. For example, the loss or gain of two pulses is undetected by parity codes but is caught by the fixed ratio code. Both types of codes fail to detect loss or repetition of complete characters. A common method of guarding against this is to organize the data into groups having a definite number of characters and transmit a signal after each group. Both types of code fail to detect a loss and gain of a pulse within the same character. One method of increasing the effectiveness of parity codes is shown in Figure 2. A 7-level odd vertical parity check is combined with a horizontal check. After each block of data there is inserted a character chosen so as to make each of the 7 levels have odd parity.

Transmission within a computer is usually on a parallel basis. Each level of the code is transmitted by components individual to the level. Faults are generally confined to one level. The vertical parity code is very effective for this mode of operation.



VERTICAL & HORIZONTAL PARITY CHECK
FIGURE 2

Over a communication line, code pulses are transmitted serial form. Fortuitous faults are very apt to affect two or m adjacent pulses within a character. Some tests made ove marginal line indicated that 7-level vertical parity checking tected about 90% of the errors. A horizontal parity check app to groups of approximately 60 characters detected approxima 99% of the errors. It is reasonable to expect that a combina of the two would have been almost 100% effective.

Clearly there are many problems to be solved before a teleg switching system can be designed which will accommodate t various codes and checking systems and yet have the general plicability of present systems that operate on the 5-level code. siderable thinking is being done along these lines, but prob more important, an EIA committee composed of representa from communication companies and computer manufacture attempting to standardize code practices. Meanwhile, imme demands for the transmission of the various codes and chec systems will be met by conversion units or custom tailored sys

### *Multi-Station 7-Level Data Transmission with Error Detection*

Modern equipment which is used at one station of a rec developed multi-station system will permit a central station as many as eight outstations to share a one line circuit. equipment transmits tape perforated with a 7-level, odd p checking, data code, and checks each character for parity a receiving station. Commercial Controls tape readers and pun and Model 28 printers are used in the system.

To send a data message from any outstation, one inserts 7-level tape in the reader and depresses a request button. W the circuit is idle, the station is automatically connected to circuit and the message is transmitted into the central sta The central station can similarly send a message to any outst by depressing the appropriate push button. When the circu idle, the outstation will be selected automatically and the mes transmitted.

As each received character is punched in the tape, an parity check is made. If it does not meet the check, the transm is stopped, alarms are actuated at both the sending and recei stations, and the printers are cut into the circuit. The oper use the printers to determine what action to take. Generally, tapes are set back to the same point, and at the receiving end errored portion of the message is "rubbed out" by overpunch Then transmission is resumed.

### *5-Level Code Transmission with Error Detection*

The foregoing illustrates a method of error detection emplo a 7-level code. However, the public telegraph system and private wire networks—both commercial and military—ope with the 5-level telegraph code. Since this is the common teleg language, there are a large number of business machines and o data equipments in daily use that function with 5-level tapes. have, therefore, devoted much of our effort to developing met of error detection and correction in 5-level code transmission.

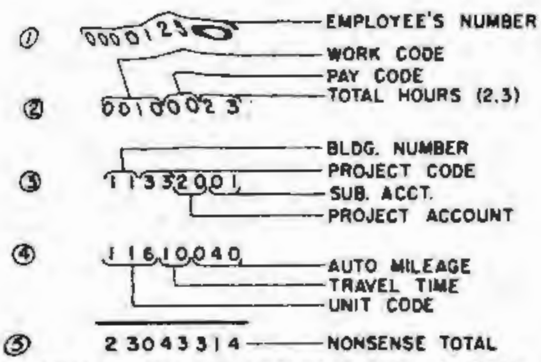
Before considering error correction, we must first develop acceptable method of error detection for the 5-level code. background for the method I am going to describe, let us re a successful application of a programmed accuracy check.

When data consist of groups of figures, totaling each group transmitting the total provides a very effective method of error tection. The receiving station performs the same addition determines whether its total agrees with the transmitted t This method of error detection is limited to numeric informat but it provides an effective foundation for the development method for checking both alphabetic and numeric characters.

Western Union is making extensive use of this type of accur check in transmitting its own payroll and other management trol data over our Public Message System. In field offices, forated tapes containing operating data entirely in numeric f are prepared on Friden Add-Punch machines. These adding chines prepare a printed tape and a perforated tape. Figur shows the information extracted from an employee's daily work port. All of the information is entered into the add-punch chine in 4 groups of digits. A "nonsense total" is calculated recorded automatically on the printed tape and in the perfora tape.

Thn tapes are then transmitted to division headquarters wh they are converted to punched cards. The cards are run thro computers for the automatic preparation of payrolls and mana ment control reports. To insure accuracy, the computer also a the numbers in each group and compares the total with the tra mitted "nonsense" total. If they do not check, the card is reject and a re-run is requested.

The "nonsense" total method of error detection has proved be very satisfactory in practice, and we have yet to discover error which was not detected by this check.



PAYROLL AND MANAGEMENT CONTROL DATA

FIGURE 3

Western Union is developing a system that will provide error etection and correction for data consisting of both alphabetic nd numeric characters. This system employs a totaling technique omewhat similar to the "nonsense" total in that the marking ulses in a line of data are totaled on a weighted, binary basis. 'he system employs equipments at the sending and receiving ends f a circuit for providing error detection and correction while ransmission is taking place.

The transmitting equipment can send tapes already having hecking information or can automatically insert checking infornation after each line. In either case, the transmitter will stop ifter sending the checking information for each line of data to wait instructions from the receiving station. The receiving equipnent checks each line of data with its associated checking charicters. If the check indicates no error, the transmitter is signalled o send the next line. If an error is indicated, the reperforator leletes the errored line from the tape, and signals the transmitter o repeat the line of data. This type of system has been christened EDIT. This term has a significance other than its literal meaning —it is "Error Deletion by Iterative Transmission."

Figure 4 shows the prototype EDIT reperforator, used at the eceiving station. It is arranged to handle 5, 6, 7 or 8-level tapes. t has both punching pins and sensing pins. These two sets of ins are one character apart. Immediately after a character is eceived and punched, the tape is advanced to its next position, vhere that character can be read by the sensing pins. In this manner, characters are read for error checking purposes. To "rub out" a line of data having an error, the tape is back-stepped with ll punching pins operating to over-punch each character. The ensing pins determine how far to back-step. The EDIT transnitter also is arranged for handling 5, 6, 7 and 8-level tapes. It an step and read the tape either forward or backward.

The reperforator and transmitter operate on a parallel input-output basis. Electronic distributors are associated with them for erial operation over a telegraph circuit. They may be operated it regular telegraph speeds of 65, 75 and 100 words per minute, r a higher speeds up to 200 words per minute.

With suitable associated circuitry, the EDIT equipments can be sed for error detection and correction in the transmission of any of the 5, 6, 7 or 8-level code systems. However, this discussion will e limited to a system that has just reached the prototype stage, n which error detection is applied to the standard 5-level telegraph code.

The redundant error checking information is contained in two ode combinations that are inserted after the "carriage return" that lenotes an end-of-line. This signal for inserting the error checking information could be two "carriage returns," or for that matter, any character or combination of characters that is not used for data characters.

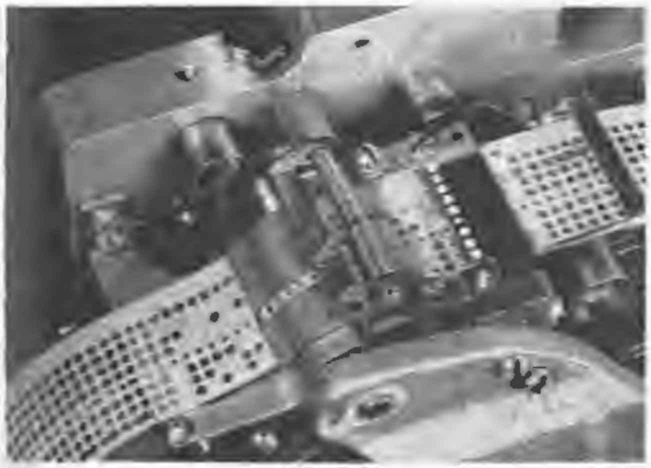
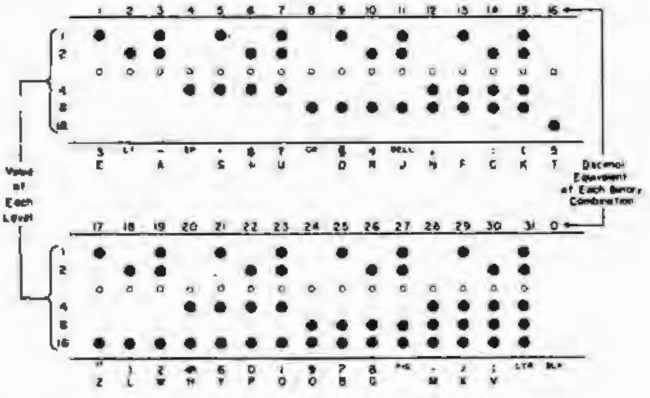


FIGURE 4

The two error checking characters carry the binary total, on a modulus of 256, of all the code combinations in a line of data.

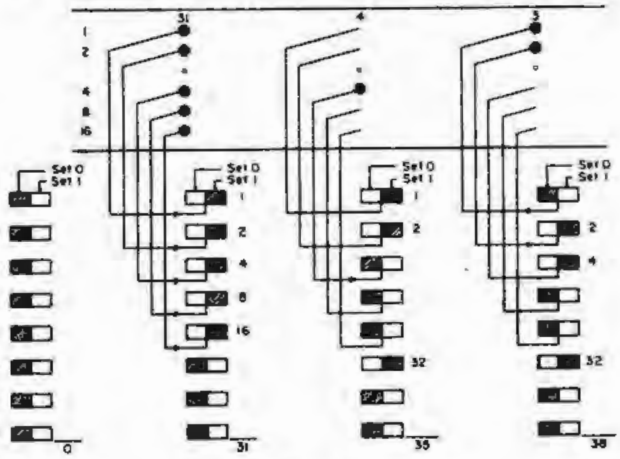
Figure 5 shows the 32 combinations of the 5-level code. At the bottom of each combination appears the character assignment generally used in telegraph service. Above each code combination is shown its binary value expressed as a decimal number.



5-LEVEL TELEGRAPH CODE

FIGURE 5

The method of accumulating the binary total of all the code combinations in a line of data is quite simple. The different valued pulses of each code combination are fed into the corresponding stages of a binary counter. As shown in Figure 6, the first character has five marking pulses which will cause the first five stages of the counter to set from zero to one, giving a total count of 31. The next character has only a third marking pulse. This resets the third stage to zero, which in turn causes the fourth and fifth stages to reset to zero. The resetting of the fifth stage to zero causes the sixth stage to be set to one, thus giving a total of 35. The next character has a first and second marking pulse. While the pulses are essentially fed into the counter in parallel, varying degrees of delay, measured in microseconds, are included in the five wires so that the pulses actually arrive in the counter one at a time.



COUNTING BINARY CODES

FIGURE 6

It was desired in the checking system to restrict the binary counter to 8 stages. Thus the counting is on a modulus of 256 since each time the counter passes through a count of 256, it starts over at one.

In Figure 7 we see the organization of a line of data (shown as black circles) with its checking characters (shown as open circles). The binary total of the line equals 130, which is registered in the "one" side of the counter. However, the readout is made from the "zero" side of the counter which is set to the complement of 130. The first four bits of this complement are transmitted as the first, second, fourth and fifth pulses of the first checking character. The last four bits of this complement are transmitted as the first, second, fourth and fifth pulses of the second checking character. The third pulses of the two checking characters are always transmitted as marking pulses. This avoids

(*Continued on page* 43)

R

## RAPID

RACE* eliminates slow, time-consuming manual tests by electronically checking complete weapon system such as missile or aircraft. Operating on initial assumption that system is functioning properly, RACE speeds through primary test of over-all system or major sub-systems. If fault exists, RACE signals "no-go", then isolates fault through secondary tests. Complete job is done in only minutes.

**1008 HOURS**

A

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**1009 HOURS**

C

## CHECKOUT

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**1025 HOURS**

E

## EQUIPMENT

Design flexibility adapts RACE for use at operational sites in pre-launch and preflight check-out, for in-flight testing, for maintenance areas and overhaul depots. Current and future applications include missile data reduction stations, shipborne and airborne radar, automatic navigation systems, aerial reconnaissance systems, ground fire control systems and missile guidance systems.

**1030 HOURS**

*T.M.

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*1957 AFCEA Convention Presentation*

# Processing, Narrow-Band Transmission And Remote Display of Radar Data

***by Sheldon P. Detwiler, Supervisory Engineer, Electronics Division, Lewyt Manufacturing Corp.***

N RECENT YEARS, AS THE USE OF radar systems has become more nd more extensive, requirements have developed for the remote isplay or use of radar data. These requirements have been atisfied by several types of remoting systems—each fitting a articular need. This article discusses, in general terms, one amily of such systems and, in particular, the AN/FST-1 Coordiate Data Transmitter, nick-named SDV for Slowed Down Video, which is utilized in the SAGE system for the transmission of o-called "gap-filler" radar data to a central coordinating system.

Faced with the problems of transmitting radar data to some emote point, a choice of several methods exists. The simplest s the use of some system which will transmit the video data directly, such as by a microwave relay link, or for very short distances, by a coaxial cable. For very short runs where a coaxial able is practical, the advantages of its use are obvious. Mainenance of the electronic equipment which drives the cable repreents the principal operating expense. For transmission over omewhat greater distances, a microwave relay link may be desirable. If the remoting can be done on a single hop without he need for repeaters, the original investment and maintenance ost may compare favorably with that for other means of data ransmission. However, as the remoting distance increases to the point where several repeater stations are necessary, a low-bandwidth data transmission system which can operate over ordinary communication circuits becomes more attractive.

On several occasions, I have had people inquire whether the uspension of some of the natural laws is not necessary in order o transmit satisfactorily a radar PPI picture over a narrow-band channel. Since a typical video signal coming from a radar contains frequency components up to 2 or 3 megacycles, such a question is not completely unreasonable. However, when one considers the amount of information which can be conveyed from a PPI picture to a radar operator, one will find that the bandwidth involved is relatively small.

Considering the face of an indicator as a collection of elemental areas (the illumination of any one of which might denote a arget), we find that the number of such elemental areas might reasonably total somewhere between 10,000 and 500,000. If 500,000 elemental areas were assumed, it is doubtful whether an operator could detect the movement of a target from one elemental area to an adjacent one. If as few as 10,000 elemental areas were assumed, the picture would be considerably coarsened. However, an operator could estimate the position of a target to nearly the accuracy possible with an ordinary radar PPI display. The pertinent question, as far as bandwidth is concerned, is how many of these elemental areas must we transmit each second in order to keep pace with the radar antenna as it turns. As a specific example, consider the problem of remoting the data from a SAGE Gap Filler radar. If we divide our PPI indicator face into 256 azimuth elements, each of these azimuth elements will be a wedge radiating from the center of the indicator and about 1.4° in width. Since 1.4° is in the neighborhood of the beam width of most short-range radars, the quantizing of a PPI picture into such angular elements will introduce a loss of angular resolution in the order of half the beam width. Let us also divide each azimuth element into 64 range elements. Considering the picture as a whole, we now have 16,384 elemental areas. For those who may be wondering why we chose such numbers as 256 and 64, I'll mention that they are powers of 2 which makes life much easier on most digital equipment. Let us also assume that we have an antenna rotating at about 5 rpm. We then have a total of 81,920 elemental areas per minute or 1365 elemental areas per second to transmit. The transmission of this number of bits per second over an ordinary telephone line or radio communication channel presents no real problem.

A PPI picture, as reconstructed at the receiving end of the communication channel, contains nearly all the intelligence available in the original radar signals. Assuming this to be the case, why do those original radar signals contain such high frequency components? One answer which the less charitable of you will immediately offer is that we have coarsened the picture. This, of course, is true, but to what extent have we coarsened the picture? By what factor have we increased the size of the elemental area? Surely by not more than a factor of 10. Perhaps then, more bandwidth is occupied by the radar signals than the PPI display that they create justifies. For instance, we might reduce the bandwidth in the video amplifier to 1 megacycle without noticing any change in the PPI picture. Even then, there is still a factor of about 60 to be accounted for somehow. Sure enough if we watch carefully, we find that the radar set is not content to transmit only one pulse each azimuth element and develop its picture on the basis of the information from that one pulse. It is instead transmitting somewhere in the neighborhood of 50 or 60 pulses per azimuth element—a rather considerable redundancy. Before we leap in and criticize the radar for inefficiency, we should recognize that the velocity of radio propagation being what it is, a single transmitted pulse each beam width would leave the radar unoccupied most of the time. It also would leave us with the same bandwidth as if the pulse were being repeated frequently. Because of this fact alone, we can afford to be magnanimous and not ask the radar set to transmit only pulse per azimuth element. It appears that we cannot hope to make the radar set by itself deliver low-bandwidth signals which may be transmitted to a remote point.

Even if the processing for data transmission were made easier by utilizing a single radar pulse per azimuth element, the performance of the radar would be very seriously degraded. It is difficult, when examining the video waveform resulting from a single radar pulse, to differentiate targets from noise. However, when the integrated result of a large number of transmitted pulses is examined, the repeated target returns stand out clearly in the presence of random noise. It can be said that the repetition of the target return over a larger number of radar trigger periods is redundant. However, this redundancy and subseqeunt integration are necessary in maintaining a reasonable radar sensitivity.

I believe we have shown that a radar PPI display may be transmitted over a narrow-band channel without excessive degradation of that picture. The problem is to devise a processing method to convert the radar video signals into narrow-band signals for transmission. One simple method might be to set up a television camera in front of the PPI indicator. If the scanning of this camera were made extremely slow so that one frame was completed for each rotation of the radar antenna, a usable remote display might be achieved. There would be a number of very serious "bugs" which would have to be ironed out of such a system. In addition, it probably would be difficult to maintain the stability necessary to permit coordinate measurements to be made on the resulting remote display. Even though serious faults are obvious in this system, let us examine the process of bandwidth reduction which it employs. The PPI phosphor performs an integrating function, building up a discernible target display from repeated returns. The television camera treats the picture as a series of horizontal lines, each having the width of an elemental area. As each horizontal line is swept, the television camera, in effect, treats it as a series of elemental areas.

Let us make an improvement on this television camera system.

Instead of a conventional television scan, let us make the scan polar, lagging an azimuth element or two behind the PPI scan as it rotates around the indicator. This eliminates some of the "bugs" from the system but, unfortunately, adds others. Again, it would be extremely difficult to maintain accuracy and stability in the system so that coordinate measurements could be made from the resulting remote display. The basic principle used here, however, has been successfully employed in slightly different fashion in other equipments.

The Rafax Bandwidth Compressor, developed at Haller, Raymond and Brown, starting in 1948, employs this same basic principle. In this equipment, a circular sweep is generated on a small cathode ray tube with a sweep being initiated by each radar trigger. The radar video signals are used to intensity-modulate the trace. Targets then show up as intensified spots whose angular positions on the tube are determined by their ranges. Using a medium persistence phosphor, the decay time of each target presentation is roughly the period necessary for the radar to turn through one beam width. A rotating optical pickup system feeding into a photo-cell is placed in front of this cathode ray tube. If this pick-up system is rotated at a speed so that one rotation is competed during each azimuth element, the signal from the photo-tube constitutes a slowed down version of the original video suitable for transmission over a narrow band channel. Many of the difficulties we found in our hypothetical television systems are avoided in Rafax. It is possible to maintain relatively accurate range and azimuth calibration. The principal weakness of such a system is the use of a phosphor for short-term storage. If the phosphor maintained its initial intensity until the scanning system read out each target and then caused that intensity to drop to zero, the system would be near ideal. However, the time between the intensification of a spot indicating a target and the scanning of that spot may vary from near zero to the time necessary to rotate through one azimuth element. The result is a loss of several db in the ability to distinguish weak returns in the presence of noise.

## *Slowed Down Video*

About 1951, the Slowed Down Video was conceived at the Air Force Cambridge Research Center. Later, practical models were developed at Lincoln Laboratory. The Lewyt Manufacturing Corporation was given the job of re-engineering this equipment into suitable form for use in the Sage system. The complete system of the Lewyt AN/FST-1 Coordinate Data Transmitter occupies four cabinets and consists of two independent channels, each capable of processing the data from a radar set and transmitting it over a telephone line. Automatic fault sensing circuits and remote control facilities are provided to permit substitution of the stand-by channel in the event of failure or marginal operation of the operating channel. Each channel is housed in a pair of cabinets, one containing complete power supplies, and the other the Coordinate Data Transmitter itself. Two middle cabinets house the two transmitters. Logic wiring on these racks is exposed to view. There are transparent plastic masks which cover the eight sub-racks, and which have provided in them slotted holes through which special test prods may make contact with appropriate test points. Also, there are a large number of pairs of neon lamps indicating the state or activity of a number of flip-flops. These neon lamps and the test points make it possible for a maintenance man to make adjustments or to identify and locate malfunctions within the equipment easily.

In the rear of each transmitter rack there are eight sub-racks of plug-in circuit modules. The relatively small number of different circuit modules used in this equipment and the ease of their replacement simplifies maintenance. Field maintenance of this equipment can be by substitution, with repair of defective modules being accomplished at depots. These plug-in circuit modules are constructed on printed circuit boards, resulting in a compact, reproducible package. Since this equipment was intended for ground station use, no premium was put on reduction to the smallest possible size. Reliability and ease of maintenance were of prime importance.

If the development of such equipment were undertaken today, it would undoubtedly take a radically different form. The present availability of transistors and magnetic cores would permit much more reliable and compact equipment.

This equipment was built for use in the Sage system, using as inputs the signals from a short range gap-filler radar set. It processes those signals for transmission over a single telephone circuit. The area covered by the radar set is treated as a number of elemental areas. Each such elemental area is about 1.4° in width and 1/64th the maximum range of the radar. This corresponds with the example which we treated before with our hypothetical data processing equipments. The basic principle of processing for narrow band transmission is also similar to our hypothetical examples. However, a number of refinements worthy of mention are used.

One of the essential parts of the system is a means of st
in which the high-speed radar data may be accumulated
later released for transmission. A Radechon barrier-grid st
tube was chosen to perform this function. In this applica
a raster of up to 256 dots may be applied to the storage
target. Each of these dots may accumulate a charge duri
number of writing operations. When desired, a readout
may be obtained from any one of these spots, more or
proportional to the amount of writing which had been
on that spot. Since the readout operation is destructive,
charge is erased from a spot and the accumulation of ch
during subsequent writing operations may start from zero.

Each spot on the raster corresponds to a range element, g
a capability of 256 range elements, although only 64 are
in the current application of the equipment. As the video
resulting from each radar pulse is received, the appropriate ch
corresponding to the signals present in each range elemen
deposited in the storage tube. Once per azimuth element,
readout circuits work their way through the raster, one
each 1/1600th of a second producing output pulses whose a
tudes are measures of the radar signals appearing in the r
elements since the last readout.

The output signals from the storage tube circuits could
stretched and displayed on an indicator, giving a multi-
presentation. However, the signals necessary to convey suc
multi-tone picture would require more bandwidth to transmit
we can afford. In addition, a decision must ultimately be m
as to whether a target does or does not exist. In most instan
the machine is more capable of making this decision than
observer at a remote indicator. Therefore, a threshold circu
utilized following the storage-tube output to accept as targets
transmission only those signals exceeding a pre-determined l
The remote display will therefore consist of either no spo
the definite presence of a spot in each elemental area.

In writing into the storage tube, it would be practical to i
grate the video signal returned for each radar pulse in
range element and to apply a proportional charge to the appr
ate spot on the raster. However, a simpler input system ha
a number of advantages is used instead. The incoming v
signals are passed through a threshold circuit causing a flip-
to set up whenever this threshold is exceeded. A range m
generator is used to generate a train of pulses marking
boundaries of the range elements. A range mark pulse w
occurs while the flip-flop is set is used to reset the flip-flop
also to apply a unit charge to the appropriate spot on the sto
tube raster. The result is that a unit charge is deposited for
range element within which the video waveform exceeds
pre-determined threshold. Here again, we have allowed
machine to make a decision as to whether a target did or
not exist for the return from each radar pulse.

## *Recording the Signals*

We have quantized in range by breaking the range into
elements, and we have quantized in amplitude at the inpu
the storage tube by permitting only "target" or "no tar
signals to be recorded on the storage tube. The picture is bro
into azimuth elements by reading out each range element
during each azimuth element. It appears, then, that we are ask
the storage tube to count the number of target returns per azim
element in each range element. At the output of the sto
tube, the decision is made to transmit a target pulse if the co
exceeds a pre-determined number. Actually, the storage
is not a digital device but it is able to count to an accuracy
about ±10%, which is adequate for this application.

As we had mentioned before, it is very difficult to disting
the presence of a weak target in the video signal resulting f
a single radar pulse; however, this is just what we are ask
the input threshold circuit to do. We must expect that it
make frequent mistakes. We would prefer that the equipment
a whole transmit false alarms (or targets which do not actu
exist) very seldom. On the other hand, we are interested
displaying targets which may be practically indistinguishable f
noise. The input threshold level is therefore set so that w
no target returns are received, quantized video pulses will
generated a certain percentage of the time due to noise alo
The threshold circuit following the storage tube is then adjus
so that it will produce an output due to the quantizing of no
alone, only infrequently. If the proper choice of both of th
thresholds is made, the machine can have the ability to dis
guish weak targets as dependably as a reasonably alert m
observer. In order to maintain such performance, the percent
of quantized video pulses resulting from noise alone must rem
relatively constant. A variation of a fraction of a db in aver
radar noise amplitude could completely disrupt the operation
the equipment. It would be unreasonable to attempt to maint
a constant noise amplitude within the radar over long peri

h time, therefore, a type OF automatic gain control is employed a the Slowed Down Video equipment.

One of the range elements near maximum range is monitored nd a voltage proportional to the rate of quantized video pulses *ue to noise* alone is generated. This voltage, amplified and veraged through an extremely long time-constant, is used to ontrol the gain of the input video amplifier. Thus, a nearly *onstant per*centage of quantized video pulses due to noise alone s generated by the input threshold circuit. When properly calirated, the equipment is capable of operation without attention *or indefinite* periods of time.

Let's digress for a minute, and discuss one of the advantages of this type of input circuit—where digital integration follows *amplitude quantization*.

I'm sure most of you have had the misfortune to observe radar ndicators whose display was practically useless because of interference *being* received from nearby friendly radar sets. I'm afraid "friendly" is perhaps a poor word to use here. About the only consolation at a time like that is the knowledge that the ellows who are jamming you are probably looking at the same ind of picture. This sort of interference is almost entirely leaned up by amplitude quantization and digital integration. he mechanism for removing this interference is fairly simple. uch interference usually takes the form of intense spots displayed as dotted spirals of varying pitch, or even as apparently andomly distributed spots. The important point is that each ne of these spots is the result of a *single* radar pulse from a earby radar. If that single pulse happens to come from a high-powered set using a wide transmitted pulse, the presentation n an ordinary PPI might very well be as bright as the display of a strong target return. However, where the data processing onsists of determining whether the video quantizer threshold vas exceeded for a minimum number of radar pulses, the effect of such a single high intensity return is negligible since it does not repeat several times at one range during an azimuth element. The result is that even the most cluttered radar display will be leaned up and transmitted without a significant increase in the alse alarm rate..

I don't think it would be proper to engage in speculation or other possible applications of this digital integration technique for cleaning up radar interference. However, I suspect *many* of ou recognize applications for such a clean-up where processing for low bandwidth data transmission is not a requirement.

I might mention that a good part of the bulk of this machine is taken up by auxiliary circuits. These provide for the sensing of faults, the automatic transfer of channels in case of faults, provision for control from a remote point and report back on the status of the equipment to that remote point, and circuits for the generation of test patterns and calibration signals used during maintenance or which may be initiated remotely.

### *Telephone Line Entries*

Now a word about what actually goes out to the telephone line. Each 1600th of a second, the storage tube output circuits either do or do not generate a pulse signifying the presence of a target in the elemental area under consideration. The sampling of all 64 range elements is completed about every 1/20th of a second. Square modulating waveforms 1/1600th of a second in length are used to control a 2000 cycle carrier and transmit target data, an 800 cycle timing signal, and a synchronizing signal signifying the start of each Slowed Down Video sweep. These signals are mixed in the appropriate proportions and are delivered directly to a single telephone line for transmission to the remote station.

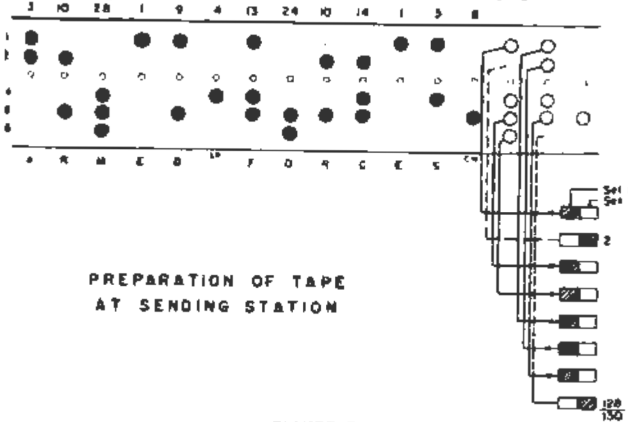
In conclusion I would like to mention the OA-947 Coordinate Data Monitor which is the indicator designed to display data received from the Slowed Down Video equipment. It contains all the circuitry necessary to demodulate the signals received from the telephone line and to reconstruct and display the PPI picture. Individual intensity control of target displays, range rings and north strobes are provided. In addition, other data may be displayed if desired. Over the indicator face, and normally stored at the top thereof, is a photo-electric light gun which may be positioned over any spot on the indicator and used to initiate the recording on adding machine tape of the range and azimuth coordinates of a target falling within its view.

The same type of modular construction for electronic circuits is used in this indicator as is used in the Slowed Down Video equipment. The door on the front of the equipment may be opened to expose the logic wiring. An inner door, consisting of the sub-racks housing the plug-in modules, may then be swung open to permit removal of any of the modules and also to provide access to the cathode-ray-tube-yoke drive. A back door provides access to power supplies.

Editor's note: Questions of security prevented the author from being more specific in some areas of this article.

## Telegraphic Data

(*Continued from page* 39)



PREPARATION OF TAPE AT SENDING STATION

FIGURE 7

ertain undesirable code combinations such as "blanks," which re deleted by some switching systems, and two consecutive "cariage returns" or "Figure Shift H," which are end-of-message sigals in some switching systems.

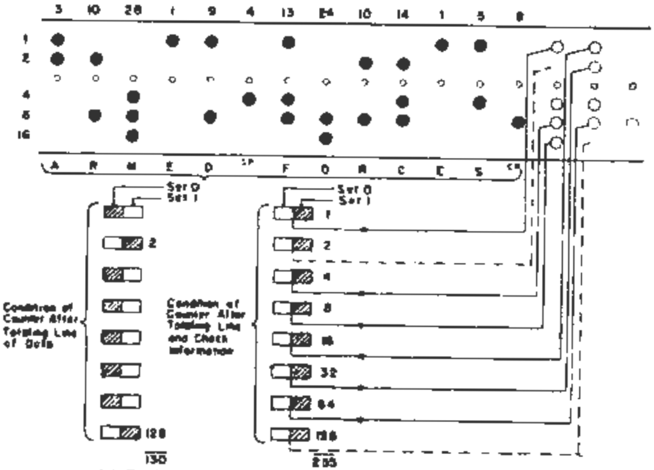
The carriage return is added after the two checking characters or control purposes, as will be explained later.

At the receiving end of the circuit, the sensing pins of the reperorator read the received characters into a binary counter. If no rror occurs in transmission, this counter should have the total of 130 for the line of text illustrated in Figure 8. Upon detecting he end-of-line signal, the receiving equipment directs the 8 bits ontaining the checking information into their respective stages of he counter. Since these 8 bits are the complement of the binary otal, every stage will be set to its "one" condition if there are no rrors. Any deviation from all stages being set to one, will indiate an error.

If no error is indicated, the transmitter receives a signal that auses it to send the next line of data. If an error is indicated, the ransmitter receives an "error" signal that causes it to back-step its ape to the "carriage return" code that terminated the checking haracters of the previous line of data. Then upon a "ready" signal from the receiving station, it repeats the errored line. Meanwhile, the reperforator back-steps its tape and at the same time over-punches with five holes each character in the errored line. When its sensing pins read the "carriage return" code that terminated the checking characters of the previous lines, it starts stepping its tape in the forward direction until it reaches unpunched tape, when it sends the "ready" signal to the sending station.

The binary total gives an extremely effective error detection system with low transmission redundancy. Its totaling of the values of a group of characters gives protection against the loss or repetition of complete characters. If an error is confined to one character in a line, it gives positive protection on errors that would be compensating in the parity or fixed ratio codes.

At the present time, EDIT is essentially for point-to-point communications. However, it is evident that it has possibilities for use on a complicated switching network for automatically detecting and correcting data transmission over each link of the system.



CHECKING AT RECEIVING STATION

FIGURE 8

# "re: *Your Signal of the 5th*..."

Some people still send communications one character at a time.

Others use DATAFAX—the fast Stewart-Warner electronic way to transmit all data over telephone lines.

*Datafax* transmits and records any material: correspondence, drawings, pictures, printed matter, even handwritten notes. And since copies are exact duplicate images of the original, chance for error is eliminated.

**Cost?**

Automatic transmission and recording eliminate need for full-time operator; recorders will even respond to transmissions sent after the office is closed for the day. Datafax also eliminates retyping, proofreading, intermediate handling, intransit delays—and their clerical costs. The clear, smudge-proof, permanent Datafax copy costs less than 2¢ for a letter-sized unit.

Chances are your operations have outgrown Primitive Communica
If so, you'll want to find out
Datafax. First, send for your
the free Datafax bulletin.
Stewart-Warner Electronics, Dep
1300 N. Kostner Ave., Chicago 5

STEWART SW WARNER ELECTRONI
a Division of Stewart-Warner Co

# photoprogress

by FRANK SMITH
**PHOTO EDITOR**
**SIGNAL**

### *High Intensity Mercury Arc Lamps*

News of an experimental development in lighting for night aerial photography which is creating no little interest in this field, is contained in a recent announcement of the Wright Air Development Center (WADC), Wright-Patterson Air Force Base, Ohio, which gives some details of the development. Present night photography systems use flash bombs or photoflash cartridges to provide intermittent light whereas the new method, developed by ARDC's Wright Air Development Center, utilizes a commercial type high-intensity mercury arc lamp to provide a narrow, directed beam of continuous light.

Although the active element (mercury arc) of the lamp is no larger than a cigarette, it provides adequate light for aerial photography. Excellent photographs have been obtained by Wright Air Development Center at various altitudes and speeds.

The lights are difficult to see from the ground because of their narrow beam and bluish hue. On an approaching aircraft, the light appears as a distant star to ground observers.

Standard flash bombs and cartridges produce a brilliant flash lasting only a fraction of a second, and dissipate light in all directions. Use of the mercury arc lamp enables Air Force reconnaissance aircraft to "sweep" light along the ground underneath the aircraft.

Air Force engineers in the Aerial Reconnaissance Laboratory at WADC pointed out that use of the light eliminates the need for heavy, bulky equipment used with pyrotechnic illuminants is much less expensive, and also safer, since no explosives are necessary.

In addition, the mission of a reconnaissance aircraft using the mercury arc lamp is limited only by the range of the aircraft and the amount of film carried.

The new method produces continual, constant-level light and works best with so-called aerial "strip" cameras which roll the film at a speed proportioned to the speed of the aircraft as it flies over the ground.

### *Lightweight Aerial Panoramic Camera*

A versatile lightweight panoramic camera developed by the Perkin-Elmer Corp., Norwalk, Conn. for wide-angle aerial photography is expected to give new impetus to commercial as well as military use of aerial photo reconnaissance. The new camera, designated the Model 501 Lightweight Tracking Camera, is designed for diverse applications in military operations and other fields requiring extremely wide-angle continuous aerial photographic coverage of terrain.

The camera employs rapid-scanning principles to obtain successive photographs covering 180 degrees from horizon-to-horizon across a plane's line of flight, with true velocity compensation throughout the scan. It is an automatic sequencing camera with sufficient film capacity for a complete mission, and it can be set for either adjacent or stereo-overlapping pictures. Operation can be automatic or manual (preset), and can be started and stopped by remote control of power.

The camera is designed for 1000 feet of 70mm film with built-in red and yellow filter for black-and-white film and clear for color film and uses only 10½ inches of film for each horizon-to-horizon picture. The camera has the high resolution of 40 lines/mm on high-speed film and operates on 28 volts, D.C. power.

It contains no shutter, exposures being made while moving the film over a slit in the camera. Thus, as the prism rotates, the image is "wiped" on the sensitized film. The time required for each scan is adjustable, and can be set as fast as ¼ second.

These three, small lights mounted in the nose of a C-47 test aircraft provide sufficient, continuous light for night aerial photography.

### *Sound Reproduction*

An interesting discovery which promises to have a significant effect on the foreign rescoring of Army training and other bi-lingual films, among many other possible uses, has been made by Mr. George Lewin, Chief of the Pictorial Engineering Office of the Army Pictorial Center, 35-11 35th Ave., Long Island City 1, N. Y.

Mr. Lewin has discovered that magnetic sound tracks on motion picture film, previously believed to be opaque, are reasonably transparent to infra-red "light." This means that it will no longer be necessary to resort to half-width tracks when combined photographic and magnetic tracks are required.

The discovery also has important implications for the entire motion picture industry, since producers of multi-magnetic track films can place a full-width rather than half-width photographic track on their prints, along with the magnetic tracks, so that the same prints may be run in the many theaters which are not equipped for magnetic sound, without sacrificing picture area as is presently necessary. It is now possible to superimpose a magnetic stripe completely covering the full-width photographic sound track and still obtain good quality reproduction from it, while at the same time using the magnetic stripe for an entirely independent recording. The result, which permits maximum fidelity of sound from the magnetic track and only a slight loss of volume from the photographic track, is immediately applicable to the familiar JAN portable motion picture projector, a standard item of military equipment. These JAN projectors employ a lead-sulfide photo-conductive cell which is infra-red sensitive. By adding magnetic facilities, it will be possible for the projector to reproduce the sound from either track, as desired.

However, it is anticipated that additional tests will be necessary before it can be safely assumed that this newly discovered transparency effect is a permanent and commercially feasible one. Since the effect depends entirely upon the infra-red transmission of the magnetic oxide and the infra-red sensitivity of the lead-sulfide cell, it will be necessary to study carefully the uniformity of both the oxide and the cells. Proper selection and control are expected to reduce the transmission loss, and may at the same time improve the quality of both the photographic and magnetic reproduction. Improved cells and more efficient infra-red "light" sources are also a distinct possibility.

In a personal communication to the writer, Mr. Lewin stated that the transmission loss is approximately 11 db at 400 cycles. At 7000 cycles there is an additional loss of from one to three db, which can be recovered by refocussing for infra-red.

### *"Photographic Science and Engineering"*

A new technical publication which has created great interest in scientific and engineering circles generally, and particularly those utilizing photography in some form or other, made its debut in July 1957 with the issuance of Volume 1, No. 1.

Entitled *Photographic Science and Engineering*, the new publication is a masterpiece of the editorial and publishing art and if the number of plaudits greeting its appearance is any criterion, it is certain to become a welcome addition to the very few publications covering the highly specialized field of photographic science and engineering. The new periodical which initially will be published quarterly, is the official journal of the recently formed Society of Photographic Scientists and Engineers which was created as a result of the union of the former Society of Photographic Engineers and the Technical Division of the Photographic Society of America. The new journal replaces the Society of Photographic Engineers' former official journal entitled *Photographic Engineering* and as such is dedicated to the advancement of the knowledge and application of photography and other directly related sciences.

The pages of the new journal are open to all who wish to report on new studies dealing with the theory of photosensitive systems, the design of photographic instrument and apparatus useful in the treatment of photographi materials, photographic optics and illuminants, the u of photography for scientific or engineering measureme or recording, and photographic instrumentation and dat recording.

The first issue of *Photographic Science and Enginee ing* is a publication of 44 pages with six excellent pape covering the broad field of the subject and two depa ments covering literature abstracts and new developme and patents. Later, it is planned to add a book review d partment which will cover pertinent books as they a published.

Inquiries concerning the publication should be a dressed to the Society of Photographic Scientists and E gineers, Box 1609, Main Post Office, Washington, D. C.

### *"Modern Applied Photography"*

Since we are on the subject of literature, particular that which applies to photographic science and enginee ing, it is pertinent that your attention be called to a vo ume of 162 pages just published by the Philosophical L brary, Inc., 15 East 40th Street, New York 16, N. Y.

Authored by G. A. Jones, a recognized expert on th subject of photographic instrumentation, *Modern Applie Photography* is a summary or outline, and a very goo one too, of the major applications of photography, and, stated by the author in the preface, is directed towar those not mainly concerned with the art or science of th subject. To that end, as far as possible, technical term have been omitted, though it has been assumed that th reader possesses a general knowledge of elementary ph tographic principles. In this book he draws upon his e perience to survey the scope of applied photography i most major branches of industry, emphasizing its value i research and investigation as well as in simple recordin All major modern techniques are explained, with the re sons underlying their uses broadly analyzed in terms the fundamental properties of light-sensitive photographi material. For the practical man, many examples are i cluded of applied photography in a wide variety of i dustries.

The book consists of 12 chapters, a bibliography an index, plus a list of plates of which there are 18. Som idea of its comprehensiveness may be gained from a pe usal of the chapter titles which include, "Photography A an Aid to Memory;" "Scientific Recording;" "Photog raphy by Dim and Bright Light;" "Recording of Color "Infra-Red Sensitivity;" "Ultra-Violet Photography; "Radiography;" "Atomic Particles;" "Recording an Analysis of Motion;" "Photography in Production," an "Photography as an Instructor."

Well written and technically authoritative, Jones' boo is certain to find wide acceptance as a brief but excelle outline on the subject of applied photography which re duced to its simplest terms is photographic instrumenta tion. Priced: $4.75.

### *"Wollensak Lens and Shutter Guide"*

Another recent arrival in the field of literature pertaining to the subject of photography, at least that part of it concerning lenses and shutters, is a small paper bound volume of some 126 pages entitled *Wollensak Lens and Shutter Guide*, published by Greenberg, 201 East 57th St., New York 22, N. Y.

As indicated by the title, the book covers Wollensak lenses and shutters plus a chapter on Wollensak high speed motion picture cameras and for the first time offers to the photographer who wants to know, a complete

(*Continued on page 48*)

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and fully illustrated guide to the lenses and shutters of th Wollensak Optical Co. The book deals with lenses an shutters in general and particularly covers lens aberr tions, lens construction, lens mounting, depth of fiel lens coverage, resolution, lens coating and cleaning, en larging lenses, image size, color, light and shutter sy chronization.

Particularly interesting is the chapter on Wollens high speed motion picture cameras which introduces so of the fundamentals of this fascinating art.

Though the book covers the products of only one man facturer, it is broad enough in its coverage to be of i terest to any one who desires to know more about the tw basic elements of any camera system. The book reflec great care in its preparation, is technically accurate, a thoritative and as complete as a book of its size could b It is well illustrated and priced $1.95.

### *SPSE 1957 Annual Technical Conference*

An event of great importance in the field of phot graphic science and engineering was the 1957 Annu Technical Conference of the Society of Photographic Sc entists and Engineers, held at the Hotel Berkeley-Carter Asbury Park, N. J., Sept. 9 to 13, 1957, with the coope ation of the U. S. Army Signal Engineering Laboratorie Fort Monmouth, N. J.

Brigadier General Earle F. Cook, Commanding t U. S. Army Signal Engineering Laboratories at Fort Mo mouth, N. J., delivered the welcoming address. Gener Cook discussed the newer concepts of military phot graphic requirements and the role that industry cou play in fulfilling the needs of the Department of the Arm in the photographic aspect of the combat surveillance pr gram.

During the conference, Dr. John Eggert, Director of t Photographic Institute at the Technical College in Zuric Switzerland, was awarded honorary membership by t Society in recognition of his contributions and achiev ments in the field of photographic science. Dr. Eggert technical paper, "Photographic Development in Theo and Practice," was well received and excited great inte est among his audience.

A representative cross section of other papers presente included "Multiflash Photography," by Dr. Harold Edgerton; "Airborne Photographic Processing," by C. Edwards, S. Schreck, and A. G. Hutchins; "Improvemen in Densitometry," by Albert J. Derr; "The Use of Ele tronic Image Intensification in Cinefluorography," by H. Tolan and J. L. DeClerk, and "The LogEtron—195 by Dwin R. Craig. Some 36 papers in all were presente covering many of the multitudinous facets of phot graphic science and engineering.

One of the most interesting features of the conferenc was the equipment exhibit which was unusually goo Some 20 exhibitors, including the U. S. Army Signal En gineering Laboratories at Fort Monmouth, N. J., di played their latest and most up-to-date development Bell and Howell Co. of Chicago, Ill., was easily the ex hibitor with the largest number of new equipments o display, having twelve altogether.

Some of their outstanding items included the new CBVM-JAN type 16mm magnetic television projector; th new 240 EE 16mm automatic threading electric eye cam era, and a 35mm and 16mm electric scoring camera, th latter with Globavision lens.

LogEtronics, Inc., exhibited their latest development o the LogEtronic printer with automatic dodging and auto matic exposure control. Zoomar, Inc., exhibited severa

/ the newest developments in lenses and their new 360 legree Panoramic Camera.

Foreign exhibitors also were on hand, among them eing Andre Debrie of France with the Aiglonne Model ) daylight-film developing machine which is available in 6mm and 35mm negative-positive, and 16mm reversal ypes. Canadian Applied Research, Ltd., of Canada, dislayed and demonstrated their Type T 246 Automatic Tri-Film Processor, the Type T 232 MK 8 Aerial Camera and he Type T 232 MK 7 Instrumentation Camera.

All the items displayed by the various exhibitors were ew and equally interesting but lack of space prevents even a short resume of them in this column. However, mention should be made of the excellent display of several ate photographic developments of the U. S. Army Signal Engineering Laboratories, chiefly among which was the Processing Machine, Photographic Film and Paper, EH-28( ) for forward area photographic processing. Technical information accompanying the display stated that the machine processes both film and paper in 70mm, 5" and 9½" widths and 200' long with full daylight operation. The machine utilizes the recently developed High Temperature Signal Corps Stabilization Process which was developed at the U. S. Army Signal Engineering Laboratories. The equipment is used with and is part of the Signal Corps Laboratory Darkroom, Semi-Automatic, Division Area. Speed of the machine is 2½' per min. for 9½" wide film, 5' per min. for 5" film and 15' per min. for 9⅜" paper.

The significance of this display indicates that military photographic processing is no longer a rear area operation but that it has moved right up to the combat area.

The Society plans to hold its next annual conference in October 1958 at Rochester, New York.

### *Flight Research, Inc.*

Flight Research, Inc., Richmond, Va., have announced a new 70mm missile-tracking camera, designated Multidata Model V. Specifically designed for missile tracking, the new camera provides greater magnification and higher resolution than that provided by cameras using smaller film sizes. The 70mm film used permits a 2¼" x 2¼" frame size which minimizes the effect of tracking error and helps keep the missile within the frame.

The camera accepts 400 or 1000 foot magazines and lenses are interchangeable. Other features of the camera include a timing system of two neon lights which provide visible coding on both edges of film for perfect correlation with time base; four lighted fiducial markers which indicate centerlines of aperture to within 0.001"; adjustable shutter from 0 degrees to 120 degrees, and automatic output pulse which indicates center of exposure at any shutter opening. As missiles go farther and faster, the larger field of view and greater magnification provided by 70mm film result in a great increase in tracking range and increase in detail that can be seen in fins, exhaust patterns, nose cone, missile attitude and other important aspects of the missile in flight.

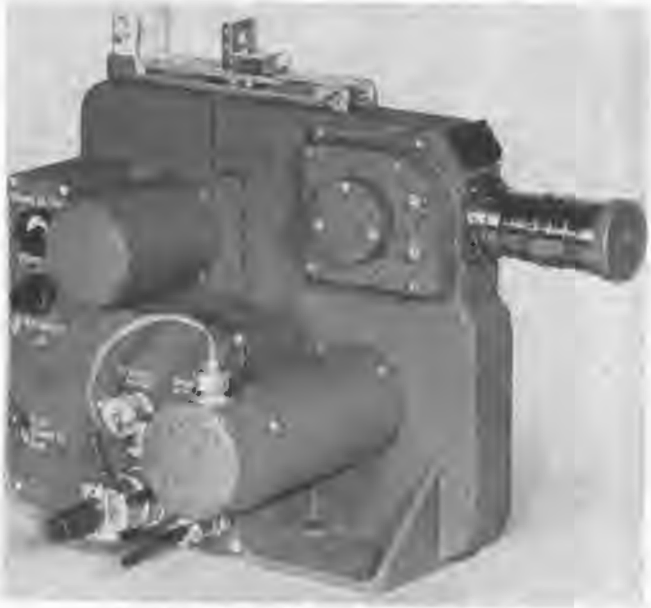
### *Fairchild Camera and Instrument Corp.*

From Fairchild Camera and Instrument Corp., Industrial Camera Division, Jamaica, N. Y. comes news of a new 16mm motion analysis camera, Model HS-401. With its interchangeable motors it provides picture taking rates of 10 to 80 p.p.s.—25 to 300 p.p.s.—200 to 1500 p.p.s.—500 to 2500 p.p.s. and 800 to 6000 p.p.s.

The manufacturer states that although the camera weighs only 24 lbs. with its double motor set, it is really a lightweight and produces clear, smear-free and jitterless pictures at all speeds. It is delivered with your choice of 13mm, 75mm, 102mm, or 152mm lens, and can be used with the Fairchild battery pack at speeds up to 4500 p.p.s. Its motors, lenses and auxiliary equipment are interchangeable with the HS-100 and HS-101 models.

The camera is provided with an open sight which features focal length and parallax correction. A boresight slips easily into the port on the camera. Size of camera (with 75mm lens) is 9" x 13¼" x 16-13/16".

Features of the camera include dynamic and electromagnetic braking which provide maximum efficiency in rapid start-stop applications. This permits repeated short bursts at all speeds up to 6000 pictures per second.



Fairchild HS-401 Motion Analysis Camera

### *Photographic Instrumentation Developments*

Developments in this field seem to have been accelerated during the past two months due no doubt to the recent annual (September) technical conference of the newly formed Society of Photographic Scientists and Engineers and the 82nd October convention of the Society of Motion Picture and Television Engineers.

During the above period, one of the leaders in this field, the Wollensak Optical Co., Rochester, N. Y. announced several new items chief among which is their new TL 35 time lapse camera.

The TL 35 is a data recording time lapse camera designed to photograph panels, meters, gauges, instruments, mechanical devices, etc. for time study and sequence analysis of movement. Each exposure is made at a predetermined interval depending upon the motor used of which there are many available to obtain various time lapse intervals from one picture every six seconds to one picture every 30 minutes.

The camera uses 35mm film (picture format 23.8mm x 25.4mm) wound on 50 foot daylight loading spools. It is equipped with a Wollensak Amaton 35mm f/3.5 lens, a No. 0 Alphax shutter and 6-volt D.C. motor using 0.1 amperes. Dimensions of the camera are 6½" x 4-13/16" x 2-27/32" and weighs 2½ lbs. Accessories such as a finder, terminal block, footage counter, etc., can be supplied.

In addition to the above, Woolensak has announced their new Model WF-17 16mm 100-foot picture Oscillo

(Continued on next page)

# SIC . . . why is it? what does it do? who does it affect?

**William F. E. Long, Manager, Marketing Data Dept. E. I. A.**

THE STANDARD INDUSTRIAL CLASSIFICATION (SIC) is the system by which the Federal Government defines the American economy in terms of 1,100 groups of industries and sub-industries for the purpose of gathering data to be used as the basis of legislative, fiscal, mobilization and other policy decisions. Thus explained, it is obvious that SIC is vital to management, labor and Government. And SIC which does not give proper recognition to an industry can result in serious damage to that industry as, for example, through unwise tax policy (due to the lack of good official Government statistics) or through a disproportionate allocation of scarce materials. To labor, SIC can mean a real loss or gain in the pay envelope through Walsh-Healey determinations, Social Security benefits, etc.

Because SIC is one of the most important foundations of Government policy, the Bureau of the Budget, which has the responsibility for maintaining SIC, about five years ago began to work on a revision of the classification, to make it more representative of our dynamic and rapidly changing economy. An unprecedented undertaking resulted, consuming the time of hundreds of businessmen, and many man-years of Government effort.

Thirty-five industry committees made 2,500 recommendations to the Technical Committee on Standard Industrial Classification in the Office of Statistical Standards of the Bureau of the Budget, Executive Office of the President. The Technical Committee acted on recommendations in accordance with the following principles:

(1) SIC should conform to the existing structure of American industry. For the purposes of the SIC, the structure is separated into a number of divisions, such as Agriculture, Mining, Construction, Transportation, Communication, Wholesale and Retail Trade, et cetera, in addition to Manufacturing.

(2) The classifications should be based on the characteristics of plants rather than companies.

(3) Each plant should be classified in that industry which describes its major product.

(4) To be recognized as an industry, each group
plants must be "significant" from the standpoi
of the number of persons employed, volume
business, and other important economic featu
such as the number of establishments.

In view of the above principles, it is difficult to und
stand some decisions of the Technical Committee. F
example, Electronic Industries form an important p
of the existing structure of American industry. They
the fifth largest industry group. Yet, in the SIC, El
tronic Industries are not recognized as a major 2-di
industry, such as Major Group 36, "Electrical Machine
Equipment, and Supplies." On the contrary, Electro
Industries, whose fruits affect our lives through televisi
industrial controls, electronic computers, missiles a
hundreds of other products, are concealed and buri
within the Electrical Machinery Industry Group wh
they resemble about as much as the airplane resembl
the kite.

However, some gains were registered in the 1957 e
tion of Standard Industrial Classification Manual over t
1945 edition which it replaced. Electronic Compone
and Accessories were given a 3-digit industry gro
(367) and two other 3-digit groups—365 and 366—we
established. This compares with one—366—in the 19
edition. Unfortunately, the titles are not properly descri
tive, and a number of important activities of plants in t
electronic industries are to be found elsewhere in t
structure. Furthermore, while the Electronics Industri
plants account for more than half of the employment
Major Group 36, they were given only three 3-dig
groups compared with five for the establishments produ
ing such products as switchgear, motors, generators, se
ing machines, and lighting fixtures. It is not too early f
the members of the electronic and communication equi
ment industries to begin to develop an adequate Standa
Industrial Classification for the next edition.

* * *

## PHOTOPROGRESS

Fastax high speed camera which enables one to record photographically combined picture and oscillo recording of an event where electrical and mechanical data are desired. The camera can also be used for either picture or oscillographic recording independently of each other.

Camera speed is from 150 to 8000 p.p.s. (5 ft. per second to 200 ft. per second). Two lenses are furnished, both of which are 50mm f/2 Fastax raptars in focusing mounts, one of which is for the picture image and the other for the oscillograph trace which is recorded simultaneously with the picture record. The camera is furnished with integral viewfinders and removable reflex finders and timing light.

Two motors are furnished (115 volt AC-DC 60 cycle), one for drive and one for take-up. Size of the camera is 12" x 12" x 12" and the weight is 25 lbs. Price is $2250.00.

### *The Konica Hand-Held Aerial Camera*

A new hand-held aerial camera of Japanese origin h
been announced by the Konica Camera Co., 76 We
Chelten Ave., Philadelphia 44, Pa.

The camera is a precision, spring-driven fast shooti
aerial camera for spotting or general aerial photograph
The spring-drive permits 10 successive exposures with
15 seconds with a single click of the release button. Th
camera may be equipped either with a Hexanon f/3.
135mm or a Hexanon f/3.5 85mm lens. Aperture stop
are f/3.5, f/4, f/5.6, f/8, f/11, f/16 and f/22. Shutte
speeds are 1/50th, 1/100th, 1/200th and 1/400th second

The camera uses standard 120 roll film and produces
picture 2¼" x 2¼" in size and is equipped with a sport
type finder with framed prism and cross hairs etched i
prism with center marker for level alignment.

The camera with lens weighs 6 lbs. Overall size is 9¾"
x 6¾" x 6". List price $650.00.

* * *

**parrow I**

(Continued from page 15)

*actured* at reasonable costs on a chedule which meets Navy requirenents. As a result of the achievenents on this program, the U.S. Vavy's supersonic Sparrow I air-toir guided missile system is now in combat-ready status. Squadrons of he Navy's operational jet interceptors armed with the missiles are de*loyed* on carriers in both Atlantic nd Pacific Fleets. Other Sparrow I nissiles are operational with allveather squadrons of the U.S. Maines at shore bases. The Sperry parrow I now is on guard day and ight around the world for Naval fleet nits and shore installations.

### *Sparrow Accuracy*

United States Navy and Marine ilots have demonstrated the high eliability and deadly accuracy of the Sperry Sparrow I Weapon System y hundreds of missile launchings gainst target drones. The lethal warhead has blasted out of the sky all types of targets including highspeed jet aircraft and missiles.

The Sparrow I guided missile system is undoubtedly the most versatile weapon used for arming Naval aircraft. Previously, attacking enemy aircraft might have escaped detection by operating under conditions of poor visibility or by cloud screening. Now, the Sparrow I guidance system can aim the missile directly at the target in spite of the inability of the pilot "to see;" destruction of the enemy aircraft by the lethal warhead is assured. Versatility of the Sparrow I Weapon System has been proven by effective attacks against high and lowaltitude targets flying either singly or in groups.

### *R&D Pays Off*

The present readiness of the fleet with this highly reliable and effective air-to-air missile system results from years of intensive development by the Navy's Bureau of Aeronautics and Air Missile Test Center, and the Sperry Gyroscope Company. The delivery of Sparrow I missiles in production quantities to fill the magazines of aircraft carriers with this "new type of ammunition" is a result of proficient plant operation with exceptional quality control at the Sperry Farragut Company. This competent human effort directed by the National Defense authorities has produced a weapon that is a powerful deterrent against a surprise atack by enemy aircraft.

# Association affairs

## Honor Graduate Awards

Eleven officers graduating with top honors at the United States Army Signal School were recently presented the AFCEA Award for outstanding achievement.

Highest percentiles in the Signal Officer basic course were held by the following:

Section 751 — Second Lieutenant Robert E. Hill, 212 N. Broadway, Hobart, Okla. EE, U. of Oklahoma.

Section 752 — Second Lieutenant Stuart K. Yuill, Box 404, Rt. #1, Lanham, Md. EE, Johns Hopkins U.

Section 753 — Second Lieutenant Ward R. Kelley of 3009 S.E. Rex, Portland, Ore. ME, Oregon State College.

Section 754 — Second Lieutenant Thomas K. Batson of 1308 Second Ave., Bessemer, Ala. CE, Alabama Polytechnic Institute.

Section 755 — Second Lieutenant Paul D. Carmichael, Jr., 368 Burton Ave., Washington, Penna. EE, Carnegie Institute of Technology.

Section 756 — First Lieutenant Richard V. Morris of 9 Evergreen Ave., Bedford, Mass. EE, Rensselaer Polytechnic Institute.

Section 757 — Second Lieutenant John R. Cummings, 21 Chestnut St., Westfield, N. Y. EE, Rensselaer Polytechnic Institute.

Section 758 — Second Lieutenant Robert S. Lowrey, Jr., RFD 1, Rome, Ga. Animal Husbandry, U. of Georgia.

Section 701 — Second Lieutenant George C. Smolenyak, 697 Brookside Rd., Rahway, N. J. Natural Sciences, Seton Hall U.

Section 702 — Second Lieutenant Charles R. Pendred, 4525 Cooper Ave., Merchantville, N. J. EE, U. of Pennsylvania.

Section 703 — Second Lieutenant Leon P. VanSpeybroeck, 253 N. Madison, Wichita, Kans. Physics, Massachusetts Institute of Technology.

The Signal Officer bas[illegible]se p
vides basic branch trainin[illegible] new
commissioned officers. It [illegible] desig
to give a working knowledge of
duties and responsibilities which
officers may expect during their ea
service with the Signal Corps.

Captain Carl Dennis of 604 E
Main Street, Benton, Illinois, a
Captain George M. Best, 105 Ma
son Avenue, Walsenburg, Colora
Section 302, took high hon
academically in the Signal Compa
Officer Course (Branch Transferee
The course is designed to prov
branch training to officers so th
will be thoroughly grounded in
duties and responsibilities approp
ate to company grade Signal Co
officers.

First Lieutenant Edmund J. Cre
er, Jr., 616 East 29th Street, Ba
more, Maryland, from Section 37
of the Electronic Warfare Offi
Course, took top academic hon
This course trains officers to dir
and supervise electronic coun
measures activities.

First Lieutenant Lawrence
Davis, 851 Brill Street, Philadelph
Pennsylvania, took high honors
Section 502 of the Field Grade (
ficer Refresher Course. This cou
provides refresher training in tacti
techniques and material appropri
to Signal Corps company and fi
grade reserve component officers.

## AFCEA's New Group Member

The AFCEA recently welcom
Stoddart Aircraft Radio Co., Inc.,
Hollywood, Calif., a firm which de
with electronics research and d
velopment, and the manufacturing
radio interference and field intensi
measuring equipment.

Members of the firm who will
company representatives in AFCE
are: Richard R. Stoddart, presiden
John R. Stevenson, administrati
as 't.; J. D. Nightingale, personn
manager; Alfred T. Parker, chief e
gineer; Donald S. Radmacher, ass
chief engineer; Gerald O. Essex, sta
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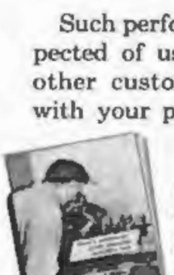

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# Chapter News

*Atlanta*—Fort McPherson Officers' Club was the scene of the chapter's September 24th meeting. Photo at left shows Lt. Col. Don Adams, chapter president, awarding a past president's pin to Charles M. Eberhart, 1956-57 president. At right, Southern Bell Telephone Telegraph Company hostesses Hazel Hill (left) and Ruby Terry pin a name badge on Dr. Robert N. Lehrer of Georgia Tech, guest spe while President Adams looks on.

### *Atlanta*

Opening meeting of the fall season took place at the Fort McPherson Officers' Club on September 24th, with 162 members and guests in attendance. Featured speaker was Dr. Robert N. Lehrer of the Georgia Institute of Technology who presented an illustrated lecture and a film on "Data Processing."

During the business session, Lt. Col. Donald L. Adams, chapter president, formally presented the past president's pin, an AFCEA gold lapel button, to Charles M. Eberhart, who had headed the chapter during the past year.

President Adams introduced the new chairmen appointed for the various phases of chapter activity as follows: membership—John W. Owen, Southern Bell Telephone and Telegraph Co.; program—W. O. McDowell, Southern Bell; reception—Lt. Thomas A. Pugh, Third Army Headquarters; civil defense—J. S. Bonner, Southern Bell; publicity—Clack Tucker, Southern Bell. The new secretary-treasurer, A. M. "Gus" Wilson of Southern Bell, was also introduced.

An additional feature of the evening was a program of entertainment presented by the Third Army's Special Service Section.

The chapter's next meeting will be held on November 19th, with a scientist from the Naval Research Laboratory conducting a special program on the earth satellite.

### *Baltimore*

Capt. Leslie M. Slack, U. S. Navy, Bureau of Ordnance, Navy Systems Director, Surface Weapons Systems, conducted a program on shipboard guided missiles at the chapter's first meeting of 1957-58 at the Park Plaza Hotel.

Captain Slack, who was the officer in charge of the first Navy guided missile unit, presented an authoritative discussion, illustrated by motion and slide pictures, of some of the Navy's guided missiles, their handling and launching, and computer functions as
the missiles track down and dest
their targets. In addition, John R
roth, Captain Slack's civilian assist
showed a film describing the prod
tion, installation and testing of
"Terrior" Weapons System.

Prior to the program feature, C
V. E. Day, commandant of the
Coast Guard Yard, displayed a ph
graph of the Navy MSTS Task Fo
which had completed a third sum
of activity in a strait in the Arctic w
may become an escape route for
sels trapped above Point Barrow d
ing the winter. Captain Day repor
that three Coast Guard vessels had
cently completed this route thus
coming the first vessels to circu
navigate the North American con
ent.

Chapter president Henry B. Y
brough officiated at the meeting
outlined plans for the year's activiti

*Baltimore*—Shown at the opening meeting of the fall season on September 17th are, left to right: Rear Adm. George J. King, Bendix Radio; Capt. Leslie M. Slack, USN, principal speaker of the evening; Chapter President Henry B. Yarbrough; Leroy D. Kiley, Bendix-Friez; and George C. Ruehl, Jr., AFCEA Regional Vice President.

### *Boston*

The senior Service commanders
the New England area were hono
at the "kickoff" meeting of the
season. Held on September 12th,
meeting took place at the Commission
Officers Mess, Boston Naval Shipya

The commanders were: Rear Ad
John A. Snackenberg, USN, Comma
dant First Naval District; Maj. G
William M. Morgan, USAF, Co
mander Air Force Cambridge Resear
Center; Rear Adm. Edwin J. Rola
USCG, Commander First Coast Gu
District; Maj. Gen. Sidney C. Woote
USA, Commanding General F
Devens, and Rear Adm. William
Howard, Jr., USN, Commander Bost
Naval Shipyard, host to the chapter.

A brief review of the activities of h
command was given by each of t
honored guests. Col. Murray D. Harri
PMST at Northeastern University, pr
sided as the new president of the Bo
ton Chapter.

# top team on TWT's

*Advanced wave tube design being discussed at Varian by Jack Ruetz, Monty Rogers, Willis Yocom, John Sullivan and Wells Dodds.*

Traveling-wave tubes, as any of the men above will tell you, are slated for an important place in the world of electronics. And these men, backed by Varian know-how, are out to assure the fullest possible realization of the wave tube's promising future.

With one of the industry's most competent wave tube development groups, Varian is geared to meet a wide range of difficult challenges in its field . . . applying to newer systems problems the same know-how and teamwork that just a few years ago established Varian's leadership in klystrons.

Many new ideas and applications are on the way, to back up the success of tubes like the VA-121 and VA-161 shown here. The entire Varian wave tube team is ready to go to work for you, to shape up a wave tube application or come up with the answers you've been looking for. Write or call your Varian representative or Varian's Application Engineering Department.

**VA-121** ***traveling-wave amplifier***-synchrodyne or serrodyne driver for high power S-band pulse applications. Performs to detailed specifications of phase and amplitude stability to meet the stringent requirements of phase-coherent MTI radar systems.

| | |
|---|---|
| Power Output | 25-40 watts |
| Saturation Gain | 30 db min. |
| Duty Cycle | .01 max. |
| Beam Voltage | 2250 volts |
| Grid Pulse Voltage | + 27 volts |

**VA-161** ***backward wave oscillator*** for use in tunable radar local oscillator, countermeasure and bench and test applications. In the frequency range from 8.2 to 12.4 kMc.

| | |
|---|---|
| Power Output | 30 to 120 mW |
| Anode Voltage | 150 to 600 volts |

Permanent Magnet
Size: 4⅛ x 5 x 6½ inches
Weight: Approx. 6 lbs.

*THE MARK OF LEADERSHIP*

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*KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES*

### Dayton-Wright

Committee chairmen have been appointed as follows to direct the various phases of chapter activity:

Willis K. Sutton, Summers Gyroscope Co.—membership; Jack Kinnally, Philco Corp.—publicity; John Wilkinson, American Phenolic Corp.—meetings; Harry C. Blackburn, Sylvania Electric Products—rules; Henry Taylor—budget; James J. Magill, Westinghouse Electric Corp.—arrangements.

### Fort Monmouth

William H. Foster, Associate Director of Research for the Philco Corporation was guest speaker September 19th at the opening dinner-meeting of the 1957-1958 season.

His talk, "An Aspect of Infra-Red," was made before a large audience of members and their guests in the Sapphire Room at Gibbs Hall Officers Club. The meeting was presided over by the chapter's new president, Halsey F. Hubbard of the U.S. Army Signal Equipment Support Agency. Mr. Hubbard succeeds Colonel Olin L. Bell, who left Fort Monmouth last July to take over a new assignment in Washington.

**Fort Monmouth**—Newly installed president of the chapter, Halsey F. Hubbard (left) is pictured with Maj. Gen. George L. Van Deusen, USA (Ret.), at the September 19th meeting.

Several other chapter officers took over their duties at the meeting. They were Colonel A. L. Burke, first vice president; Norman Freeman, second vice president; Harry C. Ross, secretary; and Miss Margaret Manuel, treasurer. Colonel Robert P. Haffa, Director of Evans Signal Laboratory, is the new chairman of the membership committee.

**Boston**—The chapter's September 12th meeting took place at the Boston Naval Shipy Pointing out anchor chain links used on the "U. S. S. Forrestal" is host Rear Adm. Willia Howard, Jr., commander of the shipyard. Looking on, left to right, are: Rear Adm. Joh Snackenberg, USN; Maj. Gen. William M. Morgan, USAF; Fred E. Moran, past cha president; Rear Adm. Edwin J. Roland, USCG; Maj. Gen. Sidney C. Wooten, USA, Col. Murray D. Harris, USA, chapter president.

### Gulf Coast

The program for the chapter's September 9th meeting was presented by Roy Woodhouse of Bendix, who showed and discussed scenic slides taken in Alaska and described some of the problems of installing and maintaining equipment in the Far North.

The meeting was held at Gus Stevens Restaurant in Biloxi with Ancil Z. Arseneau, chapter president, presiding.

### Kansas City

The earth satellite was the subject of the chapter's September 20th meeting, with N. Whitney Matthews of the Naval Research Laboratory conducting the program.

Mr. Matthews' talk, illustrated with slides, detailed technical information covering electronic developments of the proposed satellite. Also displayed to the group was a miniaturized, transistorized 48 channel encoder which Mr. Matthews had designed and built. Included in the talk was data for "hams" in the audience who were interested in attempting to receive signals direct from the satellite.

A number of officers and directors of the Astronomy Society of Kansas City were guests of the chapter.

At the conclusion of the meeting, Chapter President Don Meserve acc panied Mr. Matthews to Station WD TV where the latter was interviewed "The Closer Look" news program.

### Louisiana

Col. W. J. Given, Officer of C Defense, State of Louisiana, spoke "The Problems of Communication Pl ning for the State of Louisiana" a chapter meeting held at the Naval Station, New Orleans, on August

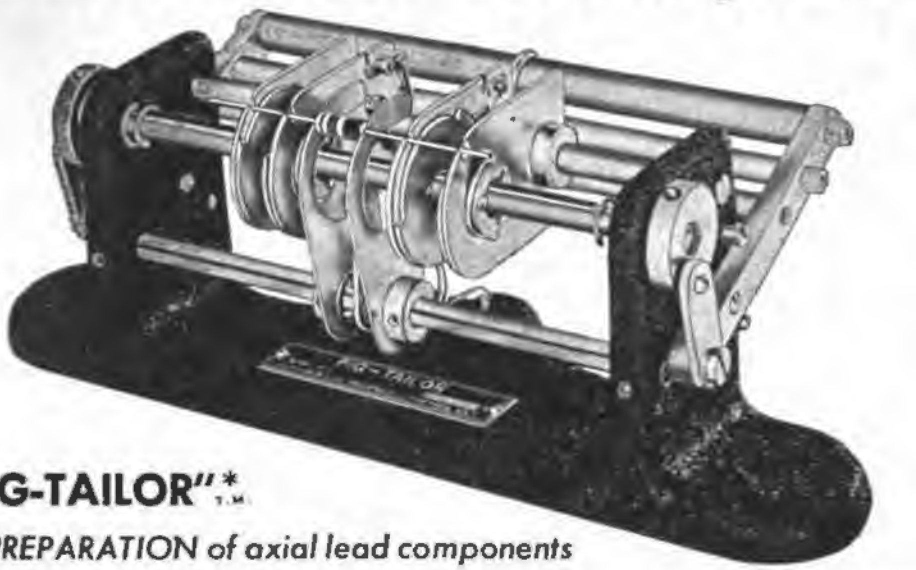
Guests of the chapter were: William P. Gardiner, Director, Bo of Health; Col. James A. More Deputy State Director, Selective S ice; Father Carl Schutten, Pastor, James Major Church; Lt. Col. John Jones, Deputy Director, 8th Mar Corps Reserve and Recruitment I trict; Lt. Hugh J. Leblanc, Commu cations Officer, 8th Coast Guard I trict; Father Frank Benedetto, Ch man, Physics Department, Loyola U versity of the South, and Brig. G Francis A. Woofley, USA (Ret.).

### New York

The initial fall meeting was h at the New York Naval Shipya Brooklyn, on September 18th. Prior the start of the meeting, the memb and guests were conducted through Electronic Section of the Material La ratories. They saw many of the ela rate and sensitive test equipments us

**Louisiana**—Head table at the August meeting held at the Naval Air Station. Left to right are: Lt. Col. John H. Jones, 8th Marine Cor Reserve & Recruitment District; Lt. Hugh J. LeBlanc, communications officer, 8th Coast Guard District; Fr. Frank Benedetto, Loyola Un versity, chapter vice pres.; Col. W. J. Given, State Civil Defense, principal speaker; Brig. Gen. Francis A. Woofley, USA (Ret.); Chapt President Charles Pearson, Jr., Southern Bell; Fr. Carl Schutten, pastor, St. James Major Church; Col. James A. Moreau, State Selective Servic Dr. William P. Gardiner, New Orleans Board of Health; Bruce Hay, Southern Bell, chapter secretary.

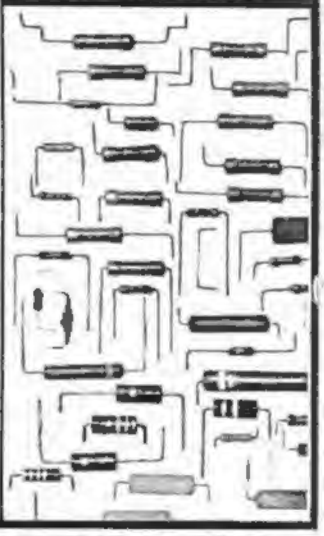
# PROVEN-on the assembly line!



**"PIG-TAILOR"** $^{*}_{T.M.}$

*For PREPARATION of axial lead components*

**PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"**



# "PIG-TAILORING"

***. . . a revolutionary new mechanical process for higher roduction at lower costs. Fastest PREPARATION and ASSEMBLY f Resistors, Capacitors, Diodes and all other axial lead omponents for TERMINAL BOARDS, PRINTED CIRCUITS and INIATURIZED ASSEMBLIES.***

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

**PIG-TAILORING provides:**

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
0. Immediate cost recovery.

**PIG-TAILORING eliminates:**

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

**"SPIN-PIN"** $^{*}_{T.M.}$

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

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ENDING

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DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
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***Northeastern University***—Members of the student chapter are shown with Superintendent Albert L. O'Banion of the Boston Fire Department who explains the operation of an automatic fire alarm recording device. Looking on, left to right, are: Cadet 2nd Lt. Edward O'Keefe, Cadet 2nd Lt. Thomas King, Jr., Cadet 1st Lt. Wilfred Picard, Bill Regan, Cadet Capt. Joel Chase, and Maj. Fred J. Frank, chapter advisor.

by the Navy to test electronic components and other apparatus to verify that they meet specifications and reliability requirements.

The new aircraft carrier "Independence," presently under construction, was visited as well as the site of the new "Constellation" whose construction will be soon started.

Rear Admiral Leslie A. Kniskern, Commandant of the N.Y. Naval Shipyard, welcomed the chapter members at the dinner-meeting which started after the completion of the inspection tour.

Rear Admiral F. R. Furth, AFCEA national president, and other guests at the head table were introduced by chapter president Benjamin H. Oliver, Jr.

The guest speaker of the evening was Mr. R. J. Rhael of the Naval Material Laboratories who spoke on "Precision Navigation." He discussed the various factors which affect a ship's navigation system and the need of developing a precise navigation system that would be independent of weather, radio, magnetic influences, etc. Ballistic missiles require such systems of which inertial navigation is the heart.

## *Northeastern University*

The following activities were scheduled for the September—November term of Division A:

Sept 11—orientation meeting, film: "Challenge of Outer Space;" Sept 13—special meeting for friends of AFCEA, movies and refreshments; Sept. 18—field trip to Fire Alarm Control Center; Sept 25—lecture-demonstration on Earth Satellite; Oct. 2—films: "Tale of Two Cities" (atomic bombing of Hiroshima and Nagas and "Weapons of Artillery;" Oct. helicopter flights and tour of B Harbor; Oct. 16—nominations office, film: "This is Your Army;" 23—field trip to Station WBZ-TV; 30—elections, group discussions, for annual convention.

The chapter is already at work motion picture production for 195 Ed O'Keefe and Tom King took m of the presentation of the Cadet gade to Dr. Carl S. Ell, Preside Northeastern, and the film was use Station WBZ-TV on its news pro

A special brochure, issued to men to acquaint them with the ter's activities, has resulted in a number of new AFCEA membe Northeastern.

***Scott-St. Louis***—A Western Union program featured the October 4th meeting. The g pictured above includes twelve Western Union representatives at the meeting. Seated, to right: Col. William D. Cairnes, commander, 1405th Air Base Wing (MATS); Perry man, Dallas; George Trapp, Chicago; Paul H. Greer, New York, principal speaker; Rob Dierkes, New York; Col. Charles W. Gordon, chapter president; Harry E. Vermillion Louis. Standing, left to right: Dwight E. Morga, Thurston P. Anderson, G. P. Short, Jame Blain, W. J. Abram, T. Lew Moore and Jay R. Riggs, all from St. Louis.

## *Philadelphia*

Chapter officers elected to serv the 1957-58 term are:

President—J. B. Henry, Internat Resistance Company. Vice preside Colonel E. L. Littell, USA (USASS Captain H. W. Englund, USN; R Wickes, Wickes Engineering & struction Co.; F. O. Ziegler, Radio poration of America; F. D. Langstr Philco Corporation. Secretary—R. Halberstadt, The Bell Telephone C pany of Pennsylvania. Treasurer H. Armstrong, Radio Condenser C pany.

## *Rome-Utica*

The chapter's September 18th m ing was reported in the Rome D Sentinel as follows:

" 'Old Days of Radio' was the subj of Harry Sadenwater, Radio Engin ing Laboratories, Inc., who spoke night before the Rome-Utica chapter the Armed Forces Communications Electronics Association.

"Meetings at the Griffis AFB Offi Club, the group heard Sadenwater cuss radio highlights, beginning w 1908 when, as an amateur, he thrilled to transmit a message and th walk to the receiving station a m away to see if the message had be received.

***South Carolina***—"Earth Satellite for Geophysical Studies" was the subject of a Bendix Radio Presentation at the September 19th meeting held at Shaw Air Force Base. Shown, left to right, are: Brig. Gen. Stephen B. Mack, Commander of Shaw Air Force Base, host for the meeting; Cdr. Harry C. Rodin, USN, chapter president, and Ernest A. Duquet of Bendix Radio who conducted the program.

## CHAPTER NEWS

"Mr. Sadenwater was one of 105 members of the Institute of Radio Engineers when it was formed in 1912. The IRE now has more than 40,000 members.

"In 1915 Sadenwater and Maj. Gen. David Sarnoff, now of RCA, were wireless inspectors. Sadenwater pointed out the importance of communications even in those days of experimentation. At that time they, as inspectors, would not permit a ship to sail until satisfactory communication was established. If a ship sailed without satisfactory communication, the captain would be fined $5,000.

"A major step in wireless communications was accomplished in 1916, he said, when John F. Grinan, a sugar planter of Jamaica and at that time a radio inspector, sent and received a coast-to-coast message in 24 hours.

"The year 1919 saw the forerunner of the first aircraft navigation wireless flight across the Atlantic, Sadenwater related. He was in one of three Navy planes which took off from Rockway Beach Naval Air Station, N. Y., for Plymouth, England.

"To aid with navigation, receive advance weather reports and assist if necessary with 61 destroyers, five battleships, four supply ships and four seaplane tenders spaced at 50-mile intervals. One of the three planes completed the trip. Sadenwater's plane sank off the Azores.

"For his participation in the advancement of aircraft wireless navigation across the Atlantic, he was awarded the Navy Cross and the Order of the Tower and Sword. Sadenwater has been with Radio Engineering Laboratories since 1947, working with some of the first tropospheric scatter developments."

### *San Francisco*

The chapter's annual Ladies' Night meeting, held on September 27th at the Fort Mason Officers Club, enjoyed its traditional success.

The evening was devoted to a social hour, steak or seafood dinner, and dancing into the late hours.

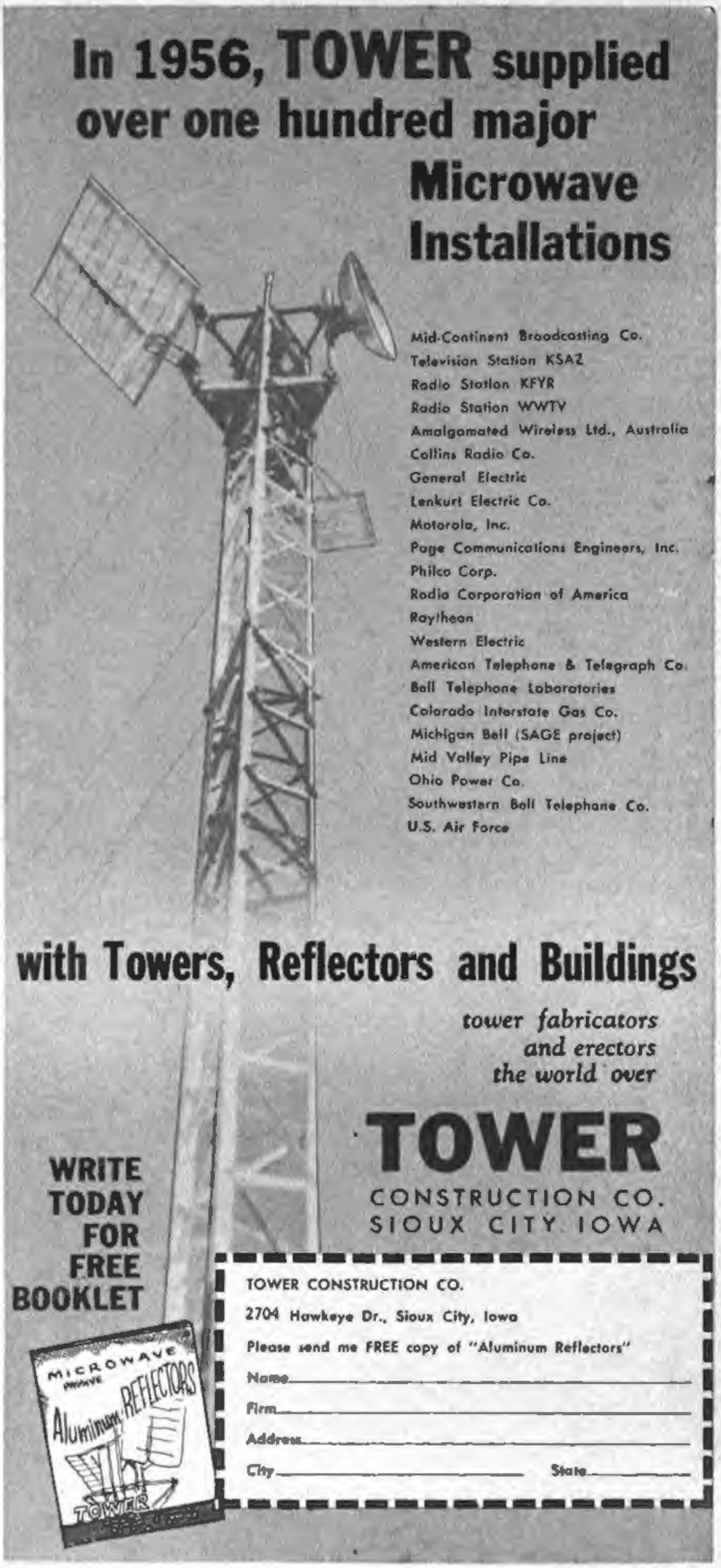
### *Scott-St. Louis*

The U.S. Naval Air Station in St. Louis was host to the chapter for its first meeting of the fall on September 6th. Members and guests were welcomed to the Station by Commander Thornton on behalf of Capt. Clayton L. Miller, the commanding officer.

The program commenced with a conducted tour of the facilities of the Station and those of the tenant CAA Control Tower. This was followed by a social hour and dinner at the BOQ.

Principal speaker of the evening was Rear Admiral Joseph N. Wenger, USN, Deputy Director for Communications-Electronics, Joint Staff, whose subject was the importance of teamwork—within the Services and between the Services and industry—in the fields of communications and electronics.

On October 4th, the chapter met at



*Southern California*—Chapter officials are shown with James M. Bridges, Dire Electronics, Office of the Assistant Secretary of Defense, who addressed a recent in Los Angeles. Left to right: Richard Fuller, Bendix-Pacific, director; Lester R. Daniels Engineering, Inc., president; Mr. Bridges; C. A. LaHar, RCA, director; an Adm. Charles F. Horne, Convair, director.

Augustine's in Belleville and heard Paul H. Greer, Assistant Director for Private Wire Service and Facsimile, Western Union Telegraph Company, New York, discussed "Facsimilie, Today and Tomorrow."

Mr. Greer's talk, supplemented with slides, concerned both military and industrial applications and installations of facsimile equipment. In addition, he reviewed the history of facsimile, its speed and degree of advancement to the present day, and the forecast of expectations for its future.

Harry E. Vermillion, Operating Superintendent, Western Union, St. Louis, introduced Mr. Greer to the group. Other Western Union representatives were guests of the chapter as follows: Robert F. Dierkes, New York; Perry Norman, Dallas, and George Trapp, Chicago.

### South Carolina

The chapter held its first meeting of the 1957-58 year at Shaw Air Force Base on September 19th, with over 125 in attendance.

The program, "Earth Satellite for Geophysical Studies," was presented by Ernest A. Duquet of Bendix Radio Division of Bendix Aviation Corporation. Mr. Duquet described the satellite in flight from its launching to its self-destruction. He also discussed Minitrack, the radio tracking system for which Bendix produces the ground receiving components.

Brigadier General Stephen B. Mack, Commander of Shaw Air Force Base, was host for the meeting. Commander Harry C. Rodin of the Charleston Naval Shipyard, who is president of the chapter, arranged the program.

The Charleston subsection of the IRE met with the chapter.

### South Texas

The chapter opened the fall season with a dinner-meeting at Randolph Field Officers Club on October 3rd. Some one hundred members and guests were present.

"High Fidelity" was the subject of a program presented by the Southwest Radio and Sound Equipment Company. Representatives of the company explained the high fidelity sound system and described the components required to make up a hi-fi set.

Highlight of the program was a demonstration of stereophonic sound, the newest development in the audio world.

### Southern California

James M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense (Research and Engineering), addressed the chapter at its dinner-meeting in Los Angeles on June 25th.

In his talk, Mr. Bridges stressed the significant technical manpower shortage which has been developing in our Nation during the past decade. As a means to interpret properly the technical manpower problem, Mr. Bridges outlined the effect of the present period of technological, economic and political revolution which has drastically increased the demand for scientists and engineers and altered the basic processes and procedures of engineering management.

To every company having major contracts for developing equipment or weapon systems, he said: "Make an objective and critical self-appraisal of the management of at least one of your programs, including a detailed analysis of the accountability of all engineering effort expended on the project in your own plants and in those of your subcontractors. The results of such a survey would be of great value
level industrial management.
larly in revealing areas where
zation of technical manpower
made more effective, and our Co
on Technical Manpower Ut
would certainly welcome inform
this kind from a broad cross
of industrial concerns."

### Washington

Sea power in the nuclear-mis
was the subject of a discussion
tain Henry L. Miller, Office
Naval Operation, Department
at the first fall meeting of th
ington Chapter on October 1s

Speaking to a group of ne
members at the Willard Hotel,
Miller and a crack Navy pre
team gave a dramatic projectio
Navy's capabilities in maintain
of sea communication. Also
was the Soviet war machine.
growing menace of the Soviet
freedom of the sea.

First fall meeting of the cha
convened by L. Harriss
(Motorola) as new presiden
him at the head table were
Percy G. Black (Automatic
Company), past AFCEA
President; Millard C. R
(Western Electric), new AF
tional Treasurer; Captain W
Goulett (USN Ret.), new
National Executive Vice P
Major General J. D. O'Conne
Signal Officer), National AF
President; Rear Admiral F.
(International Telephone & T
Corporation), AFCEA Nation
dent; Captain Marshall H.
(Office, Chief of Naval O
USN); Captain C. M. M
(Office, Chief of Bureau of O
USN); Rear Admiral Wil
Schoech (Deputy and Assista
Bureau of Aeronautics, USN);
Jack Dorsey (Office. Chief
Operations, USN), Vice Pre
Washington Chapter, and
Henry L. Miller, USN (Office,
Naval Operations), who pres
program.

Admiral Furth officially in
Captain Goulett to the group.

*Washington*—At the October 1st meeting, which featured a Navy program on "Sea Power in the Nuclear-Missile Age," are left to right: L. Harriss Robinson of Motorola, chapter president; Rear Adm. F. R. Furth, IT&T, National AFCEA President; Maj. Gen. James D. O'Connell, Chief Signal Officer and National AFCEA Vice President, and Capt. Wilfred B. Goulett, AFCEA Executive Vice President.

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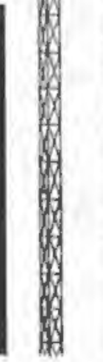
RCA Microwave Radio Systems are designed with future needs in mind. They do not face obsolescence because of users' growth. High channel capacity permits orderly growth up to a total of 120 channels for voice, data transmission, supervisory control and other purposes.

RCA was one of the earliest pioneers in the development of microwave for commercial communications. Today, RCA Microwave Systems provide users throughout the world with many important features . . . operation in the most advantageous frequency bands, simplified installation and minimum maintenance cost.

Serving their users with dependability and precision, RCA Microwave Systems are now operated by utilities, gas and petroleum pipelines, cross country turnpikes, and government agencies.

More than a million channel miles of RCA Microwave Systems in service . . . performance proved throughout the world.

*RCA Microwave specialists will be glad to answer any questions and help plan your installation. Mail coupon for further particulars.*



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**COMMUNICATIONS PRODUCTS**
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CITY________ ZONE____ COUNTY______ STATE______

☐ Have representative contact me.

# ITEMS OF INTEREST

## From Government, Industry and the Services

### Sharp Sun Spots

The sharpest photographs ever taken of the sun were secured recently by a unique telescope-camera which had been attached to a giant unmanned Skyhook balloon and sent into the stratosphere. The flight was the first in a series, under the title Project Stratoscope, being conducted for the Office of Naval Research.

Launched from the General Mills Flight Center, New Brighton, Minnesota, the balloon hovered for 3 hours and 45 minutes at a predetermined altitude of about 81,000 feet. The telescope-camera took a total of 8,000 35mm photographs of the sun at intervals of one second.

Considerable time is said to be needed for astronomers and other scientists to evaluate properly the knowledge gained from these photographs, but it is expected that the pictures will greatly broaden man's knowledge of the smaller turbulent sun eddies, the local hot gas storms, solar flares, and ultimately, perhaps, long-distance radio disturbances.

### Ramjet Sets Records

Three new speed records were set recently by a Lockheed X-7 ramjet missile as it completed its 10th successful flight. The event also was a record for any single U. S. supersonic missile.

The X-7, dubbed "Methuselah," marked up the following faster-than-sound records: Fastest speed for (1) any ramjet powered missile (2) any ground controlled missile and (3) any recoverable missile.

According to Lockheed technicians, the supersonic speed run resulted in paint burned black by the blazing air friction heat.

The Air Force reports that due to the fact that the Lockheed X-7 is recovered by parachute and flown again, each reflight saves taxpayers $350,000 in missile research costs. The "Methuselah," with its 10-flight record, reportedly has already "banked $3.5 million in missile expenditures."

This particular X-7 has successfully flown an average of almost once a month since its first air launch last summer and has never been returned for repairs.

Out of sight during most of its flight, it is piloted by earthbound engineers and radios performance data back to technicians as it maneuvers to fully test ramjet engines.

Launched from a B-29 mother ship at a high altitude, the ramjet takes over and begins its supersonic climb into the stratosphere after a flame tailed rocket booster zooms it to required speeds.

One of the nation's first missile developments, the Lockheed craft was created more than a decade ago under Air Force contracts.

### "Flat Plate" Tube

A transparent "flat plate" cathode ray tube has been designed which "will definitely help to make instrument flying as simple as flying in good, clear weather."

The tube, which an airplane pilot can either look at or through without shifting his reference, according to weather conditions, was described at the 82nd semiannual convention of the Society of Motion Picture and Television Engineers.

The new visual aid to aviation, which the Navy has dubbed the "Buck Rogers viewing screen," is designed for installation in the area of an airplane windshield. It permits the pilot to view at will, either the flight data displayed on the tube or the actual air space visible beyond the transparent screen.

Establishment of the need and requirements for the tube, its physical aspects, and the development of the transparent phosphors used on the screen were described in three separate papers by Commander George W. Hoover, of the Office of Naval Research; Ross Aiken, of Kaiser Aircraft and Electronics, who developed the tube, and Dr. Charles Feldman, of the Naval Research Laboratory.

### New Fuel Cell

With the development of the first fuel cell capable of economically producing thousands of watts of power, direct conversion of the chemical energy of gases into electricity has been accomplished.

First significant military application of the cells, which use hydrogen and oxygen as fuel, is in providing silent electrical power for the U. S. Army Signal Corps' "Silent Sentry" radar. The "Silent Sentry," which is the world's smallest known radar set, is a lightweight, portable unit that provides mobile Army forces with local combat surveillance of enemy movements despite smoke, darkness or fog.

The new source of power was developed by scientists at the Research Laboratories of National Carbon Company, Division of Union Carbide Corporation.

"Secret of the new fuel cell's success," Dr. C. E. Larson, National Carbon's research vice president, said, "is the chemically treated, hollow, porous carbon electrodes through which the gases enter the cell, and which also conduct the electricity produced by the electrochemical reaction."

### "Manned Satellite"

A design for a "manned satellite," which within eight years could become the nucleus for an economically feasible space station, has been developed by Goodyear Aircraft Corp., Akron, Ohio.

According to a Goodyear scientist, the proposed manned satellite would attain a speed of 16,660 miles an hour while cruising in an orbit 500 miles above the earth. Technically described as a "manned earth satellite terminal evolving from earth-to-orbit ferry rockets," it has been dubbed "Meteor Junior." The "Junior" refers to the fact that the new project is a modification of an earlier and larger version talked of in 1954 and identified as "Meteor."

The scientists further reported that the satellite also could be adapted for use in "near-by" space explorations, including trips to the moon.

Details of the vehicle were reported in a paper prepared for a meeting of the International Astronautical Federation in Barcelona, Spain.

### USC Receives Computer

The University of Southern California has received an electronic digital computer which will be an aid to new research in measuring man's intelligence. According to reports, this may lead to a comprehensive theory about the intellectual processes of man, with special emphasis on creativity.

(*Continued on page* 68)

# FOR DYNAMOTORS...

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Sangamo Dynamotors are available in two basic design series: the rugged "G" series for commercial use, and the "S" series for special purpose and military applications. Both types are small, compact, yet capable of unusual output and high efficiency under the most rigorous conditions of service.

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SG57-3

# ITEMS OF INTEREST

The computer was presented to the University by the National Cash Register Company, Electronics Division of Hawthorne, Calif. Complete with an auxiliary tape memory unit and input-output equipment, the system is installed in special new facilities in the school's engineering building.

The project is being conducted for the Office of Naval Research by Dr. J. Paul Guilford, SC professor of psychology, with Philip R. Merrifield as assistant director.

The old, standard IQ test, with its single score, was far from an adequate yardstick of adult intelligence, according to Dr. Guilford. His new system, based on about 45 established factors of intellect, provides a "many-sided" picture of intelligence; one of the implications of the system is that there may be as many as 75 intellectual factors in which individuals may differ.

The NCR electronic computer system, by reducing the time needed to analyze test scores, will make it possible to obtain results much more quickly, even from large groups of people.

As data from many tests are fed into the computer, intercorrelated results emerge immediately on punched paper tape. The tape in turn operates an automatic typewriter which rapidly prints the results in tabular form.

In addition to making computations in engineering and the physical sciences, the computer will play an important part in other fields of research.

## Air Navigation System

Stavid Engineering, Inc., Plainfield, N. J., has a new air navigation system which proposes a solution to the mid-air collision threat.

According to the company's president, David F. Sanders, the system, called Radio Web, "offers the most promise for the interim period and for the foreseeable future in the handling of increasing traffic loads." It is said to be the only method capable of solving with ease all three common system requirements, i.e., air navigation, traffic pattern control and air collision warning for both short and long range (50 miles) conditions.

Radio Web will consist of modular airborne units to provide all types of aircraft with one or more of the following information-sources: heading and distance to destination; a continuous graphic display of position, track and ground speed; a relative position indicator (with collision warning) plus other refinements for large aircraft to establish voice communication with the ground, altitude control and a data link for ground control.

Deriving its name from a web or grid network generated by transmitting towers spaced approximately 600 miles apart across the U.S., the system contains radio signals which sweep the area between any 4 towers to provide aircraft with a position fix.

## "Radar Remembrance"

Special "radar remembrance" techniques were reported by two Texas A & M College scientists, Myron G. H. Ligda and James Sullivan, at the recent 1957 Conference of the Society of Photographic Scientists and Engineers in Asbury Park, N. J.

The radarscope operation makes possible the detection of transient echoes from lightning discharges, flash-flood-producing storms and even the horizontal distribution of rain in different layers of the atmosphere.

The techniques include such diverse and unusual procedures as high-speed continuous strip photography, image addition and subtraction and color photography, along with time lapse, time exposure and rapid process photography. All of these, Ligda and Sullivan report, have been employed effectively in radar meteorology.

## High Speed Films, Dry Process

An Army general, speaking before the 1957 Annual Conference of the Society of Photographic Scientists and Engineers, cited, as military needs, the development of high speed films and a completely dry photographic process.

Brig. Gen. Earle F. Cook, commanding officer, Army Signal Engineering Laboratories, Fort Monmouth, N. J., told the scientists that photography is the most advanced sensory technique available to the military for gathering intelligence information in combat surveillance.

While the Signal Corps is currently sponsoring development of more advanced equipment for use on the ground and in the air, General Cook said, there are several long range objectives beyond the current program of research. He listed four of these:

(1) A completely dry photographic process with capabilities for taking and reproducing photographic information in much shorter time than now possible.

(2) A photographic sensing material that is sufficiently sensitive in the visible spectrum and at the same time of negligible sensitivity to nuclear radiation.

(3) A high speed photographic film or sensor which will permit photography under very low-level illumination such as passive night photography. This may also require concurrent development in optics and processing fields to evolve an overall compatible system, the General pointed out.

(4) A satisfactory technique and equipment for the automatic and timely extraction and processing of essential information from the thousands of photographs required in a military operation.

## Launching Test Program

The Department of Defense has announced some details of the test program leading up to the launching of a scientific earth satellite during the International Geophysical Year.

The U. S. IGY scientific program is under the over-all direction of the IGY Committee of the National Academy of Sciences. Launching vehicle tests are being conducted by the Naval Research Laboratory at Patrick Air Force Base, Cape Canaveral, Florida. These tests are designed to allow orderly evolution from a single-stage rocket to the three stage launching vehicle required for placing a scientific earth satellite on orbit to gather upper atmosphere scientific data.

To date there have been two test vehicle launchings, both of which have been highly successful. The first, on December 8, 1956, was a single-stage rocket using a Martin Viking. The second, on May 1, 1957, was a two-part rocket

## Cable System Ceremony

The world's longest and deepest undersea telephone cable system, linking the Mainland with Hawaii, was opened to public service October 8 following an exchange of greetings among dignitaries at Washington, San Francisco and Honolulu. The event introduced a new feature to overseas telephony . . . operator dialing.

Frederick R. Kappel, President of A.T.&T., acted as master of ceremonies for the proceedings which were held in the Executive Office Building in Washington. Other participants in the Capital were secretary of Defense Charles E. Wilson; Postmaster General Arthur E. Summerfield; Gen-

## ITEMS OF INTEREST

eral Nathan F. Twining, USAF, Chairman of the Joint Chiefs of Staff; John C. Doerfer, Chairman of the Federal Communications Commission, and Henry T. Killingsworth, Vice President of A.T.&T., in charge of its Long Lines Department.

At 4:00 P.M. (EDT), inaugural conversations began. These included one which extended from Washington to London, back to Ketchikan, Alaska, via New York and Seattle, and on to Honolulu. This call was 18,000 miles in length and utilized all three deep-sea cables placed by A.T.&T. during the past year—the transatlantic, the Alaskan and the new one to Hawaii. The ceremony lasted 40 minutes, then the Pacific cable system was opened for commercial use.

On completion of the impressive ceremony, many of those present, including the new Executive Vice President of AFCEA, Captain W. B. Goulett, USN (ret.), enjoyed the privilege of talking over the Hawaiian cable to Honolulu.

### R.I.T.C. Anniversary

The Radio Interference Technical Committee of Los Angeles recently celebrated its first anniversary. The membership roster includes over 109 engineers from major aircraft and component manufacturing companies, military establishments, testing labs, etc. Its members are employed throughout the United States as specialists in radio interference suppression.

The voluntary group was formed primarily as a result of military concern over the increasing problems of radio interference in communication and guidance systems. The aim of the group is to advance the science of radio interference control through education and exchange of technical information.

Vast increase in radio-electronic activity today has brought complex problems of noise interference in spheres ranging from aircraft communications and transmission for guided missile navigation, to private television sets. (See page 72.)

## Names In The News

**John R. Townsend**, of the Sandia Corp., has been named as Special Assistant to the Assistant Secretary of Defense for Research and Engineering. He also will serve as the Director of the Office of Fuels, Materials and Ordnance.

**Charles P. Ginsburg**, manager of Advanced Videotape Development, Ampex Corporation, received the David Sarnoff Gold Medal Award for his achievements in the development of a practical video recorder. The presentation was made at the recent 82nd Semi-Annual Convention of the Society of Motion Picture & Television Engineers.

**Frederick R. Furth**, president of AFCEA, has been appointed Director of Research and Engineering for IT&T. He succeeds **Harold H. Buttner**, who will continue as Vice President and Technical Consultant.

**Richard J. Meyer's** promotion to the rank of Brigadier General was announced recently by the Department of the Army. General Meyer is Chief of the Research and Development Division, Office of the Chief Signal Officer in Washington, D. C.

**Charles S. Rockwell** has been named President and General Manager of the Ford Instrument Company, Division of Sperry Rand Corporation. Mr. Rockwell assumed the post upon the retirement of **Raymond F. Jahn.** In addition, he will serve as president of Sperry Farragut Co. Division of Sperry Rand, a post Mr. Jahn also held.

**Brigadier General J. Harry LaBrum** was honored with a garrison review at Fort Monmouth, N. J., upon his retirement from Reserve [illegible]. A member of a Philadelph[illegible] General LaBrum was r[illegible] active duty in 1945.

**Sir Robert A. Watson**[illegible] dio-physicist of Toront[illegible] Canada, was the recipi[illegible] Elliott Cresson Medal of [illegible] lin Institute. Sir Rober[illegible] kinsman of James Watt, [illegible] steam engine, is being ci[illegible] conception of pulsed ra[illegible] vital air defense of Great [illegible] his solutions of importa[illegible] problems, and for his in[illegible] ership which resulted in [illegible] development of these rad[illegible]

**Albert W. Hull** and **D**[illegible] **Baker** have received the [illegible] tute of Radio Engineers [illegible] Hull, consultant to the G[illegible] tric Research Laboratory, [illegible] with creating more new t[illegible] tron tubes than anyone [illegible] Baker, GE vice-president [illegible] for "outstanding contri[illegible] communications and elec[illegible]

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STATEMENT OF THE [illegible], MANAGEMENT, CIRCULATI[illegible] quired by the act of Congress [illegible] 1912, as amended by the act[illegible] 1933, and July 2, 1946, of Si[illegible] published monthly at Washingto[illegible] (additional entry, Baltimore) for Oc[illegible] 1957.

District of Columbia {
City of Washington { ss.

Before me, a notary public, in and for the State and County aforesaid, personally appeared W. J. Baird, who, having been duly sworn according to law, deposes and says that he is the Editor of the SIGNAL Magazine and that the following is, to the best of his knowledge and belief, a true statement of the ownership and management of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, to wit:

1. That the names and addresses of the publisher, editor, managing editor [illegible]

Publisher: Armed Forces Communications and Electronics Association, 1624 Eye St., N. W., Washington 6, D. C.

Editor: W. J. Baird, same address.

Managing Editor: Judith H. Shreve, same address.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.

Armed Forces Communications and Electronics Association, 1624 Eye Street, N. W. Washington 6, D. C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

None.

4. That paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also that the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

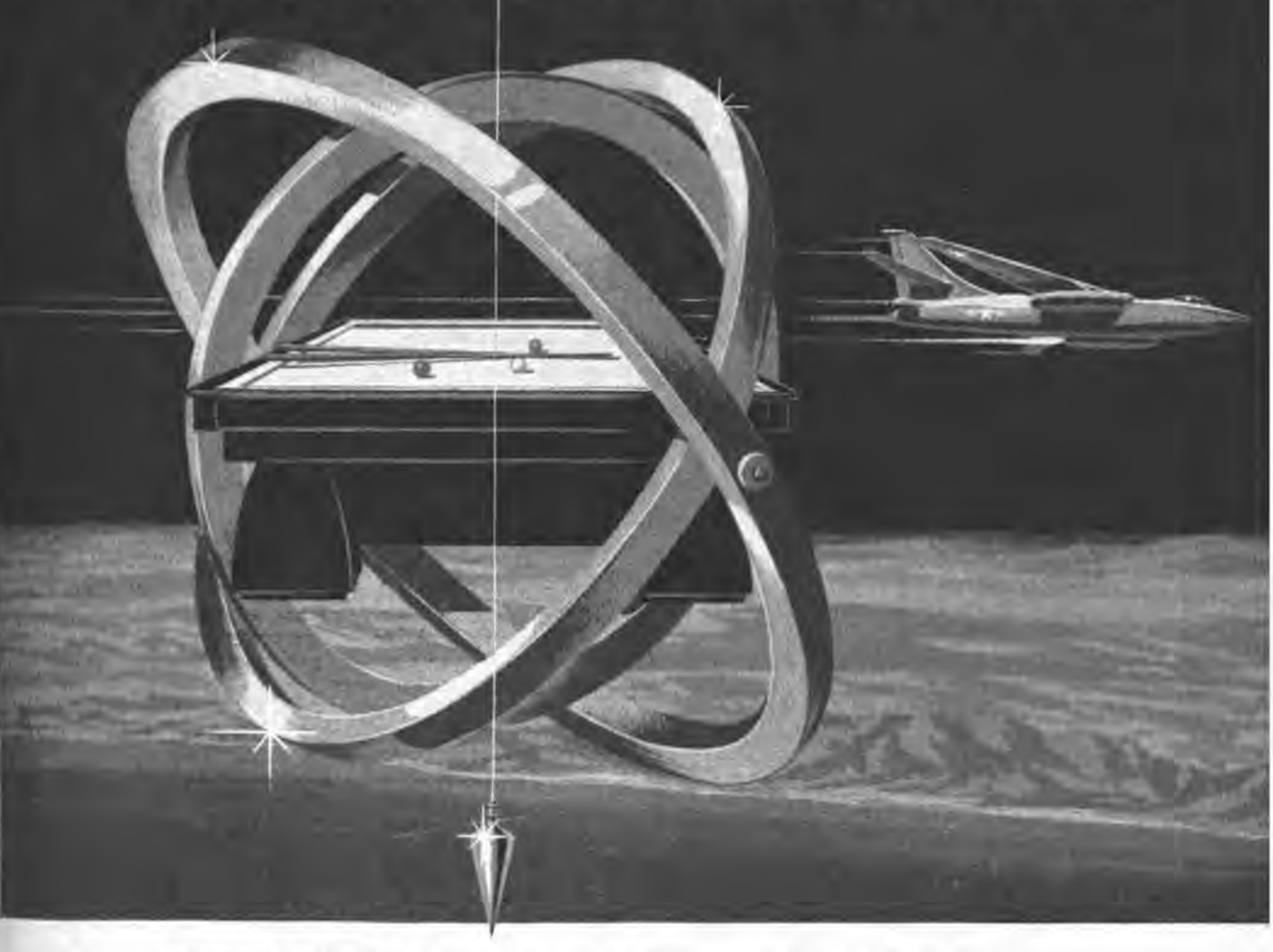
W. J. BAIRD,
Editor.

Sworn to and subscribed before me this 3rd day of October, 1957.

(Seal) HAZEL JANE DAVIES,
Notary Public.
(My commission expires June 30, 1960.)

# Admiral®

# KEEPS AERIAL CAMERAS STABLE AS A BILLIARD TABLE...



## ADMIRAL'S PALO ALTO LABORATORY DEVELOPS EQUIPMENT FOR CAMERA STABILIZATION

The art of aerial photo-reconnaissance requires absolute camera stability to obtain the fine detail needed to discern small objects from great altitudes. Even with an automatic pilot in control, the plane itself is far too unstable for reconnaissance work, and additional stabilization is required.

Now Admiral has developed equipment that automatically compensates for the slightest deviations. Electronic signals from gyros are appropriately modified and distributed as needed to stabilize each of the various camera mounts. The accuracy of the gyro signals is fully reflected in the mechanical adjustments of each camera platform. Moreover, Admiral has applied subminiaturization techniques to reduce size and weight to half of the original requirement specifications.

This system was developed in Admiral's Palo Alto Laboratory by the Advanced Development Section, Government Laboratories Division. Complete information concerning the Laboratory's capabilities and current activities is available to qualified persons.

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    - PRODUCTION

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# PERSONNEL CLEARING HOUSE

## *AFCEA Members Available to Industry*

**The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ......., SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.**

Manufacturers Representative with over sixteen years experience, partly as a USAF employee, in negotiating and liaison engineering of contracts with the USAF at Wright Field and Gentile AF Depot has time available for additional companies desiring or doing Air Force business. Box 127.

Govt. Procurement and Administrative Consultant. Wide background and experience includes practice in taxes, accountant with Attorney General of New York and Congressional Committee. Worked with U. S. Dept. of Defense in formulating ASPR, dealing with termination, renegotiation and contract administration. Box 128.

Representative with a wide following among manufacturers of electronic equipment and government agencies on the Eastern seaboard has an opening for an additional line of quality components. Straight commission basis. Box 129.

Field Engineer or Manufacturers Liaison Representative: Retired CWO experienced in radar, closed circuit TV, b&w and color and Kinescope recording, data processing and automation, and R & D work. Will relocate with family only. Box 130.

Works Manager or Chief Engineer. Record of managerial competence in integrating engineering, sales and manufacturing. Broad technical background covering several engineering fields such as missile ground support equipment and instruments, solid related manufacturing experience, top sales contacts for military R & D and production work. Box 131.

Electronics Technical Writer and Administrator: Retired Navy CWO, W-4, Electronic Technician, with 22 years of wide, varied experience in the field of electronics. Prefer Florida or Baltimore-Washington area. Box 132.

## *Positions Available*

***Industry, government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.***

Electronic Engineers (up to $7570 per year) are needed by the Civil Aeronautics Administration to apply latest knowledge of electronics to air traffic control, telecommunications and navigational aids. Individual engineer positions concerned with the design, procurement and specifications, factory inspection, installation, calibration and maintenance of ground and airborne electronic equipment. Equipment includes radar, distance aids, VHF radio transmitters and receivers and radio and land line telecommunications. Employee benefits: paid vacations, sick leave, insurance and retirement programs. Write Civil Aeronautics Administration Personnel Division (W-91.3), T-5 Bldg., 17th & Constitution Ave., N. W., Washington 25, D. C.

Scenario Writer ($7570 per year). Six years of progressively responsible and successful experience in writing scenarios, script, dialogue for motion pictures or related fields. Experience must include three years in field of motion pictures. Substitution of education for experience: successful completion of study in college or university may be substituted for not more than 3 years of the required experience on the basis of one year of education for each 9 months of experience. No educational substitution will be allowed for experience in the field of motion pictures. Grade GS-1071-12. Army Pictorial Center, Long Island City 1, N. Y.

Teletype Operators, Coastal Station Radio Operators. International communications company. Liberal company benefits. Submit resume with name, address, age, past experience—if any, military experience—if any. FCC Second Class Radiotelegraph license required for Coastal Station Radio Operator. Write to Asst. Director of Personnel, RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

Packaging and Preservation Specialists GS-7 and 9 ($4525 to $6250 per year) are needed by the Philadelphia U.S. Army Signal Supply Agency to develop and write specifications for preservation, packaging, packing and marking of Signal Corps equipment. Submit resume and the Armed Forces Communicatinns and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

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*Editor's note: In view of the importance of the development and the interest generated, a more detailed account concerning "solion" is presented here. The August issue of* Signal *carried a short item on the subject.*

## "SOLION" . . . IONS IN SOLUTION

Scientists are making it tougher all the time for electronic engineers.

First, it was the transistor, and the engineer had to learn about solid-state physics. Next, it was the magnetic amplifier and ferritic devices, and the engineer had to brush up on magnetism.

Now, scientists at the U. S. Naval Ordnance Laboratory, at White Oak, Maryland, have come up with "Chemtronics"—a combination of electrochemistry and electronics. Their first device in this new field is the "solion" — pronounced so' — lee — on, and short for ions in solution. It was developed in cooperation with the Defense Research Laboratory of the University of Texas, and the Emhart Manufacturing Company of Hartford, Connecticut.

The new device utilizes ions moving in a chemical solution, rather than electrons moving through a gas or a vacuum as in an electron tube, or through a solid as in a transistor. Physically, the solion consists of a plastic cylinder, perhaps pocket-watch in size, containing a potassium iodide solution in which two or more electrodes are immersed. Polarization is by means of a nine-tenths volt battery. Changes in temperature, pressure, light, sound, or acceleration will stimulate and vary the flow of ions and hence the current output. The device is reversible.

The principal advantage of these new devices is their very low power consumption, much less, in certain applications, than comparable transistor systems. Inherent stability, long life, ease of manufacture and simplicity of operation are other advantages, together with low cost—once fabrication is put on a mass production basis.

Potential applications for solions include:

(1) Rate circuits of all descriptions, whether operated from temperature, pressure, or electrical, etc., sources;

(2) Integration units requiring continuous read-out of high precision —apparently of sufficient accuracy for acceleration (inertial) guidance systems and small visual exposure meters for personnel projection around jet aircraft engines (similar to film dosimeters for radiation protection of personnel);

(3) Detection and measurement of acoustic signals of low frequency (below about 400 cps at present) and accelerations;

(4) Product circuits involving either electrical derivative or hydraulic flow, or both;

(5) Electrical and small signal hydraulic amplifiers;

(6) Computer circuits;

(7) Amplifiers.

Only a few

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are still available Each issue of *PROCEEDINGS OF THE IRE* is the result of the most advanced thinking in the field of radio-electronics. Based on exacting research, and written by men who are foremost in their specialty, these issues are invaluable works of reference. This is also material not available from any other source. As the official publication of *The Institute of Radio Engineers,* PROCEEDINGS presents the years-ahead ideas on which new advances are based. These history-making issues, originally over-printed for reserves are rapidly being exhausted and will not be reprinted.

**YOU CAN STILL GET:**

**VERY LOW FREQUENCY,** *June, 1957* — New research in the very low frequency band, below 30 kc., opens up greater portions of the radio spectrum for communication purposes. VLF has many new and important uses. A reference work you'll need for years.

**SINGLE SIDEBAND,** *December, 1956* — A round-up of recent technical discoveries as presented by the Joint Technical Advisory Committee through its sub committee on Single Sideband techniques. This special study for the FCC points up the many advantages of single sideband.

**FERRITES,** *October, 1956* — This new group of solid state materials outmodes the intermittent "pulse" system of World War II radar. The ferrites allow simultaneous sending and receiving on a single microwave antenna; as well as full-power transmission in microwave ranges with reduced power loss and interference.

**SOLID STATE ELECTRONICS,** *December, 1955* — This issue heralds the arrival of a new epoch in radio electronics — the solid state electronics era. Defined and named with the birth of the transistor, this concerns the control and utilization of the electric magnetic and photic properties of solids. There are now whole new classes of electronic devices due to discoveries in this field.

**SCATTER PROPAGATION,** *October, 1955* — Here's radio history in the making. This issue presents practical application of a new principle in the fields of broadcasting and electronics. Thirty-five papers lay the foundation of a new means of communicating over long distances.

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# NEW PRODUCTS FROM INDUSTRY

## *Triple-Track Tape*

Designed to give the utmost in high fidelity stereophonic sound, a new triple-track tape recording system developed by the RCA-Victor Division of Radio Corporation of America was recently demonstrated by the Chicago Symphony Orchestra.

The technique uses three separate sound tracks on a ½" recording tape, each of which is picked up from a separate microphone. The 3 separate recordings are fed to loudspeakers located in the same general position as the microphones, thus giving a 3-dimensional effect to the music.

## *7-Band 9-Transistor Short-Wave Radio*

Covering the six most frequently used short-wave bands as well as the standard broadcast band, a fully transistorized short-wave radio which operates on ordinary flash-light batteries is now available from Philco Corp. of Phila., Penn.

Called the T-9 "Trans-World" portable, the set weighs less than 20 lbs. and measures 16 x 11 x 7 inches. Use of "surface barrier" transistors serves to bring in weak short-wave signals, permitting the signal to be magnified over ten million correct times, it is said.

Station selectivity power ratio is claimed to be 100 times greater than that of conventional standard broadcast receivers. Other exclusive features include flywheel tuning, moisture-proof wiring circuit and a logging scale attached to the band selector for easy band identification.

## *Sub-Miniature TV Camera Chain*

Ideal for airborne and other military installations where observation personnel is impractical, a new vidicon TV camera chain, incorporating sub-miniature components designed to meet military specifications, is now available from Allen B. Du Mont Laboratories, Inc., Clifton, New Jersey.

Compact and lightweight (camera head measures 5 x 4 x 7$\frac{13}{16}$ inches), the system offers a resolution of 100% modulation at 600 lines and is capable of reproducing the ten shades of gray on the EIA test chart, in addition to a sweep non-linearity rated at 2% maximum for each sweep unit.

## *Automatic Fine Tuning For TV*

Standard Coil Products Co., Inc., 2085 No. Hawthorne, Melrose Park, Illinois, has developed 2 radically different TV circuit designs, either one of which may be incorporated into their new "Neutrode" turret tuner which features automatic, fine tuning together with automatically locked-in picture immediately after the TV set is turned on. In addition, no dial adjustment is necessary when a channel change is effected.

This new stabilized oscillator tuner, with its special high capacitance circuitry, stops the oscillator "drift" and holds its signal steady at the desired frequency.

Of turret construction, the tuner utilizes printed circuitry with provision for reception of a total of 82 VHF-UHF channels by the use of snap-in strips. Each tuner accommodates 13 such strips.

## *Canadian Press Wireless*

A "completely new concept of a printing telegraph system," which is portable, weighs some 30 lbs. and is comparatively small in size, being easily carried, was announced last week by Press Wireless, Inc., after a demonstration of the unit in PREWI's New York offices by the carrier and Jayflex, Ltd., Montreal, Canada.

Said to be extremely quiet in operation, the machine will operate on any speed between 60 and 100 wpm with merely a change of the belt pulley; contains automatic switching facilities for 64 or more circuits and automatic answer-back with no paper disablement control; and is equipped with a back-space arrangement to permit correcting or obliterating a character already typed.

By the use of sequential selector arrangements, a single machine will function as an automatic telegraph switchboard for routing messages.

## *"1000 Series" Potentiometers*

Announced by the newly organized Components Division of Chicago Aerial Industries, Inc., to be located at Franklin Park, Ill., is a new line of ultra-precision potentiometers, ranging in size from ⅞" to 3" and said to offer exceptional operation characteristics.

## *New Synthetic Adhesive*

A method which firmly bonds polyethylene plastic to rubber, brass or brass-plated metals has been developed by the Bell Telephone Laboratories of Whippany, N. J.

The new technique is based on a synthetic adhesive known as "partly hydrogenated polybutadiene," said to be so strong that it will resist a pull of about 1,000 pounds per sq. inch or many times the strength of the best present bonding agents.

## *Automatic Dial Mobile Radiotelephone Unit*

General Electric Co. of Syracuse, N. Y., recently announced a new commercial unit for use in automobiles, boats, and other mobile equipment, to provide 2-way radio communication, without manual operator handling, between vehicles and wired telephone instruments, or between 2 of the mobile units.

Key to the new unit is a "secode" selective control device, used along with standard GE mobile radio equipment.

The "secode" device can further be used to control traffic lights, start and stop machinery, turn lights and electric signs on and off, and actuate almost any kind of electrically controlled device keyed to a radiotelephone unit while the vehicle is parked or moving.

## *Two Advanced Type Transistors*

Together with the new germanium p-n-p alloy type transistor (2N274) which embodies the significant "drift" principle, another new junction transistor of the germanium p-n-p alloy type (2N 404) has been announced by RCA's Semiconductor Division for use in high frequency operation and computer switching circuits.

In addition to its major applications as a high-frequency RF amplifier, the 2N274 can be used as a mixer-oscillator and IF amplifier in entertainment-type receivers. Excellent operating features are said to be inherent in its design.

The 2N404, designed for use in switching circuits of compact, medium-speed military and industrial electronic computers, is expected to find wide application in other low-level, medium-speed, "on-off" control cir-

# NEW PRODUCTS

cuits. The device is said to allow an electronic computer design to have exceptional stability despite wide variations in temperature.

### *Pocket Tape Recorder*

The world's first pocket tape recorder, weighing only 2¾ lbs. and measuring 8½ x 3⅞ x 1⅞ inches has been developed by the Mohawk Business Machines Corp., 944 Halsey St., Brooklyn, N. Y.

Known as the "Midgetape," the unit uses hearing aid type batteries, sub-miniature tubes and a printed circuit case. Employing a dual track magnetic tape the size of a cigarette box, the Midgetape is said to permit recording up to 60 minutes.

### *Servo Systems Test Instrument*

Solartron, Inc., of Camden, N. J., has announced a new electronic device which is capable of making an exhaustive test in a matter of minutes of servo systems, such as those used in guided missiles.

Regardless of harmonics or near-frequencies involved, the instrument only picks out the fundamental frequency wanted, discarding all unwanted signals and noise.

Called the "transfer function analyzer," the device is claimed to be the most advanced instrument known to test servo-mechanisms under conditions where output may be nonlinear. Some 300 are said to be in use in Great Britain by missile contractors.

### *Image Orthicon Life Extender*

Said to be the first such unit providing maximum prevention of burn-in and stickiness of images with no compromise in picture quality, the image orthicon life extender now being manufactured by the General Electric Company's Technical Products Dept. of Syracuse, N. Y., is expected to double the life of costly TV camera image orthicon tubes.

Designated the G-E "I/O-Guard," the unit measures 8½ x 5½ x 2½ inches, weighs 5 pounds and mounts easily on the exterior of 7 out of 8 TV cameras now in use.

Approximately 50 small parts are incorporated into the complete unit, including six capicitors, synchronous resolver and drive motor.

### *Thin Screen Amplifier for X-ray*

Radio Corporation of America has revealed its new thin-screen amplifier for X-ray viewing, said to be capable of holding a bright image for viewing up to 30 seconds after a brief exposure to X-rays.

It is claimed that the device provides a stationary X-ray display up to 100 times brighter than conventional screens, retains its bright image after a short exposure and can be electronically "erased" for viewing a new image.

The significant reduction in the quantity of X-ray radiation that a patient need be exposed to during an examination is a major advantage of the screen.

### *Fully Automatic Industrial Control*

In addition to computational capability, flexibility, precision and speed, the added functions of interpretation and manipulation are combined in the new fully transistorized, digital control computer, recently developed by the Ramo-Wooldridge Corp., Los Angeles 45, Calif.

Specifically designed to automatically control a wide variety of manufacturing processes, the "RW-300" operates as a central automatic control of an entire process syster
will perform any number of func
in automatic on-line process co

Measuring 55 x 29 x 36 inche
computer weighs about 400 lb
liability is claimed through use
minimum number of high grade
ponents together with circuits h
maximum tolerance to componer
voltage variation.

Economic analyses of the c
system in existing plants is sa
have shown a return of the inves
within one to three years.

### *Silicon Iron*

Known as silicon iron, a new
of magnetic sheet material re
designed by General Electric Res
Lab., Schenectady, N. Y., pro
to increase efficiency of transfor
motors and generators.

"Orientation" in silicon ir
achieved by aligning indiv
crystalline grains in finished
material. Easily magnetized
directions, the material can be
in a wide range of thicknesse
is claimed that the "doubly-orier
"four-square" effect is achieved
different kind of alignment
gives excellent magnetic prope
both along and across the sheet

## New Literature

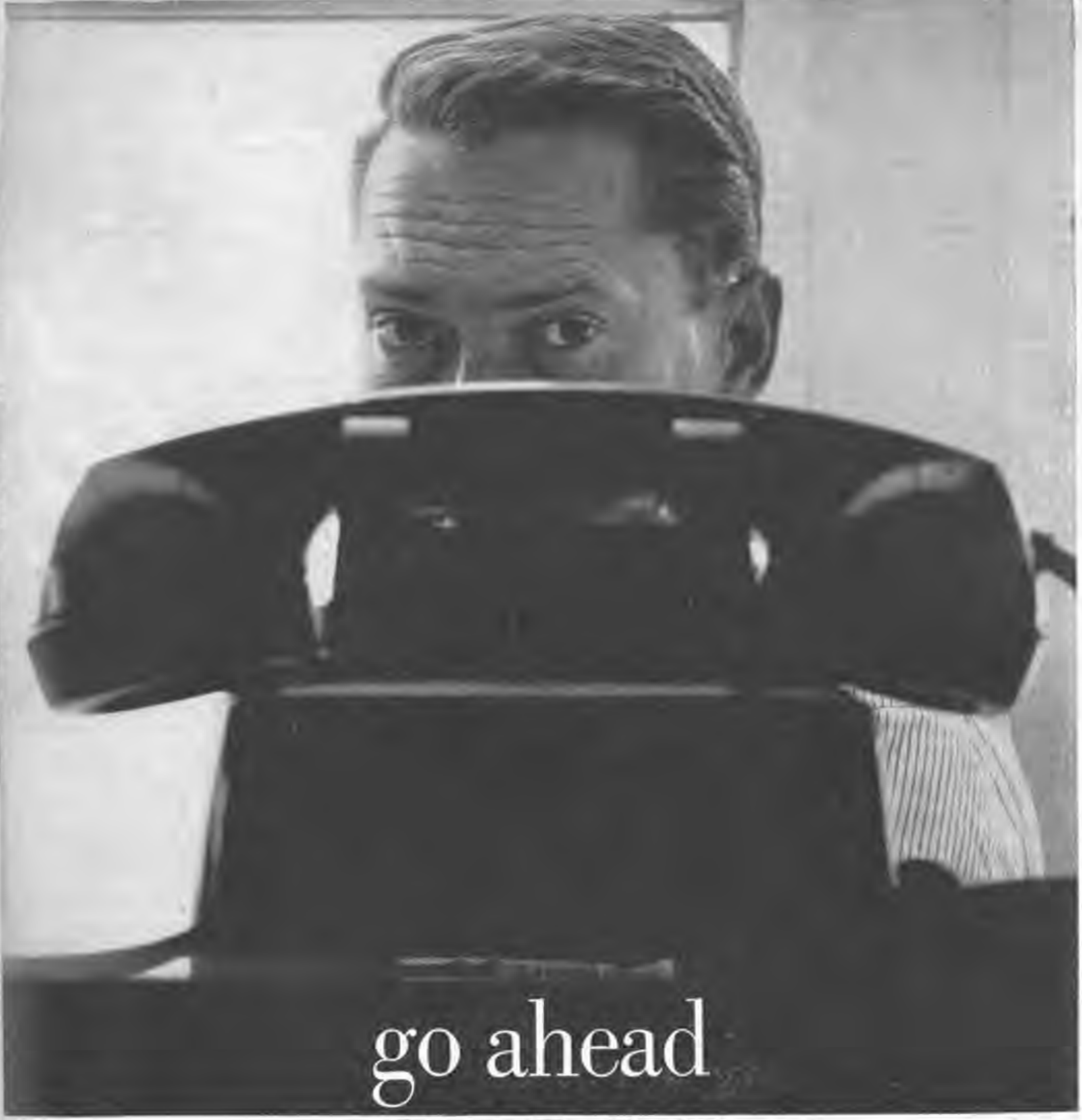
### *Qualified Product Lis*

Cited as an excellent vehicl
aiding small firms to win Go
ment contracts, the Qualified
ucts List (QPL), a directory of
tested items on which procure
is restricted to those manufact
who have proven the quality of
products by laboratory tests,
been published by the Air Ma
Command, Headquarters, W
Patterson Air Force Base, Da
Ohio.

Items are added to the QPL t
sure the Air Force that they
AF specifications and to elimi
wasted time, after contractin
manufacturer, for determining if
product qualifies for inclusion on
QPL. List inclusions are not lim
to the electronics field.

In applying for product certi
tion, the applicant states in wri
that his product conforms to spe
cations as determined by his own
ing, by a commercial testing la
atory or by arrangement with
Government wherein tests were
formed in his behalf and at his
pense.

(*Continued on page 78*)



# go ahead CALL!

## the fastest cure for worry about cancer: a call to your doctor now!

**Scared? You shouldn't be!** Look at it this way. The average man who walks into the doctor's office walks out floating. That lump that was so frightening . . . nothing to worry about at all! The sky's bluer, the air's sweeter, it's a great big beautiful day . . . because he picked up that phone and called!

**It happens all the time.** It can happen to *you*. "Sure," you say, "but just supposing". . . OK. Let's look at the facts. In past years, we were saving 1 out of 4 cancer patients. Today, we're saving 1 in 3. And the odds could get better still . . . if *people would call their doctors in time!*

**So go ahead...call.** See your doctor now. And after your checkup—how about a check for the American Cancer Society? Every dollar sends us further along the road to cure. And when *that* happens . . . it's going to be a wonderful day for us all! Send your check to "Cancer" in care of your local Post Office.

(Continued from page 76)

## FCC Bulletin on Closed-Circuit TV

"Boom in Closed-Circuit TV Operation," a new bulletin issued by the Federal Communications Commission, provides general information concerning facilities in medical, educational, business, industrial, transportation, municipal, political and entertainment activities.

On individual request, single copies of the bulletin (#49583, Sept. 10, 1957) may be obtained free of charge from the FCC Office of Reports & Information, Washington 25, D. C.

## Atomic Radiation

A new 120-page book treating the timely subject of atomic radiation and its effects is now available at the price of $1.60 from the Government Service Dept., RCA Service Co., Inc., Camden 8, N. J.

Using ample illustrations and simplified terminology, the manual discusses nuclear physics, observed biological effects of radiation, shielding methods, monitoring instruments, permissible radiation doses and medical evaluation of injuries and treatments. In addition to an excellent index, a supplementary list of reference literature is provided.

Primarily designed for use by technicians and scientists engaged in nuclear power activities, the book is believed to be of equal value to teachers, students, medical and civil defense workers, and the general public.

## Navy Report for Better Electronic Design

Prepared for Navy electronic engineers, a 57-page report, entitled PB 121123 "Twelve Guides To Reliable Electronic Design," has been compiled by U.S. Naval Ordnance Laboratory for the design of reliable electronic equipment, and is now available at the price of $.50 from the Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D. C.

Principally compiled for aid in the design of ground-based data-gathering and data-assessing equipment, the report also covers other types of electronic devices. Drawn from an extensive literature survey, the volume includes an 89-item bibliography.

Among the studies forming a base for the guides are the effects of increased equipment complexity, distribution of causes of equipment failure, technique of reliable design and selection of components.

## Weapon Systems Management

Reviewing achievements in the complete defense cycle, from research and development, engineering and design, to production, testing, installation and field maintenance, a new 32-page brochure, called "Weapon Systems Management—Through Computation," is now available from the Sales Promotion Dept., Defense Sales Div., Burroughs Corp., 6071 Second Ave., Detroit 32, Michigan.

Treatment of basic facilities and personnel at Burroughs is presented by way of introducing actual contracts in the various areas of interest.

## Magnetic Tape Instrumentation

So as to acquaint readers with "instrumentation recording"—the use of magnetic tape for recording scientific research and industrial process data —Ampex Corporation of 934 Charter St., Redwood City, Calif., is offering at no charge a new booklet entitled "Magnetic Tape Instrumentation."

In view of the growth of instrumentation uses of magnetic tape recording to the degree that they now make up ⅔ of the business at Ampex, the booklet is believed to be of value for its detailed description of
functional capabilities and use
plications of the tape recorde
cluded are the means by whic
can be applied in varieties an
and control situations.

## New Background f Marketin

Hoping to develop an org
body of basic theories and pri
to explain consumer purchasi
havior and marketing on the
can scene, *Life* magazine has
making a large survey of consu
buying habits.

More than 30 distinguished le
in business, Government and u
sities have recently appraised it
tential usefulness at a round
discussion.

Designed to acquaint those
ested in both the survey and
round table, a new booklet, "A
Background For Marketing
sion," is now available, gratis.
Mr. Andrew Heiskell, *Life* maga
Time and Life Building, Rocke
Center, New York City.

## Layman's Guide to Computing Systems

Entitled "How The Computing
tem Works For You," a 36-
guide to the electronic data pro
ing system which is designed to
fy the mysteries of the electronic
puter for the layman, may be
tained at no cost from Remin
Rand Univac, 315 Fourth Ave.,
York 10, N. Y.

A literary tour of the Univac
tronic Computing Center in
York, and an illustrated descri
of how an elementary computer
be made for less than $1, using
mechanical switches, a flashlight
tery, bulb and wire, are among
meaningful and interesting sect
found in this first of an educati
series of booklets from Remin
Rand.

## Radiation Applied In Industry

Reporting on the significant
role of radiation, a 10-page p
entitled "Applications of Radia
in Industry," by Ashton J. O'Don
and Bruce Graham, was presente
the Conference on Peaceful Use
Atomic Energy, in Tokyo, on May
1957. Free reprint copies may
be obtained from the Stanford
search Institute of Menlo Park.

Hailed as a tool with a promis
future, radiation is described as ca
ble of efficient performance of op
tions from actuating an electro
signal to inducing a chemical r
tion.

# Books

***UTOMATION: ITS PURPOSE & FUTURE, by Magnus Pyke. Philosophical Library, New York. 191 pages, $10.00.***

The idea of automation has a paricularly sparkling glitter about it as e now begin to grasp the remarkble technological possibilities that ie before us. In addition, the steadiv increasing cost of labor should ave its impact upon business mangement as a great motive force in he acceptance of automatic equipnent.

However, Dr. Pyke points out the hree causes holding back such aceptance, and places the responsibiliy for low productivity: "If technoogical advance and industrial efficiency are low, I would first blame hose people who manage businesses ather than the workmen who man them."

The author's treatment of factors affecting the speed with which automation will spread in different countries is believed tn be an important contribution to this work. "Most important is the 'climate of opinion;' this is partly a growth of the national philosophy."

***ROCKETS, MISSILES, AND SPACE TRAVEL, by Willy Ley. Viking Press, Inc., New York. 528 pages, $6.75.***

Ley's timely and newly revised edition is designed to capture the interest of the reader, whether his curiosity concerns historical background, the present progress to culminate in Project Vanguard, or such future concepts as atomic-powered rocket propulsion, space stations, the circling of the moon and planetary probes.

Including a description of the remarkable performance with which the Jupiter C broke all distance and altiture records, the work covers all modern data resulting from the past 6 years of progress in both theoretical and practical fields.

Of importance in the discussion of future projects are the papers given at the Franklin Institute Symposium on "Earth Satel'.es as Research Vehicles," in 1956.

Completing the work are two appendixes, a 31-page bibliography and a comprehensive index.

***CLOSED CIRCUIT TELEVISION SYSTEM PLANNING, by M. A. Mayers and R. D. Chipp. John F. Rider Publisher, Inc., New York. 250 pages, $10.00.***

Closed circuit TV, the infant prodigy born shortly after the end of WW II, is today a burgeoning youngster with numerous profitable applications in industry, education, commerce, business and medical institutions. Beyond the actual engineering of equipment for closed circuit TV systems, there is required careful evaluation and planning before an intelligent decision can be made as to where and how a particular organization can best use closed circuit TV. For those who undertake such a responsibility, this book is believed to offer an authoritative and complete advisory source.

Space requirements, cost of equipment and its installation, types of equipment available, their utility and functioning, and the manpower needed to operate and maintain such equipment—all are fully described and illustrated together with clear statement of both capabilities and limitations.

***KHRUSHCHEV OF THE UKRAINE: A BIOGRAPHY, by Victor Alexandrov. Philosophical Library, Inc., New York. 216 pages, $4.75.***

The shepherd-blacksmith who has dedicated his life to one aim for Russia—prosperity via socialism—the first Soviet leader to establish the precedent of being seen walking among his people, the outgoing wily Ukrainian who is a master of political self-defense, the outright dictator who handles hints of students' anti-governmental movements with threats of expulsion to Siberia, Nikita Khrushchev, top echelon of a great atomic power, has been quoted by Pravda to have said: "I shall never hesitate to use violence to save Lenin's work!"

Of special note in Mr. Alexandrov's timely book are the unpublished revelations concerning Khrushchev's famed secret 3-hour speech in which Stalin, his works and his living associates were denounced. Also of interest is the detailed portrait of post-Stalin Russia in which there gradually rose a determined, extraordinary man to the top Kremlin post.

***CAREER SATISFACTIONS OF PROFESSIONAL ENGINEERS IN INDUSTRY, a Survey conducted by the Opinion Research Corp., Princeton, N. J. The Professional Engineers' Conference Board for Industry, 2029 K St., N. W., Washington 6, D. C. 84 Pages, $3.00.***

Based upon intensive personal interviews with a sampling of professional engineers, this survey report represents the outlook of those men associated with 11 of the nation's largest industrial corporations in the fields of aircraft, automobile, manufacturing, chemicals, electronics, electrical machinery, heavy equipment, petroleum refining and rubber.

Contrasting the ideas and opinions of those whose careers are in the early stage of 3 to 5 years, in the middle stage of 10 to 15 years, and in the later stage of 20 to 25 years, the examination reveals the differences in values and thinking among the more successful engineers.

Among the sundry subjects treated are such topics as desired management which endorses means for fostering professional recognition, varied views regarding professional status in the company hierarchy, deficiencies in college backgrounds, opportunities for further training and advancement, and attitudes toward professional engineering societies.

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## READ SIGNAL

The primary objective of the Armed Forces Communications and Electronics Association is to maintain and improve the cooperation between the Armed Forces and industry in the design, production, maintenance and operation of communications, electronics and photographic equipment in times of pe as well as war.

SIGNAL, the official magazine of the Association, is a continuing contact the professions of electronics and communications. Through its ed pages and its advertising, SIGNAL provides a means of keeping in close with national and international trends and major developments of profe interest.

It is a magazine worth reading. It is a publication worth keeping the small sum of 41 cents a month, you can obtain participating memb in a local chapter and receive 12 issues of SIGNAL each year.

The membership blank below is provided for your convenience.

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## with the GR TYPE 1652-A RESISTANCE LIMIT BRIDGE

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The G-R Limit Bridge can be easily used by anyone. Built-in resistance standards are set to the component's specified value. As each unknown is connected to the Bridge, a large easily-read meter indicates component resistance directly as a percentage of its specified value . . . no further adjustments are necessary and measuring procedure reduces to simply placing the unknown into the Bridge circuit and reading one meter. Computations are eliminated, the possibility of error is reduced, and valuable testing time is saved.

The Hart Manufacturing Company of Hartford, Connecticut producer of "Diamond H" precision relays and switches, maintains a continuous check on relay coils with the General Radio Resistance Limit Bridge. Two Bridges are used in their production operations . . . one in the coil winding department for initial d-c resistance measurements, and one in the inspection department for final specification checks on the assembled relay.

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**Resistance Range:** Used as a limit bridge, 1 ohm to 1,111,111 ohms. Used as a Wheatstone bridge, 1 ohm to 1,111,111 ohms with internal standard; 1 ohm to 2 megohms with external standard.

**Limit Range:** Meter reads from −20% to +20%; ±5% and ±10% scales clearly indicated with color coding.

**Accuracy:** As a limit bridge, ±0.5% or better; for matching resistances, ±0.2%. As a Wheatstone bridge with internal standard, ±0.25% above 10 ohms, ±0.4% below 10 ohms. With external standard, ±0.2% + accuracy of standard (from 1 ohm to 2 megohms).

**Mounting:** The bridge is supplied for either relay rack or table mounting.

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# NO GETTING AWAY FROM IT!

Here's the Army's answer to a major problem in U. S. defense. Hawk, recently-revealed missile, hunts and destroys invading aircraft *even at tree-top altitudes!*

Raytheon radars of unique design give Hawk its amazing low-level ability in the blind zone of conventional radars.

This aptly named 16-foot missile is launched from fixed installations for the defense of U. S. cities. Highly mobile, Hawk can also travel with fast-moving land forces, or be carried by helicopter or plane.

Raytheon, with more than a decade of pioneering in guided missiles, is prime contractor for the complete Hawk weapon system.

RAYTHEON *Excellence in Electronics*

**RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASS.**

# SIGNAL

December 1957

Christmas Wishes from AFCEA

# MIRACLE IN MINIATURE

Observation and control of amphibious and airborne landings.

Close observation of jet or piston engine test performance.

Surveillance of assembly areas and movements of forces.

Observation of danger are where exposure would invol danger to personnel.

**Brand new! RCA "Telemite" (model JTV-1) a 1-pound ultra-miniature television camera, makes possible direct observation of sites and events never before accessible by TV**

It fits lightly into the hand; it can be carried in a pocket; it weighs about a pound; it will go places too small for ordinary cameras, too dangerous for man; it will observe without being conspicuous; it may be mounted on a tripod, fastened to wall or bulkhead, hand-held by a pistol grip. Size: 1⅞" x 2⅜" x 4¾".

By means of a transistorized circuit and the new RCA half-inch Vidicon, the "Telemite" actually surpasses standard Vidicon-type industrial TV cameras in sens tivity. It produces clear, contrasty pictures with scene illumination of 10-foot candles or less.

The "Telemite" operates with up to 200 feet of cabl between it and the control monitor, and this distanc can be further extended by using a repeater amplifie This is the first TV camera to employ photoelectri sensitivity control, which provides automatic adaptation to widely varying scene illumination.

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**RADIO CORPORATION of AMERICA**

CAMDEN, N.J.

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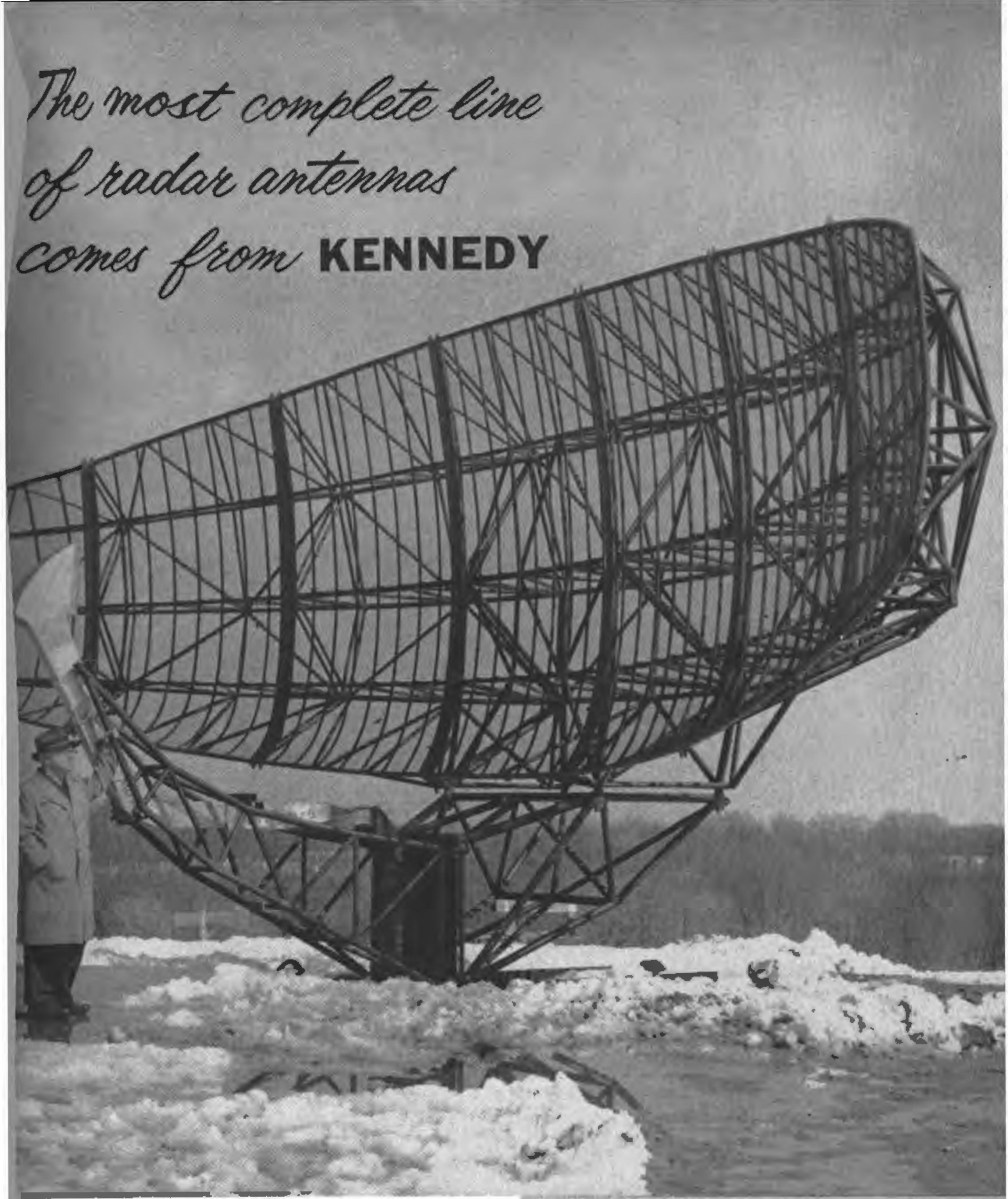
The most complete line of radar antennas comes from KENNEDY

**WARNING** -- *Radar Trap!*

One way to get a ticket that can't be fixed is to try a high-speed sneak attack past the line of "Texas Tower" radar sentinels now guarding our shores.

When an intruder approaches, his range, bearing, course and speed are instantly flashed to the Continental Air Defense Command, along with voice and intercept command signals. This information, "multiplexed" by Lenkurt single-sideband carrier equipment, rides ashore on a microwave radio beam.

Lenkurt, a leading specialist in telecommunications, has worked directly with government agencies and with other manufacturers in planning and providing communications circuits for many vital defense installations. Lenkurt equipment, whether "off-the-shelf" or designed especially for the job, offers t
trouble-free reliability so essential to applications involving our national security.

Lenkurt maintains facilities keyed to research, development, and precision production of carrier, micro-wave, and complete communications systems. Specify Lenkurt, and take advantage of the unique exper-ience of a company geared to meet the exacting requirements of government and military applications.

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# SIGNAL

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Journal of the Armed Forces Communications and Electronics Association

**VOLUME XII** **DECEMBER 1957** **NUMBER 4**

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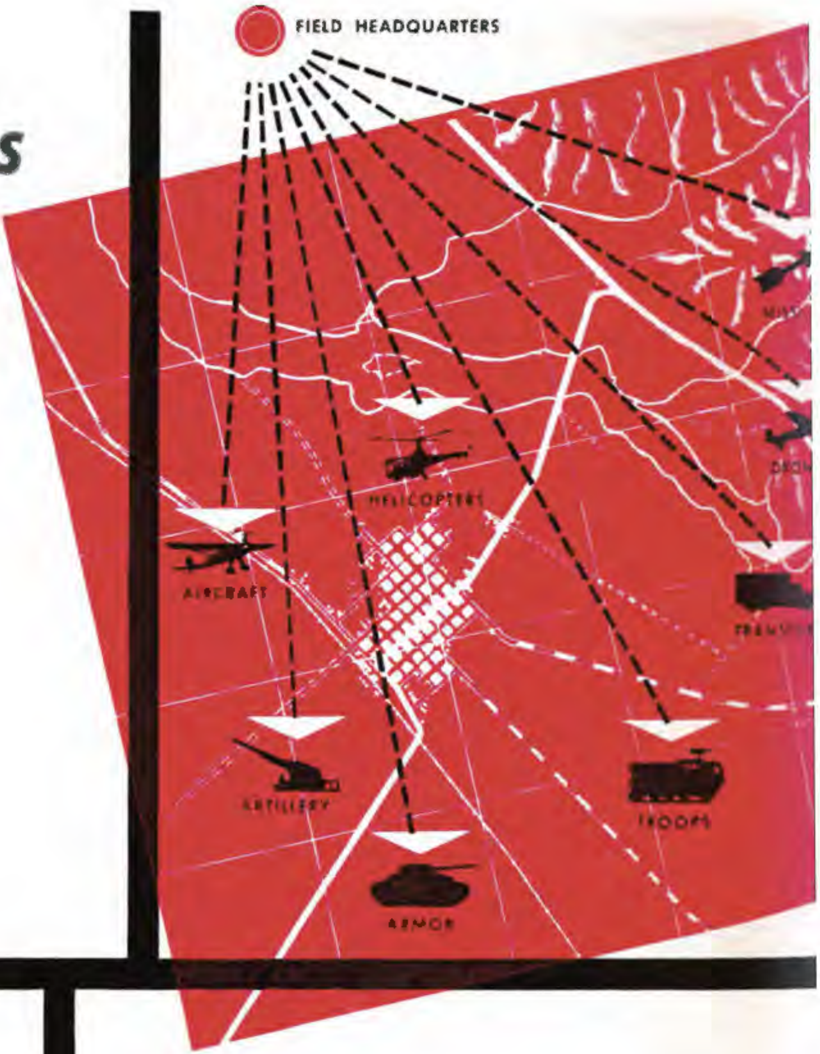
## COVER

*SIGNAL's cover represents Christmas Greetings from the Directors, Officers, the Executive Committee and Headquarters of the Armed Forces Communications and Electronics Association.*

*For the outstanding contributions of our authors and for the continuing support and services of our advertising representative and the advertisers in SIGNAL; for the complete cooperation of our printer, engraver, artist, members and friends, the editorial staff of SIGNAL is profoundly grateful and wishes to add its sincere holiday greetings.*

*Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.*


FIELD HEADQUARTERS
HELICOPTERS
AIRCRAFT
ARTILLERY
ARMOR
TROOPS

# ballistic missile

# Technology and the Air Force ∧ Program

AM GOING TO SAY a word about following: economy in Govern- t; electronics in today's and to- row's military, and the Air Force istic Missile Program.

erhaps, uppermost in your minds y is economy in Government how it affects you. For quite umber of months, the press has tained statements concerning e conservative economics in Gov- nent, particularly in the matters military spending and procure- t. More recently, a number of lic speeches by persons in policy ing positions have confirmed that ernmental economy has become order of the day and of the im- iately foreseeable future. Quite iously, those of us who are plan- g and executing military develop- it programs are affected. Some blems will certainly arise which be difficult to solve at the mo- it. A contracting operation is ainly a greater managerial chal- ge than an expanding one. On the er hand, I see no need for pessi- m. There are certain advantages careful, conservative management. urvey conducted to determine the tive success of various classes of ent years from one of our most ious universities came up with the ling that the depression borne s of 1931 had the largest aver- earnings. Intelligent thought can netimes reverse difficult situations l turn them to the advantage of se willing to meet the challenge.

The situation regarding develop- nt and procurement for the Armed rces would have been somewhat easy, even though the recent eco- mic policies had never occurred. is is true because advances in science and technology have profoundly affected military planning since World War II. I refer to the general use of nuclear and thermonuclear weapons and to the very great increases in the speed of aircraft and missile delivery systems. The result has been a retreat from the concepts of great masses of aircraft and surface vessels which characterized World War II. The impact upon those engaged in producing aircraft is obvious.

At first glance, it might appear that the market for electronic devices might be sharply reduced since the number of aircraft required to do a given task has been decreasing as the performance of weapons increased. However, due to the need for better navigation and control devices in high performance aircraft, the electronic devices have become more sophisticated, partially compensating for the reduction in numbers. Furthermore, the environment of the high performance vehicles is increasingly more difficult for air crews; therefore, they require more and more assitance from electronic, electrical and mechanical devices. This trend, of course, is carried to an extreme in guided missiles where black boxes eliminate the pilot. Consequently, in the air-nuclear age, the demands upon the electronics industry have become greater than ever.

I believe that at this point it is important to emphasize that there is now and probably always will be a demand for manned aircraft for military purposes. The performance of manned aircraft is increasing at a rate which keeps them competitive with missiles. The transition to missiles is just beginning and will continue in a slow, orderly manner as missiles prove their reliability. Consequently, organizations interested in serving the cause of military electronics must keep one foot firmly planted in the technology already established, but be prepared with the other to step into the imaginative and challenging missile electronics field.

Although most crystal balls are cloudy at best, it appears that the best advice for those interested in staying in or entering the military electronics field is sound planning and diversification. A policy of exploiting present techniques, but exploring advanced and new fundamental approaches, seems necessary. Sound judgment and good management are more essential than ever before. The low cost producer of quality goods will get plenty of business.

From the Air Force standpoint, more, rather than less, thought must be given to weapons systems before they are begun. The studies must be done in an extremely careful and competent manner. Systems engineering has become increasingly important. So from industry's standpoint, each organization participating in a military program must have people capable of understanding and matching the interface with other participants. Someone must review the entire result and see that it fits together. The fundamental results of research groups must be extracted and fed into the systems engineers to avoid entry into costly blind alleys.

The work of the fundamental research groups themselves, or more precisely, their efforts which are supported by military funds, must be planned more carefully, with less

by Major General Bernard A. Schriever, USAF / Commanding General / Air Force Ballistic Missile Division / Air Research and Development Command

duplication. I do not wish to imply that investigations of a general scientific nature should be curtailed, but that such work will probably be supported to a larger degree by organizations with a specific charter for such work.

Perhaps some of you might be interested in a few of the specific areas in electronics which some of my staff believe are particularly worthy of attention for future Air Force applications. I might mention continued emphasis on solid-state devices, particularly with regard to quality control in manufacture and to reliability in application. Improved and more accurate instrumentation for missile flights, improved packaging for high static and vibration environment, and light weight electronics associated with gyros and inertial systems are needed also. Further work on data extraction devices, and the work of those whose purpose is to convert information from analog to digital form, would be worthwhile. Since the interest in mouse traps has begun to wane, the world would probably beat a path to the door of someone who built a really outstanding accelerometer—most particularly if he could do it for a reasonable price.

Now, I would like to say a little about the Air Force Ballistic Missile Program.

The long-range ballistic missile program of the United States Air Force represents the largest integrated technical development program ever attempted by this country. It involves a simultaneous extension in practically every phase of the guided missile art. Compared with previous developments, it includes higher thrusts, higher weight-to-structure ratios, higher speeds, higher accuracy and greater versatility in guidance and control, higher rates of burning of propellants, higher temperatures, and greater expansion of facilities and industry capability in a short period of time.

### *Management and Organization*

There are two somewhat separable aspects of our ballistic missile program in which the relationship with previous projects appears worth mentioning. One aspect has to do with management and organization. The other concerns general technical aspects and testing.

First, let me discuss organization and management. From the beginning of the accelerated program, it was evident that questions of managerial, philosophical and organizational approach would need special attention. Why was this? Well, first, it was obvious that the total effort, if carried out successfully in a relatively short time, would involve a considerable fraction of the nation's scientific and material resources. Second, the simultaneous advances required for the present program in all aspects of guided missile system art made clear that large facility, hardware, and reliability testing programs would be needed. Third, it was obvious that the entire program would have to be widepread geographically and would have to include contributions by large numbers of organizations. Therefore, the entire effort would have to be unusually well organized and highly supported on a good management and good scientific base. These operations could not be left to trial and error and hit-or-miss experimentation.

Top military and technical people have joined to create and maintain a research and development plan, a production plan and an operational plan with the least doubts as to the fundamental soundness and proper timing for each step. Of course, any program comprising a vast number of interrelated steps cannot be precisely laid out ahead of time. Moreover, some steps must depend upon progress or data obtained in earlier ones. But the objective has been to plan a program that will have a minimum chance of hinging upon any greatly speculative technical issue and, equally important, upon any questionable evaluation as to th ability to perform the developmen and production as required, or to train the people and establish th operational bases on time.

A web of communications has bee set up, converging into one centr source competent to evaluate the i formation and to provide proper d rection to all the team members. Eve the initial relationship between mil tary requirements and the perform ance specifications requires regul reviews, and modifications to attai an earlier result always have to b weighed against a competitive meth od gaining a later but superior resul Plaoning, monitoring and optimu assignment of facilities is a major effort for the central management organization. Morevover, in view of the plan to parallel the research and development with production planning and complete operational implementation, a large amount of the central management's internal activities have to do with interactions among the technical, operational and procurement aspects.

### *Technical Aspects*

Now leaving management, let me say a few words about the technical aspects of our program—first with regard to previous Air Force development programs. Roughly speaking, the counterpart, in the sense of a previous technical step, can generally be found spread over the entire guided missile, aircraft and electronics art. Thus, a ground radar that had nothing to do with guided missiles in the past has furnished a basis for an extension for some of the ICBM system. Something similar can be said with regard to the ground computers. Some of the techniques and components came out of aircraft, others out of short-range ballistic missiles, and still others from surface-to-air and even air-to-air missiles.

In making the major technical decisions, a notable effort was made to bring in the experience of all of the leaders of the guided missile and associated art. As an example, for the testing plan, experts from earlier programs either joined the present one or were brought into the key discussions. Some believed that the best way to move rapidly was to analyze every test completed and to use all esults to make improvements be- attempting a next test. Others ed that without a set of tests that d provide statistical and con- ing evidence of faults, no solid ress could be made. Many had rienced their worst problems in past when they tried to repro- results and wanted special em- is on catering to the fabrication assembly problems from the out- Others felt substantial redesign d be tolerated. Judgment as to nical risk in skipping steps to time varied, of course, but we the assistance of most of the ex- s and the facts of the past. All hese past experiences naturally to be interpreted in the light of own specific problems. We final- ecided on a test philosophy which fully considered the transition roduction and the attainment of ability.

single or a few shots of a mis- built breadboard fashion by its entors in a closely supervised lel shop, may be a satisfactory roach to illustrate a principle. wever, in our guided missile de- pment, the step being taken from technical standpoint is essentially ond question as to its scientific is. The key problem is to so or- ize the program as to assure the ient working out of all of the en- eering details (some by theory and ne by experiment), the attainment reliability through a great deal of ing, and an industrial capability to roduce the results in the quanti- s required for a military force.

Therefore, we have held upper- st in our planning that produc- n and operational capability are real end goals of the develop- nt.

### *Reliability*

Now a word about reliability. In past, reliability considerations ve not been in the foreground en enough. Clearly, a complete ided missile system cannot be very ful in a national emergency if it likely to fail in some important re- ect more than a small fraction of time. But the complete system nsists of many major subsystems, cluding of course much more than e flying vehicle itself. Suppose we k for a modest 50 per cent chance at the complete system trial will cur without a malfunction of some ajor subsystem such as the power ant, the structure, the guidance sub- stem or the ground equipment. or simplicity, suppose there are five or six of these main subsystem elements. Then, to have a 50 per cent chance for a completely successful flight, each of these subsystems must be counted on for roughly a 90 per cent chance of operating perfectly. But each of these subsystems itself consists of hundreds of critical components, which must then have an average reliability during flight in the 99.9 per cent region, with a failure of only one in a thousand. Even if each of these components is laboratory tested, improved and retested innumerable times, this must be followed by systems testing to determine the interactions of one component on another when working together. And then, finally, a flight test will expose the possible reduced reliability owing to the environment and unknowns in the actual flight that no prior simulation or analysis can dependably reveal.

Typically, flights of guided missiles are measured in minutes. A flight test program, especially in its earlier stages, reveals only fragments of data for various parts of the complete trajectory. Hundreds of flights may be needed to accumulate a single hour of operating experience. It is apparent that the attainment and the proof of reliability cannot rely alone on flight test, because of the enormous expense and the relatively small amount of data obtained. Wherever possible, all subsystems must be brought to a high reliability by testing on the ground.

This does not mean that the first flight test should be delayed until testing on the ground has caused all elements to reach a stage of reliability where nothing remains but the final interactions in the operating environment. Flight testing in its initial stages obviously is carried out, not for the purpose of exhibitions, but to uncover interaction and flight environmental problems as early as possible, even with the virtual certainty that the first flight tests will be handicapped by unreliability of components. Thus, the final "ground" development of all subsystems and components for the goal of a successful operational flight depends partially on the results of earlier imperfect flights. Complete systems tests, including missile launchings, constitute the only way ultimately to completely confirm the soundness of the system design.

Another factor in achieving reliability is hardware requirements. Programs of the past have generally lacked sufficient hardware to make possible any satisfactory approach toward reliability testing. Planning the amount of hardware for each stage of the program, from the begining of component development and reliability check-out through to final systems testing and initial operational capability for military use, is a major factor in setting up a good missile development program. We think we have this in hand.

Another vital ingredient is facilities. There is probably no characteristic of major weapon systems programs that has so often in the past been the determining factor in the speed and efficiency of development than the facilities program. The tendency all too often is to fail to include the needed facilities, or to underestimate the lead time required and the technical difficulties of such facilities programs. Major facilities acquisition also involves difficult arrangement-making problems between various government agencies and between such agencies and industrial contractors. Recognition of the size, scope, and complexity of facilities problems is a prime requirement for the successful execution of a major weapon systems program.

### *Summarization*

In summary, I wish to emphasize the key elements of thought contained in my previous statements. These concern the general orientation of policy and planning which I recommend to firms or groups interested in contributing to that portion of national defense connected with modern weapons such as ballistic missiles and supersonic aircraft. These contribute to careful planning with emphasis upon over-all weapon systems rather than upon specialized functions of the "ivory tower" type. The elements themselves are: carefully directed fundamental research; teamwork as expressed by ability to see over boundaries and comprehend problems in other areas such as aerodynamics, propulsion, etc.; sound management and economics, plus imagination.

A small but well informed and highly imaginative planning group in each case can assist in "crystal ball gazing" to tie together such seemingly diverse elements as economic, over-all military policy, tactical usage, training, production and maximum use of the most advanced technology the state of the art allows. I also hope that my few observations on the ballistic missile program have been informative.

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# central RADIO PROPAGATION laboratory

by Dr. Frederick H. Brown, Director, Boulder Labs.

HREE YEARS AGO, THE National :au of Standards (NBS) opened w multi-million dollar radio re- :h center in Boulder, Colorado, door to the University of Colo- . Located at the foot of the :ies, this western laboratory is in incongested area ideal for radio agation experiments. Here the ate allows year-round field work, the varied terrain makes it possi- to study the effects of many dif- nt land formations on the propa- on of radio waves.

primary impetus for establish- the new laboratory was the ving need for accurate informa- on the characteristics of radio es over a wide range of frequen- and under many diverse condi- s. The remarkable technological elopments of recent years have stly expanded the frequency spec- n available for communications, that equipments now function at juencies up to 100,000 megacycles. the same time, the available radio ce has been increasingly utilized commerce, industry, science and Armed Services. Radio propaga- n data has thus become of vital portance in such fields as global ation, all-weather shipping and rbor control, frequency allocations d world-wide communications.

The NBS radio research center at ulder consists of two laboratories the Central Radio Propagation boratory (CRPL) and the Radio indards Laboratory (which pro- les standards for electric quantities radio and microwave frequencies). CRPL originated in the Interservice dio Propagation Laboratory, which Combined Chiefs of Staff (U. S. med Forces) established at NBS the spring of 1942. During World ar II, this laboratory provided the med Services with valuable infor- ation on radio propagation condi- ons. Now CRPL has primary re- onsibility within the nation for col- ting, analyzing and disseminating ta and information on radio propa- tion. To carry out this responsi- lity, the laboratory at Boulder con- cts research on the fundamental ture of radio waves, the basic eories of radio-wave propagation d the characteristics of radio ener- under widely varying conditions. operates a network of field stations om the arctic to the tropics, and changes data with other radio re- arch laboratories throughout the orld. Within the Central Radio ropagation Laboratory are two di- isions—Radio Propagation Physics nd Radio Propagation Engineering.

The Radio Propagation Physics program involves studies of radio-wave propagation over long distances via the ionized regions of the earth's outer atmosphere, which are known collectively as the ionosphere. The program includes: (1) basic research on upper atmosphere physics, on the formation and disturbances of the ionosphere and on the interaction of radio waves with the ionization; (2) study of the characteristics of specific propagation mechanisms such as ionospheric reflection, ionospheric scattering and guided mode propagation, and (3) regular service as in the prediction of long-term changes in useful frequencies for communication, in the warning of short-term disturbances to communication and in the collection and distribution of ionospheric and solar data on a national and international basis.

One phenomenon of the upper atmosphere being studied in the radio physics division is airglow, a faint illumination normally not visible to the naked eye but always present at a height of about 60 miles. It is caused by radiation from atoms and molecules excited by solar energy.

To measure airglow, the Bureau developed a telescopic photometer which has improved spectral resolution and gives a more rapid sky coverage than was hitherto available. It is arranged to scan the sky repeatedly and automatically and to record the observed intensity within narrow spectral bands. Filters exclude background radiation from space and allow only the airglow colors to be recorded—red and green emitted by oxygen atoms, yellow emitted by sodium atoms and infra-red emitted by OH radicals. The incoming radiation is translated into an electric current by a photoelectric cell. The current is amplified and then recorded through an inked pen attached to a recording galvanometer. Analysis of the records has been accelerated by the use of punched-card and electronic-computer techniques.

By correlating airglow data gathered from a network of field stations with other kinds of upper atmosphere studies, CRPL hopes to gain more definite information about the composition, temperature and behavior of the ionosphere. Some of the other studies include theoretical investigations and instrumental observations of the complex motions which the ionosphere undergoes as a result of solar heating and lunar and solar gravitational tidal forces.

At many radio sounding stations throughout the world, detailed observations of the ionosphere are made with specially designed instruments. At the present time, 22 of these stations are being operated either by the Boulder Laboratories or by other Federal agencies, foreign governments and universities working in cooperation with the Boulder Laboratories. Several of these stations have been established to participate in the International Geophysical Year.

Much information is being gathered on the height and density of the layers of the ionosphere through vertical incidence methods. With an ionosonde, radio pulses of various frequencies are beamed at the ionized layers and the time interval between the emitted signal and its echo is measured.

Predictions of maximum usable frequency are usually based on ionosonde data. However, it has been discovered that communication often takes place at frequencies somewhat higher than indicated by existing theory based on vertical incidence studies. This type of communication apparently occurs when some of the higher frequency radio waves strike the ionosphere and reflect obliquely over long distances. So, oblique incidence is now being studied in relation to the vertical incidence.

In the Arctic, the Boulder Laboratories are investigating the intensity of radio waves propagated via the ionosphere in the region near the visual auroral zone, where radio waves tend to be absorbed instead of reflected. Information on this phenomenon is essential if reliable radio communication paths are to be maintained from points in the United States to Europe and Asia.

### *Ionospheric Scattering*

By means of a very long antenna suspended across a nearby canyon, NBS scientists are transmitting low frequency signals directly upward to the ionosphere and studying the different modes of reflection present uniquely at low frequencies.

Since 1951, the Bureau has pioneered in the study and use of a mechanism of radio propagation via the ionosphere called "regular ionospheric scattering." By this mechanism, radio energy is scattered when it strikes irregularities in the ionosphere. These signals are remarkably dependable, actually tending to be enhanced at times when ionospheric disturbances completely disrupt regular radio communications.

The study of ionospheric scattering requires specialized receiving equipment, a powerful transmitter and large antennas. Experimental installations have been set up over paths within the United States and in Alaska, between Newfoundland and the Azores, and elsewhere in the Northern Hemisphere. From experiments conducted at these locations, NBS has found that scatter effects vary with latitude. For instance, the median power transmitted over a standard path in arctic and sub-arctic latitudes is about ten times stronger than that propagated over a similar path at temperate latitudes. The signal also varies with time of day and year.

The Boulder Laboratories now is extending its research program to study ionospheric scatter in a geographical area where the mid-point of the path will be nearly at the geomagnetic equator. As part of this research, seven stations have been set up in South America in conjunction with the International Geophysical Year program.

Research in this field is expected to provide information on heights at which scattering occurs, dependence of signal-strength on the transmission frequency and the scattering angle, relative contributions to the scatter signal from meteoric ionization and atmospheric ionization due to solar radiation, and effect of the earth's magnetic field on scattering.

Investigation of ionospheric scatter has led to an increased emphasis on antenna research which has now become an important part of the NBS program. The work on very-high-gain antennas has become particularly important in connection with ionospheric scatter communication.

A challenging study is also being made of Sporadic-E. Sporadic-E reflections are apparently the result of electron or ion clouds in the E layer of the ionosphere. These clouds are of varying sizes and drift through space so that the phenomenon seems to come and go. In certain latitudes, it seems to be related to scattering and in others its seems to result from a combination of factors including reflection. Sporadic-E is responsible, for instance, for low-band television signals being sporadically transmitted over amazingly long distances. In particular, scientists wish to know the frequency dependence, the association of vertical-incidence Sporadic-E with that seen on the oblique incidence paths, and the association of Sporadic-E with regular ionospheric scatter.

In the field of radio astronomy, much is learned about the earth's ionosphere by observing how it affects radio-star energy which passes through it. Also, by studying radio emissions from the planet Jupiter. information is gathered on this planet's ionosphere which by comparison can lead to a more precise knowledge about the earth's ionized upper atmosphere.

Action of solar- and cosmic-radio waves is observed daily with radio telescopes, and from an analysis of automatically recorded data comes information of benefit to the radio prediction services as well as to the basic study of the sun.

Also under study are the tremendously long paths traced by whistlers — radio energy that originates from lightning discharges penetrates the lower ionized layers and follows the earth's magnetic lines of force at heights up to 25,000 miles to arrive in the opposite hemisphere.

When better understood, whistlers may provide means of gathering some kinds of information on space nearly 100 times farther away from earth than the IGY satellite will travel. *It is conceivable that the whistler path may some day be used for direct communication between two points in opposite hemispheres.*

### *Prediction Services*

During the years since it was established, the NBS service of issuing radio propagation predictions three months in advance has proved invaluable to radio equipment manufacturers and to communication agencies for frequency allocation and efficient frequency usage.

Of great benefits also have been the short-term forecasts of possible disturbances in the ionosphere which might affect communication. To gather this information, the Bureau cooperates closely with solar observatories throughout the world.

The Radio Propagation Engineering Laboratory is largely concerned with studying the characteristics of radio waves propagated through the troposphere and with the meteorological and other conditions that affect such propagation. It also conducts applied research on radio-wave

*(Continued on page 12)*

propagation as it affects the design of radio systems, and places much emphasis on propagation characteristics that limit radio's effective distance range, the rate of radio transmission of intelligence, and accuracy of direction-finding and navigation systems. Recent research has shown that VHF and UHF signals often travel beyond the line-of-sight radio horizon. This is due to a phenomenon known as a tropospheric forward scatter. Theories now being developed indicate that, in this style of scatter, the radio energy is reflected over long distances by small irregularities in the atmosphere caused by turbulence.

Detailed studies are under way on long-distance tropospheric propagation and ultra-high-frequency communication to learn how they are affected by weather, terrain, antenna gain, space and frequency diversity, signal fading and the variation of polarization and phase due to propagation conditions. In addition, experimental studies of variations in propagation velocity over the line-of-sight transmission paths use techniques developed to measure these variations at 1,000 to 10,000 Mc with an accuracy, during five-minute sampling periods, of a few parts per billion.

### Atmospheric Turbulence

Since atmospheric turbulence is associated with meteorological conditions, radio measurements were made over ten-mile lengths of atmosphere under various conditions of cloud formation, barometric pressure, air temperature, relative humidity, wind velocity and solar radiations. From an analysis of the data, information can be derived about the physical nature of atmospheric turbulence that is valuable to designers of direction-finding equipment. Results of these studies have led to an estimated immediate saving of approximately $50,000,000 to the United States Government in application to radio systems.

In another approach to the problem of atmospheric turbulence, detailed measurements have been made of variations in velocity of radio waves propagated through very small samples of the atmosphere — *over paths no longer than an inch.*

Both military and commercial users of radio need predictions of the external noise level arising from man-made, atmospheric and galactic radio noise. They also need to know the character of the noise to evaluate its effect on any given system. An atmospheric radio noise recorder, developed by the Bureau and accepted internationally for use in a world-wide measurement program, provides continuous recordings of the average noise power received on a standard antenna at eight discrete frequencies in a range from 15 kc per second to 20 Mc per second. Some of these recorders have been modified to record also the average noise voltage and the average of the logarithm of the noise voltage. It has been shown that these three statistical characteristics of the noise provide a reasonably comprehensive picture of the physical nature of its amplitude distribution.

### Theoretical Investigation

Several theoretical investigations are being carried out on very low frequency propagation. To interpret electromagnetic radiation from lightning discharges and other high intensity transient sources, for instance, calculations have been made that indicate that the waveform of the radiation field is modified by diffraction and loss in the finitely conducting ground. Also investigated has been the theory of the propagation of very low frequencies over moderate and great distances via the ionosphere.

Aiming at more reliable world-wide communication, the Bureau is seeking to improve the efficiency of very-low-frequency (VLF) communications circuits from 10 to 15 kc. Since antennas for radiating VLF energy are usually very large and inefficient, a basic study of design limitations of such antennas is now in progress.

Use of flush-mounted antennas is now common in jet aircraft and guided missiles. An anaysis has been made, therefore, of the effect of covering the slot with a layer of fabric or other dielectric. In the case of the slotted cylinder antenna, this dielectric coating can improve the omni-directional characteristics which are desirable for beacon applications.

To make optimum use of the radio spectrum, it is necessary to have not only information on noise and interference charactertistics but also on those characteristics of the carrier wave that can be modulated to transmit a message, and on characteristics of systems that modulate or demodulate carrier waves.

The Bureau has designed and constructed equipment to measure carrier characteristics under a wide variety of conditions. Initial tests are now being made on HF ionospheric fading and forward scatter tropospheric fading carriers. Results o these and other investigations will b used by Bureau engineers to increas the accuracy of predicting radio systems performance under numerou typically encountered conditions.

For several years now, the Burea has been investigating precision-navigation systems that use low radio frequencies. Long-range sky wave reflection of signals from experimenta navigation-type transmitters were transmitted from eastern Unite States to Central and South America. The signals were found to have a very high phase stability, indicating the feasibility of a navigation system utilizing long-range skywaves.

The Bureau has been investigating special theories pertinent to the phase computation of the low frequency ground waves and applying the results to radio navigation systems operating in the range 10 kc to 1 Mc for earth conductivities ranging from zero to infinity. The vertical-lapse effect on the refractivity of the earth's atmosphere has also been evaluated for various meteorological conditions and for the altitudinal effect of the above-ground receiver. Although this work is applied directly to navigation systems, it is primarily basic research in radio propagation.

Although the phase and amplitude of ground waves over complex propagation paths cannot be treated theorectically, instrumentation for the exact measurement of these quantities over any propagation patb up to approximately 100 miles has been developed. This involved a measuring system with advance-type circuits and automation of all data recording. Such a measurement system is essential in confirming new propagation theory. It is specifically useful in practical-system calibration and in exploration of complex propagation paths.

To evaluate the effects that hills, trees, mountains, etc., have on received field strengths at television frequencies, the Bureau is conducting a field-measurement program to determine the variability of the fields received and to establish the number of measurements that need to be made, both in the service area and in the fringe area of a television station. Results are being incorporated in a proposed method for estimating what the service area of each television broadcast station will he.

During the past several years, a large quantity of tropospheric propagation data has been obtained in the frequency range of approximately 50 through 1,000 Mc, but only a

amount of data exists at higher
encies. Consequently, the Bu-
is now designing a complete
field strength recording system
›erate in the 9 to 10 kmc fre-
cy band. It will be used to study
ɪspheric radio propagation me-
isms both within and beyond
·adio horizon.

so being studied are the modu-
n capabilities of long-distance
ard scatter transmissions with
ly directional beam antennas.

ecently, the Bureau evaluated the
ɪagation conditions which deter-
the coverage of the Tacan sys-
of air navigation and made rec-
ɪendations for use in the common
em of air navigation. Results
expected service under a large
ety of conditions of channel and
ɪcent interference.

hese studies also provide a basis
determining the number of chan-
required for nation-wide Tacan
·ice, an important consideration in
ermining the feasibility of using
an in the common system.

'or many years, the Bureau has
ducted both basic and applied re-
rch into the uses and limitations of
io propagation techniques in dis-
ce measuring and direction find-
systems. To date, this work has
n largely concerned with measure-
nts required in commercial navi-
ion. Recently, however, new ap-
cations, such as missile "naviga-
n" or guidance, have arisen re-
iring a much more precise evalua-
n of the basic physical problems
'olved. More refined instruments
d techniques are expected to shed
w light on these problems.

During the International Geophysi-
l Year, which began July 1, CRPL
ll extend its program of research
d will set up many more field in-
illations on a global basis. The
›ulder Laboratories will be the U.
Center for IGY research on the
nosphere, airglow and noise levels.
ere will be located one of the three
›rld-data centers for collecting and
ɪalyzing data on the ionosphere. At
›rt Belvoir, Va., there is an IGY
orld Warning Center which will
ert observers around the world for
pected increases in geophysical dis-
ɪrbances so that observations can be
ɪtensified.

Results of the IGY work, when cor-
lated with the everyday projects at
ɪe Boulder Laboratories, are expect-
d to yield a wealth of information
f direct benefit to both the basic
cientific and the engineering prob-
ms of radio propagation.

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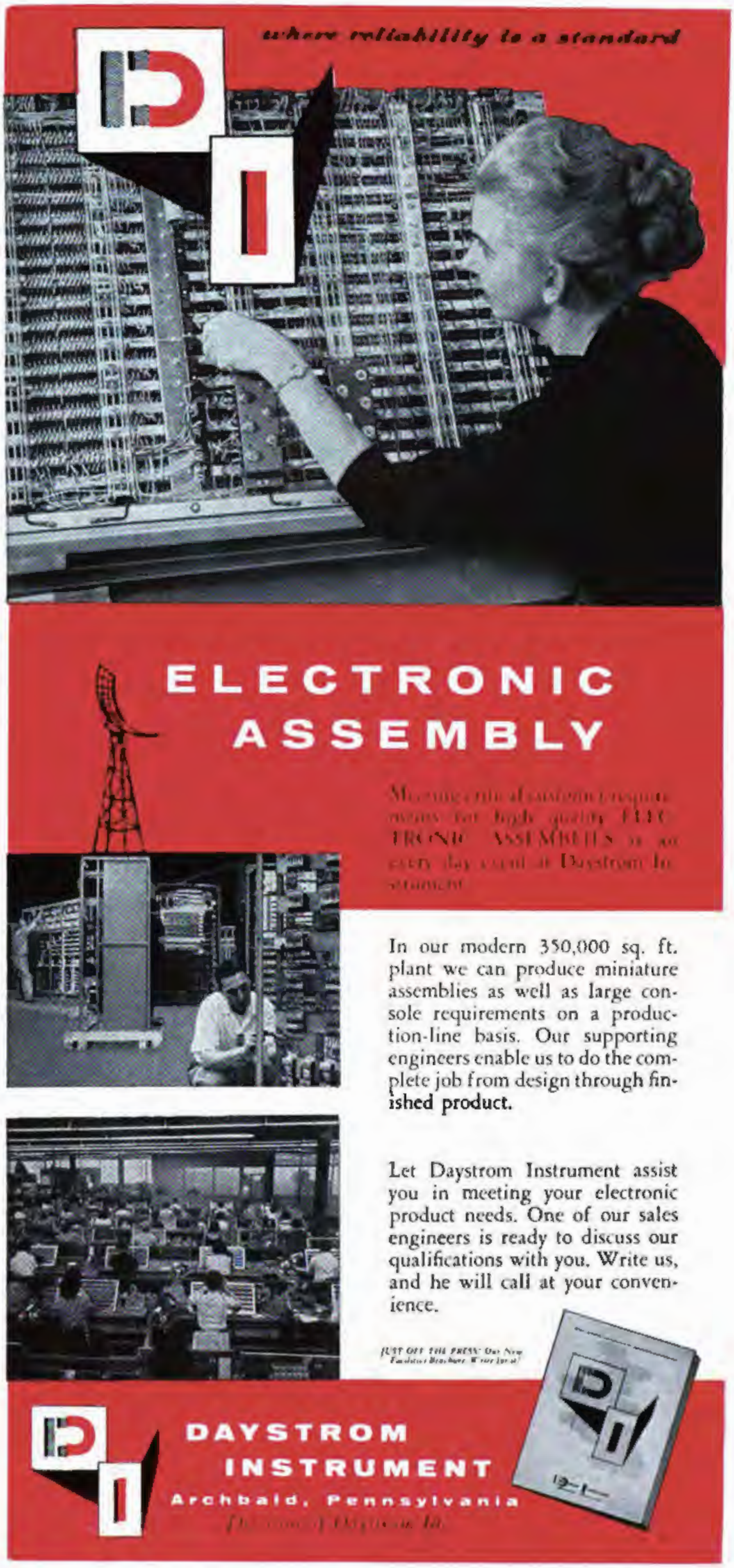

# CRYSTAL FILTERS

**by Malcolm M. Hubbard** **President, Hycon Eastern, Inc.**

**Recently, Hycon Eastern revealed design details and characteristics of a high frequency crystal filte which will be covered in detail in the following article. This revolutionary electronic device will enabl designers of high frequency radio systems to put more radio transmitters on the air within the availabl frequency spectrum, in addition to a myriad of uses as yet unforeseen.**

RADIO RECEIVERS OPERATE on the principle of selecting from a wide range of available energy some specific bit of energy containing desired information. To accomplish this feat, designers of radio communication systems use a scheme of filtering. For years, filters have been used to cut out, or do away with, unwanted radio energy so that desired energy can be used effectively. This is why home radios and television receivers have several filters built into them. Military radios, in general, have even more filters.

Therefore, a filter may be defined as an electronic network of components which will allow only certain signals to pass through it. Most filters are individually designed for the specific job they have to do. However, there are certain places in radio, radar and television circuits where the same type of filter often turns out to be necessary. This is why manufacturers of radio and electronic devices have standarized certain filter types. Up to now, most of these standard filters have been made of coils and condensers.

Nature has arranged things in such a way that it is easier to turn a sharp corner when there is less resistance to turning. In the case of filters, sharp corners are the desired end product. Abrupt changes in response to signals of different frequencies is what designers try to achieve in a filter. The less resistance an element has, the easier it is to bring about abrupt changes in response. Quartz, which is an extremely stable crystal substance, has the fortunate characteristic of possessing very little resistance to vibration at certain discrete frequencies. The frequency at which any particular piece of quartz crystal will vibrate without much resistance is dependent upon the dimensions of the crystal and mounting techniques. In general, a given piece of quartz crystal will vibrate easily at one specific frequency, but will not tend to vibrate at all at any other frequency. This fact is the key to filters made of quartz crystals.

Crystal filters do the same basic job as long-standing conventional filters, but they do the job much better, especially at high frequencies. In addition, crystal filters make possible the design of new types of equipment never before possible.

Single sideband radio equipment makes particularly good use of crystal filters. In single sideband transmission, effectively, half of each radio signal is filtered out at the transmitter and then later reinserted at the receiver by electronic means. The very nature of a single sideband system makes a good filter the heart of the system.

Crystal filters are desirable for high frequency single sideband systems because a crystal filter has an inherently sharper rejection ability than other types of filters. Use of crystal filters in a radio receiver, especially at frequencies above conventional home radio bands, makes possible the design of a simpler radi set than is feasible with conventiona filters made of coils and condensers.

For any communication or navigation system where it is necessar or desirable to transmit and receiv a narrow band of information, th job can be done better using a crystal filter than any other type of commercially available filter. In man instances the use of such a filter represents the only way to do a give job using standard, commerciall available parts.

There are, in general, three type of filters commercially available These are: (1) LC Filters; (2) Mechanical Filters and now (3) Crysta Filters.

LC filters are networks made up of coils and condensers; they represent the most conventional approach to making filters which electronic designers have used in the past. Mechanical filters make use of vibrating metal structures to filter out undesirable signals which have been transformed to vibrations. The newest and best type of filter, the crystal filter, makes use of networks of tiny quartz crystals.

High frequency quartz crystal filters are smaller, more reliable, do a better job of filtering and are simpler than their counterparts made of coil and condensers or mechanical structures.

(*Continued on page* 16)

U. S. Army Photo

**Night mobility and combat power are provided for both men and tanks by infrared devices developed by ERDL.**

# ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES AT FORT BELVOIR FURTHER SCIENCE OF MOBILITY

Mobility is a byword at the Engineer Research and Development Laboratories, the principal military R & D center of the Corps of Engineers, U. S. Army. Work in seventeen fields of endeavor is aimed at furthering the mobility of our forces, and impeding the movement of the enemy. These fields are: bridging and stream crossing, cover and concealment, construction and maintenance equipment, infrared, liquid fuels distribution, mapping and geodesy, materials, mine warfare and demolitions, buildings, processing and packaging, water supply and sanitation, special weapons and general engineering.

About 1,500 civilians, 50 officers and 200 enlisted men work at the Laboratories. An 800-acre proving ground provides facilities for testing earthmoving, firefighting and illumination equipment, obstacles and demolitions, and mine warfare items. Environmental testing under arctic, desert, and tropical conditions is accomplished by detachments of Fort Churchill, Canada; Yuma, Arizona; and in Panama, respectively. Facilities in Greenland are employed for operational testing of construction and navigation equipment for ice cap requirements. At Prince, West Virginia, there are facilities for bridge testing. A branch at Wright-Patterson Field, Ohio, coordinates ERDL and Air Force aerial photographic activities.

Typical of ERDL's work are target location systems and equipment being created by its Topographic Engineering Department—where means of accurately locating the enemy by use of drones and many other techniques are under constant development. In other departments, vehicular navigational systems, construction equipment capable of being air-dropped, and mobile assault bridges are being developed, and the effects of atomic weapons are being determined. Many hundreds of other projects are under way at ERDL, helping to keep the Army of the United States second to none.

**Technicians at Ford Instrument assembling components for vehicular navigational computers being developed under an ERDL contract.**

This is one of a series of ads on the technical activities of the Department of Defense.

**FORD INSTRUMENT CO.**
DIVISION OF SPERRY RAND CORPORATION
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Crystal filters make use of several wafers of quartz, usually either two, four or eight. The wafers, or individual crystals, are arranged in a lattice or bridge network configuration so that the entire network has certain desired characteristics. The characteristics desired and achieved in the filters are as follows.

Consider an antenna normally connected to a radio receiver. This antenna is susceptible to a considerable portion of the radio energy passing by it. However, the radio receiver is only useful to the listener if some intelligible information emanates from it. If all the information contained in all the radio frequencies (to which the antenna is sensitive) were simultaneously presented to the listener, the result would be a garbled hodgepodge of noise, with essentially no intelligible information resulting. So, the receiver is "tuned" to a narrow range of frequencies which contain only the information desired at one particular time.

Unfortunately, speech cannot be transmitted via radio on one single frequency. So, it is general practice to tune a receiver to a specific frequency (the one read on the dial) and which allows the receiver to pick up signals close to the dial frequency. Normally, the signals picked up, or detected, are equally spaced on both sides of the dial frequency. The resulting information which comes out of the loudspeaker is therefore a summation of information contained in a band of frequencies. The center of the band is the frequency to which the radio receiver is tuned. This frequency is normally referred to as the center frequency of a station. The band of frequencies over which intelligible information is transmitted is called just that, a frequency band. (In the case of home radio receivers, this band is a few thousand cycles in width.)

### *Frequency Receiving*

An essential part of a radio receiver, therefore, is a filter which will discriminate against all other frequencies, exclusive of the frequency band of the station being received. Crystal filters are designed to make the receiver extremely receptive to the frequency band desired, and at the same time extremely non-receptive to unwanted frequencies outside the band.

Communication systems more sophisticated than home radios vary the basic theme somewhat. Since the range of frequencies available in nature is necessarily limited and since more and more people continually want to get on the air with information, many schemes have been advanced to make better use of a given finite band width of frequencies. One of the better schemes is single sideband transmission in which half the frequencies are arbitrarily filtered out and thrown away. This leaves the omitted frequency band available for other people to use. In order to achieve such clever manipulation of frequencies, however, extremely good filters are required. The filters must be able to allow desired frequencies through a system virtually untouched, but at the same time must suppress immediately adjacent frequencies—hence, the sharp corner. The sharper the corner the filter can turn, the higher is its "selectivity"—that is, the more nearly can the filter approach the ideal situation of allowing one frequency to pass through, but completely blocking the next adjacent frequency along the line. Here again, crystal filters approximate this Utopian situation much more closely than other existing types of filters.

The ability of a filter to have high "selectivity" is primarily determined by the "Q" of the elements used in the filter. Q, or "quality factor," is an arbitrary symbol which permits the engineer to determine how much energy is dissipated or wasted by the filter element. The higher the Q, the less the wasted energy, and therefore, the better the filter. In addition, the same filter, produced at a higher frequency, will require a higher Q for the same performance or selectivity. Conventional coils used in L C filters have Q's in the order of 200, while the elements employed in mechanical filters have Q's of about 2000. On the other hand, ordinary quartz crystals have Q's which range from 20,000 to 200,000. In other words, the crystal filter can be made a great deal better than the LC or mechanical filter at low frequencies. and furthermore, can be produced at high frequencies where the other filters will not perform.

Quartz crystals have been used for years to control the frequency of oscillation of oscillators. It has been only within the past two years, however, that any serious work has been undertaken to make commercially available the filters containing a network of quartz crystals which will allow a band of frequencies to pass. Lattice filters made up of quartz crystals were first proposed (about twenty years ago) by a scientist named Warren Mason of Bell Telephone Laboratories. However, the mathematical calculations necessary to design these networks and the difficulty of producing the necessary crystals at high frequencies caused manufacturers to shy away from crystal filters. It was Dr. David Kosowsky of M.I.T., and now at Hycon Eastern, Inc., Cambridge, Mass., who developed a highly simplified mathematical technique for designing crystal filters and devised new methods for producing and testing the required quartz crystals. Dr. Kosowsky went further on and designed shop production equipment which makes the manufacture of crystal filters almost routine. It was this latter step which enabled Hycon Eastern to bring the price to a figure which is competitive with LC and mechanical filters.

At frequencies above a few megacycles, crystal filters are virtually unchallenged by their sisters, LC filters and mechanical filters. The older type filters just won't do the job at high frequencies. At lower frequencies, where long established techniques have brought LC and mechanical filters' prices down to low figures, crystal filters excel only in performance. At lower frequencies, crystal filter prices and mechanical filter prices are roughly the same. A typical crystal filter currently sells for forty dollars when bought in small quantities, or twenty to twenty-five dollars when purchased in larger lots. As with transistors, which sold for about two hundred dollars when originally developed but which now sell for less than two dollars, crystal filters will also come down in price when they are in high production.

### *Design Opportunities*

Athough the low frequency crystal filter will play a significant role in single sideband and telephone communication systems, the high-frequency crystal filter may well revolutionize the design of other communication and navigation systems. In addition to performance which cannot normally be obtained even at lower frequencies with conventional filters, the high-frequency crystal filter may be made extremely small in size. Models have already been produced which are about half the size of a small match box. These miniature crystal filters, in conjunction with miniature vacuum tube and transistor circuitry, are currently being employed in the design of several of the most compact communications equipment ever produced.

Biggest potential use in the next few years of crystal filters will probably be in mobile communications.

With the Federal Communications Commission constantly forcing all radio systems to operate in continuously narrower frequency bands because of crowded conditions at high frequencies, narrow band pass filters are becoming more and more significant. At the present state of the communications art, LC and mechanical filters are being used to their ultimate capabilities. The advent of crystal filters now enables equipment manufacturers to surge ahead with radio and radar systems using narrower frequency bands than were before possible.

An extremely important significance of the arrival of crystal filters on the communications scene is the possibility now of eliminating multiple conversion high-frequency receivers. Because it has been hard to filter signals at high frequencies, electronic manufacturers have utilized steps of frequency conversion to get the frequency down to a useable range. In other words, signals at high frequencies could not be easily filtered using LC or mechanical filters, so the signals have been converted to frequencies where filters will work. Often, multiple conversion receivers have three mixing stages where frequency conversion is accomplished. Each of the mixing stages requires an oscillator. In addition to the higher cost, each oscillator added to a receiver causes unwanted noise possibilities. In short, the manufacture and alignment of multiple conversion receivers is more complicated than for single conversion receivers. Crystal filters make possible the design and manufacture of single conversion receivers at high frequencies where this has not been feasible up to now.

Military and industrial users alike welcome the reliability characteristics of crystal filters. Unlike many LC filters, crystal filters need no alignment after manufactore. The quartz element is extremely stable with respect to temperature, shock and vibration. In general, crystal filters will meet guided missile specifications for environmental conditions, whereas LC and mechanical filters have great difficulty performing under the missile conditions.

High selectivity at high frequencies, extreme stability, competitive price and versatility are the outstanding characteristics of crystal filters. In the worst case, a typical crystal filter may change its parameters one part in one million over the period of a year.


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Equipment Design and Modernization
Missile Systems and Components
Solid State Physics

# looking forward to the FUTURE

By [illegible]

I PROPOSE TO SET FORTH IN THIS article the broad objectives and goals of the U.S. Army Signal Corps in our defense program. This is appropriate when we consider that our Government today is spending just about $1100 a second, or approximately $100 million a day on military expenditures of all sorts. These expenditures are reflected in the present reorganization of the Army.

But, even without a reorganization of the major combat forces, the Army would have been required to re-equip itself with new communications-electronics gear in order to keep pace with the many technological advances being made in these fields. In looking toward the future, we find that as the Army gears itself to today's Atomic-Electronics Age, the role of the Signal Corps becomes increasingly more important.

Almost every organizational change and every new weapon adopted by the Army increases the need for new electronic devices and systems. The reorganization which is now in process to form the new pentomic divisions gives greater flexibility and fire power. It reduces the over-all man power requirements markedly. It also introduces a brand new requirement, for 600 Signal Corps officers, which did not exist before.

The accelerated tempo at which the Pentomic Army is being developed places a tremendous challenge upon every element of the Signal Corps. Considering material, we are faced with the largest undertaking since the beginning of World War II. Our energies and resources in other areas of endeavor are also being heavily taxed.

So, today, the Signal Corps is embarked on an aggressive program to bring, through development and into production, a large variety of new electronic and communication devices never before employed by the Army. Our broad objectives in this area are to develop and produce the concepts and the electronic tools and to recommend systems and organization and doctrine to the Continental Army Command (CONARC) which will provide the commander with the essential elements for command control.

The provision of command control is the principal task of the Signal Corps and it will remain so in the Army of the future.

Just what is meant by the term "command control?" An accepted definition of the term is: "The systematic employment of devices and techniques designed to acquire data and transmit information essential to the control of friendly military forces, and, to counter the enemy's command control system."

If you analyze that definition for just a moment you will find that it has three basic elements: (1) signal communications, (2) combat surveillance and (3) electronic warfare.

The Signal Corps is developing basic systems for each of these 3 elements along with interworking systems for each level of employment, i.e., division, corps, army and theater. Each, of course, will supplement the others. The practice of piecemeal introduction of new equipment has been abandoned in favor of complete systems which will include provisions for equipment, personnel, organization and maintenance support.

In the approved concepts of the new Army in the field, command control has taken its place along with firepower and mobility as one of the 3 basic determinants of victory. This places it squarely up to the Signal Corps to prove that it has the technical competence to provide the Army with this capability.

THE pattern has been pretty well set for the composition of the basic team in the new mechanized divisions. As I visualize it, this team will be comprised of battalion-sized composite units of infantry, armor, artillery, engineer and signal troops. These units will be armed with ballistic rockets and guide missiles, using conventional or atomic warheads. The units will be highly mechanized, will have substantial organic aviation and will be capable of operating at distances of 50 miles or more from adjacent units or higher headquarters. This mobility, atomic firepower and dispersion could represent confusion and even self-destruction without adequate command control capabilities.

The kind of communications we envisage for 1960-1970 involves new techniques of radio having long range, greater capacity and design to offset the enemy's jamming efforts. In the use of radio relay, for example, our objective is to double its usefulness and, at the same time, reduce the number of technicians required for operation and maintenance.

Another objective in the communications area is to develop new types of wire which can be laid by helicopter, drone or missile. and which can successfully transmit its message even though it may be broken in a half-dozen places.

Perhaps the most widely known change in the field of Army communications is the "Area Communica-

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*The author, AFCEA contributor and supporter, prepared this article when he served as Chief of Combat Development & Operations Division, OCSigO. He recently assumed the post of Deputy Commandant of the Industrial College of the Armed Forces, Ft. McNair, Wash., D. C.*

tion System" concept. This system has been designed to insure that the new type combat groups will, at all times, be tied into a flexible communication system which can be deployed throughout the combat zone, so that no matter how it moves or how it is displaced, it can talk to communications central which can rapidly link the unit commander with adjacent troops.

### *Requirements*

In the face of enemy atomic warfare capability and the accompanying supersonic delivery systems, a strong requirement is generated for a comunications system capable of absorbing the impact of atomic attack and capable of quick reaction to meet changes in operational plans and in task organization. The increased emphasis of direct operational and administrative communications also dictates a departure from the present echelon-to-echelon concept.

This new system must be capable of supporting the requirements of the combat surveillance system, the electronic warfare system, the air navigation and traffic control system and the various weapons systems which evolve from technological improvements in methods of target acquisition and delivery of missiles. To meet these requirements, this new communications system is being perfected to meet the following characteristics:

a. It must be designed to provide communications to widely dispersed units and installations. It must minimize the need for support units to concentrate around one or two major communications centers located along a single axis of communication.

h. It must be a flexible system which can readily accommodate itself to changes in organizational structure and to re-locations or concentrations of units, command posts and installations. Its structure and patch-through facilities must permit electrical rerouting and physical re-locating of circuits with a minimum of changes in the system. Systems' components must be made up of building block type units so that rapidly changing requirements can be met by adding or removing unit elements to meet specific conditions.

c. It must be a reliable system, designed to provide continuity of communications in the face of enemy action. Destruction of a portion of the system by an atomic weapon, for example, must not disrupt the entire system.

d. It must be a common user system, designed to provide communication (particularly trunk-line service) for installations and units which would otherwise use organic facilities. Its other features must make it adaptable to provisions of special purpose circuits required to coordinate the employment of new weapons systems and for other special operations.

e. It must have a high capacity potential designed to meet the extensive demands placed on it.

f. It must be a high quality system designed to reduce the degradation of service which would otherwise result from the distances involved under the new concepts.

g. It must contain sufficient mobile elements to keep pace with movements of the Field Army. To create the degree of systems flexibility required, these facilities must be mounted in vehicles, vans or transportable shelters.

The most significant features of the area communication system are:

a. A lattice work of high quality, high capacity communication links, with signal centers at each link intersection.

b. An increase in the use of multichannel radio relay and field cable systems, with a major decrease in the use of pole line type of construction and single circuit systems.

c. Development of the communication means, which serves the several command echelons, into components of an over-all integrated system rather than a group of independent facilities.

d. An increase in the capacity and operational quality of equipments, and in the mobility and flexibility of employment.

Also, there will be provided greater flexibility in tactical communications. Under this system, there will be almost instantaneous switching of voice circuits to any combat group or unit within the combat area. This concept will, of course, virtually eliminate the use of wire in its area.

Combat surveillance is a new name which has been applied to one of the most difficult facets of ground combat—i.e., obtaining information of the enemy and keeping abreast of both friendly and enemy activities on the field of battle.

Combat surveillance is a continuous, all-weather, day and night systematic watch over the battle area to provide timely information for tactical ground combat operation. Combat surveillance includes friendly as well as enemy information obtained by both technical and non-technical means. The Army's combat surveillance system is the aggregate of all means of collecting information of the enemy, weather and terrain, and the means required to process and display this information rapidly and effectively to the commander.

Military leaders within the U.S. Army have recognized the vital importance of maintaining our combat surveillance/target acquisition capability, commensurate with the maneuver and fire capability of the Pentomic Field Army.

The U. S. Army Combat Surveillance Agency (USACSA), commanded by Brigadier General William M. Thames, was established in January 1957 with offices in the Pentagon. USACSA is directing the Chief Signal Officers' effort toward improving the Army's combat surveillance/target acquisition capability in consonance with the Pentomic and Pentana Army concepts.

A combat surveillance equipment system consists of several subsystems or main elements:

a. The information-collecting devices, with their aerial platforms, if appropriate.

b. The data link or electrical communications means required to transmit the information gathered by the collecting devices to a central station.

c. Processing, evaluation and collation of information to produce intelligence.

d. Display of the information and/or intelligence to the commander and staff in a useful and effective manner at appropriate echelons.

### *Means and Devices*

For the collection subsystem, several means may be used. All of the tried-and-true means of both World War II and the Korean conflict, such as photography, patrols, observers and interrogation of PW's, are still used, and added to that family are new or improved surveillance means such as infrared, radar, television, acoustic and seismic, U.S. Army Signal Corps equipments. These devices include the 100-inch camera, infrared scanners, ground radars, side-looking airborne radar (SLAR) and many others.

*(Continued on page 32)*

by C. F. Flannell
Royal McBee Corp.

# THE small COMPUTER

## and Decentralized Computing Facilities

DIGITAL COMPUTERS OF CONTEMporary vintage have made two major contributions in scientific and engineering applications which were hardly possible for computers of pre-electronic vintage. First, they have solved many problems which would be too large for even a lifetime of horse and buggy methods of calculation. Second, by assuming the burden of repetitious computations, they have provided engineers with more time for creative thought.

So valuable are these contributions to industrial technology that they have stimulated a remarkable development in the size and speed of computers. The giant brains are providing engineers with answers of precise accuracy in cases where educated guesses were previously the rule. The wide margin of safety provided with the educated guess resulted in the design of inefficient equipment creating continuously high costs of operation. In other cases, cut and try methods involving the building and testing of prototypes of trial design were used. Now the testing of many trial designs can be simulated at electronic speeds to eliminate the expense of building and testing actual prototypes. Recognizing the importance of such developments, the engineer is quickly accepting the giant brains available to him.

However, the use of giant brains is not without its price. While computers have grown to be very large and very fast, they have also grown to be very expensive and very complex. The expense requires critical scheduling for efficient use and the complexity makes scheduling difficult. In addition, efficient computer operation requires highly trained personnel who are difficult to find. Furthermore, the large computing installation is not flexible enough to keep up with the fast-changing demands of the engineering group. Hence, after the engineer learns to rely upon the giant brain and use it regularly, it becomes the source of several major obstacles.

The first obstacle an engineer faces in getting a problem solved on a giant computer is having the problem programmed, that is, put into machine language. I had personal contact with this problem during my employment in a large computing installation of an aircraft company. The last problem which I programmed had waited to be programmed for over six months. The engineers finally had to make a decision on the metal to be used in an air frame before they received the results of our heat calculations. Our calculations showed that the temperatures involved would stay slightly below the melting point of the metal selected by the engineers. If they had guessed wrong, thousands of dollars and a great deal of time would have been lost. This was a very important problem and the engineers were very unhappy with this computing service. Many groups waited even longer for their answers.

The second obstacle an engineer encounters in having a problem solved on a giant computer is the dual problem of communication and scheduling after the programming is completed. The data must be sent to the central installation each time a run is made. The large companies which have the large computers frequently are widely dispersed so that inter-office mail may require a half day for delivery. After the data arrives, it must be logged in, assigned a priority, punched in cards or tape for entry into the computer and held until the machine becomes available. Only then are the answers returned to the engineer.

In some situations, the obstacle to communication created by the large computer installation is even more critical. For many engineering groups, one day or even one week's service from the computing group is quite adequate; nevertheless, many engineers want their answers within a few minutes. One good example of this demand for quick results is in aerodynamic wind tunnel applications. In many cases when a wind tunnel test is completed, the engineers want to see the results of that test before they set up the next test; this requires that the pressures, temperatures and other measurements which were taken during the test be reduced to physical quantities which are meaningful to the engineer. Such a situation provides an ideal application for a computer. However, if the engineer must wait a day for these results, not only is his work less effective but also expensive wind tunnel equipment is inefficiently used. Therefore, such a delay represents a considerable financial loss to the company.

There are many other cases where immediate results are desirable. For instance, in research problems, the engineer may first try a given set of values and then when he sees the results he may want to change one number slightly to observe the effect on the answers. If he must wait a day or two for his answers, he is less inclined to try a new value. When he gets an answer which is close enough, he is inclined to draw his conclusions without trying for a more accurate answer. Hence, it appears that the barrier to communication with giant brains stultifies the experimental spirit.

In spite of this discouraging picture, a great deal of progress has been made toward improving the system of communication with the central computing installation. One method of improving communications is to feed data directly to the computer and receive answers immediately. Such a system in its ultimate form would be very complex indeed, and, with current techniques, is still impractical. The alternative method is to locate a computer at each source of data. The introduction of the small computer has made such decentralization possible. Hence, many large organizations have become interested in a decentralized operation as a method of increasing the efficient use of their personnel and of breaking up the bottleneck created by giant brains.

Some electronic engineering companies have responded to this interest by developing very versatile small computers. Many of the building blocks for these computers were developed for use by military aircraft and ships where limitation of component size is important. The General Precision Equipment Corporation is using such building blocks in developing small electronic computers. The Royal McBee Corporation, which has developed an international sales and service organization for its typewriters, office equipment and business systems, is marketing these computers. These two organizations have combined their facilities to produce and market the Royal Precision line of data processing equipment. One of these products is the LGP-30 computer, a small electronic computer designed primarily for scientific applications.

What comparisons can be made of the small computer with the large computer? First of all, recent developments with magnetic drum and disc memory systems have made it possible to produce a large memory in small computers at a relatively modest cost. Furthermore, a small ratio of physical size to effective circuitry can be maintained by the use of time-sharing of components. As a result, it has been possible to develop a truly general purpose computer of small size. Hence, the modern small computer can solve any problem which can be solved on the large computer; the only real difference lies in the time required for problem solution and the amount of human supervision required. Modern design techniques, then, have made it possible to put a very powerful computer in a very little space.

A second point in favor of the small computer is the ease of installation. Computers have been developed with remarkable capacity which occupy less space than a normal office desk, which operate from a standard wall outlet and which require no more power than an ordinary home iron. For such computers, no air conditioning is required and hence no major overhaul of buildings to house them as required for large computer installations. The cost of installation of such a computer is practically zero.

### *Principal Uses*

There are three principal ways in which small computers are being used today. One way is the use of several small computers as satellites to a large computer in order to reduce the difficulties attending the use of the large computer. Another is the use of a group of small computers to replace a large computer. A third way is the use of the small computer, by itself, as the principal computing device for a company, division or department. The expense of the large computer makes its use in this third case prohibitive. There are several interesting examples of such uses of small computers. Here is one.

The head of the computing department of a large aircraft company, after a six-month feasibility study, recommended to management that they open the bottleneck of the central computing installation by purchasing a group of small computers to be located in various engineering departments. Their central computing installation operates on an "open shop" basis where the engineer does most of his own programming. This programming is simplified by an algebraic interpretive routine which translates algebraic expressions into computer language.

The programming procedure was to remain unchanged with the installation of the small computers. The engineers would continue to program their problems in algebraic form using the interpretive routine to translate this algebra into machine instructions. The engineer who had a small computer in his own department would use an interpretive routine which would produce a program for the small computer rather than the large computer. The engineer then would return to his small computer where his problems could be solved without the delay of sending the data to the central installation and waiting for it to be returned a day or perhaps a week later. With this system, the engineer would make only one trip to the central installation or send information to the central installation only one time. Then he could continue to use his program, independent of the central computing installation, until he chose to solve another problem on the computer or make a major modification of the existing program.

The LGP-30 computer was recommended for this application because its order structure is compatible both with the large IBM computer and the Univac computer which this aircraft company is using. They planned to punch the program on IBM cards and use a card-to-tape converter or, if the Univac computer was used, they would punch the program tape directly from the computer. The engineer would return to his department

(*Continued on page 24*)

with a program tape ready for entry into the small computer.

The LGP-30 has been chosen to augment a large computer installation in another way. The compatibility of LGP-30 code with the codes of large computers has led to its use in program check-out. Anyone who has worked in a central computing installation realizes that an engineer rarely states his problem in the first writing exactly as he wants it; invariably he wishes to make additions to the program or changes in the program almost immediately upon its completion. Debugging of new programs and revision of programs consume a great deal of machine time and when the machine involved is a giant computer, time can be very expensive. In working through parts of a problem to find the source of difficulty, the greater speed of a large computer is of no advantage. An inexpensive man tends to become the slave of an expensive machine.

Hence, some people have chosen to eliminate this expenditure of valuable machine time by placing new problems on a small computer for solution until the details are formalized and a satisfactory program is developed. Then if the volume warrants, the program is translated to the language of the large computer. In this type of operation, the small problems and the "one-shot" problems never reach the large computer. This approach has another advantage besides the saving of money. It reduces the pressures which are exerted toward standardization of procedures. The engineer can feel free to try new approaches to his problem on the small computer while his old approach is being employed on the large computer.

### *Other Applications*

Some large companies are taking still another approach to the application of small computers. Management has chosen to let each large department or division select a computer which will satisfy its own needs. The computing facility is on a completely decentralized basis. By having the computer close at hand, the engineer is encouraged to make good use of it rather than waste his time on a desk calculator or content himself with educated guesses or "ball park" answers. For this type of installation, care should be taken in selecting a computer which is relatively simple to program and operate so that the engineer can spend more time concentrating on finding methods leading to more accurate answers than on programming and operating the computer.

Another interesting application of a small-sized computer on a decentralized basis is its use as a special purpose computer. A major oil company is using an LGP-30 in one of its refineries. The computer has been set to assist in the one difficult task of finding a combination of operations that will produce the desired motor fuels on any particular day from the crude that is presently available. In this application, the use of a central computing service is inadequate because immediate answers are important. Accurate solution of this problem can mean as much as $.01 per barrel difference in profit. Since over 100,000 barrels per day are involved in this operation, computation can make as much as $1000 difference in profit per day.

### *Capacity Considerations*

The small company which cannot afford the price of a large computer or does not have enough work volume to warrant the use of a large computer, may find use for an installation similar to that in a department of a large company. Similar considerations should govern their choice of a computer. However, in addition to such things as ease of operation, they must also consider the capacity of the machine. In the small company when a problem is encountered which is difficult to squeeze into the small computer, there is no large computer standing by which may be used. Hence, it becomes even more important for the small company to select a computer which has a capacity adequate for the broadest range of problems they expect to encounter.

In summary, the speed and capacity of modern digital computers have greatly broadened the effectiveness of scientific and engineering efforts. The recognition of computer usefulness has been the impetus for the development of the giant brain. However, useful though it is, the giant brain is attended with difficulties. These difficulties can be overcome in many cases by the use of several small computers, either to augment the large computer or, in some applications, to replace it. In addition, the small computer can be used in cases where computing volume and cost factors make the use of no other computer possible. We can expect that the recognition of its great potential will generate in the coming years a remarkable expansion in the use of the small computer.

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# The Director of Naval Communications Looks at . . . .

# *Value Engineering*

COMMUNICATIONS EQUIPMENT AND systems are fast becoming one of the more complex and expensive factors in the military electronics field, which is reason enough why we are thoroughly sold on the Value Engineering Program of RAdm. A. G. Mumma, USN, Chief of the Bureau of Ships.

As Director of Naval Communications, I am reminded daily that modern warfare tactics are placing an ever-increasing demand on communications, regarding both quantity and quality. In order to fulfill our communication objectives, it is becoming necessary for us to resort to unconventional methods of modulation and propagation and to concentrate on optimized equipment and systems for specific applications. Communications equipment and systems are fast becoming one of the more complex and expensive factors in the military electronics field.

We are faced with the reduced purchasing power of the dollar, the continued rise in costs of materials, man power and services, as well as curtailed Department of Defense appropriations. Therefore, it is mandatory that each of us does his utmost to reduce costs wherever and whenever practicable, as long as such reductions do not jeopardize the essential performance characteristics necessary to meet our operational needs.

By Navy definition, value engineering "includes an intensive and critical review of the operational and maintenance requirements, specifications, design, manufacturing processes, materials, inspections and testing by the contractor of the equipment to determine the minimum functions and parts, and the least expensive materials, processes and procedures necessary to produce a functional, maintainable and reliable equipment," with a view toward reducing the total costs of the equipment without "adversely affecting the essential characteristics."

### *The Procedure*

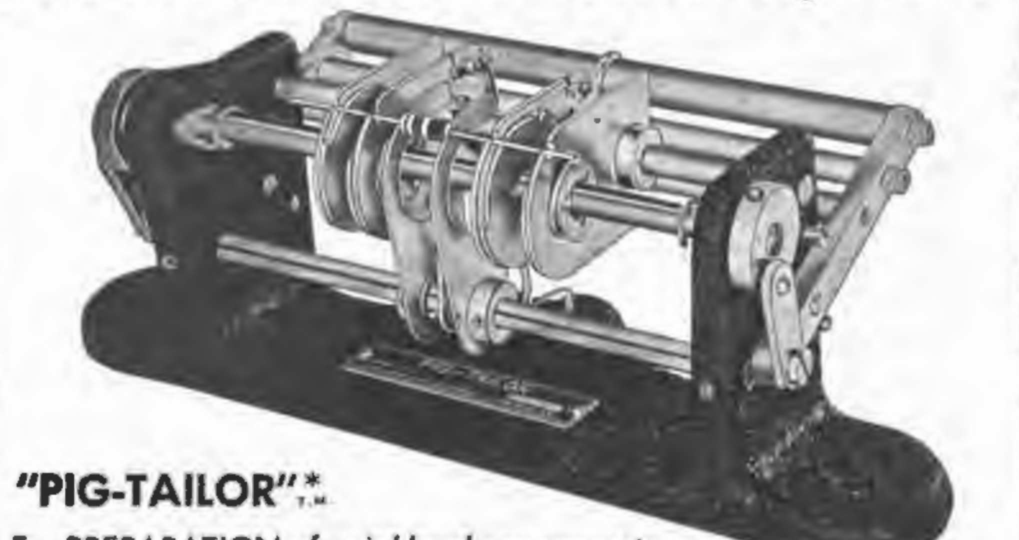
The intensive and critical review of operational requirements brings the operators into the value engineering fraternity. They, the users of the equipment, must apply the value engineering concept when stating their operational requirements. This is the first step to insure that the requirements reflect the minimum acceptable functions and reliability which the operational people consider they can tolerate. Following this, the line of communication must be kept open between the operational people and the technical people who translate these requirements into design, development and eventually, hardware. If, at any level, a stated operational requirement appears unrealistic of accomplishment at reasonable cost, this fact should be brought to the attention of the operators, as represented by the Chief of Naval Operations, for reconsideration.

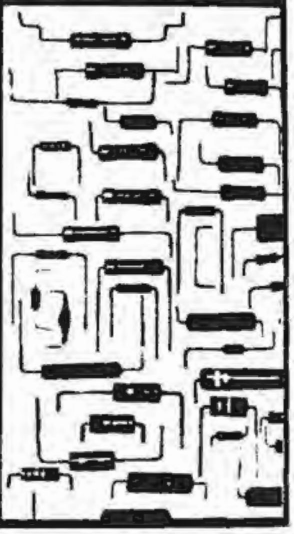
In this connection, the following is an extract from the Chief of Naval Operation's directive on Navy Research and Development Planning and Management Procedures, which is required to be included in the operational requirement document:

"In all material developments, the Chief of Naval Operations considers timely availability and suitability of first importance. Considerations of cost, critical materials, and man power are of almost equal importance. The performance figures given in this requirement are goals, except where specifically noted as minimums. During the course of planning for this development, it may be found that in meeting these goals a large and complex or costly article will result; whereas it may be found possible to develop a much simpler and therefore more readily available, reliable and suitable equipment short of the ultimate specified, but which, nevertheless, will constitute a considerable advance over presently available equipment. Determination of such alternatives should be considered an essential part of the preparation of the Technical Development Plan. In the submission of the Technical Development Plan, the developing agency shall inform the Chief of Naval Operations, or the Commandant of the Marine Corps, as appropriate, of the results, with respect to the factors enumerated above, in order that consideration may be given to making an appropriate modification of this

*(Continued on page 27)*

by
RAdm.
H. C.
Bruton
USN






FOR ASSEMBLY

operational requirement."

Establishment of the formal operational requirement document is one of several procedural steps which is required in the control of material procurement for the operating forces of the Navy. In response to the operational requirement, the cognizant technical bureau of the Navy, such as the Bureau of Ships, prepares a recommended Technical Development Plan and includes proposed development characteristics for equipment and systems which will meet the requirement. If approved by the Chief of Naval Operations, the Technical Development Plan and development characteristics are promulgated to the cognizant technical bureau for implementation.

The development cycle leads to the development of prototype material and equipment, which is accomplished under the direction of the technical bureau. Throughout the development phase, effective coordination between the Chief of Naval Operations and the bureau involved is necessary to insure close adherence to the desired objective.

### *Evaluations*

The prototype material and equipment is then manufactured in sufficient quantity only to provide for evaluation. The evaluation usually is in two phases, namely, technical evaluation and operational evaluation, and they should be accomplished in that order.

The purpose of the technical evaluation is to determine by engineering tests the ability of the prototype to meet the technical requirements, and to determine the suitability of mechanical, electrical and maintenance engineering from the standpoint of design and selection of components. This technical evaluation is accomplished by the developing agency, that is, the cognizant technical bureau, assisted by the operating forces as necessary, and is the means for determining whether the prototype meets the specifications and is suitable for the next step: an operational evaluation by the potential customer, the operating forces.

An operational evaluation is the test of an equipment or system under service operating conditions, to determine the ability of the equipment or system to meet its specified operational performance requirements, and to determine its over-all suitability for service use. The operational evaluation is accomplished by an operational unit; in the case of equipment or systems designed for shipboard use, by a unit of the forces afloat; in the case of material for use by supporting activities ashore, by one of those units ashore. Most of the forces afloat type of operational evaluations are performed by the Operational Development Force, U.S. Atlantic Fleet.

After a review of the results of the operational evaluation, a final decision as to the suitability of an equipment or system is made by the Chief of Naval Operations. This final approval as to suitability for service use is a prerequisite to the release of newly developed equipment and systems for production. The production phase of material procurement is then undertaken by the technical bureau, and delivery is scheduled in the quantities required to meet the needs of the operating forces.

I have outlined the major procedural steps that must generally be taken in the management of material procurement for the Navy's operating forces with the purpose in mind of showing, first, how the Chief of Naval Operations fits into this picture, and second, his interest in obtaining the highest degree of readiness in the fleet. This is because the Chief of Naval Operations has paramount responsibility for all matters which affect the military effectiveness of the operating forces of our Navy.

### *Program Requirements*

Now, from the standpoint of the Chief of Naval Operations, how is all this related to value engineering?

First—Equipment and systems developed by the technical bureau and contractor team must perform the functions that are necessary to meet the requirements of the Navy. If those requirements are not in fact met, the equipment can be considered a failure and any money spent on its procurement would not be wisely spent. This does not mean, of course, that the operators should not revaluate their requirements, and temper them when they can.

Second—The new equipment should be a significant improvement over that which the Navy may now have in use in the same general area. If it is not a significant improvement, we are not making progress. Relatively, we are losing ground instead of maintaining or enhancing our readiness.

Third — The equipment must be reliable. It must be ready to perform its function when needed. Otherwise, we would be better off without it, since we would have spent money procuring and installing it, while wasting valuable space and weight, particularly on shipboard or in aircraft.

Fourth—It must be maintainable. An equipment that cannot be maintained by the operational and technical personnel on board our ships and stations is equipment that cannot be depended upon to perform its function when needed. In this connection, we have had too many equipments with "unmaintainable" complexity introduced, intended to simplify operation. The result often has been equipment which we could neither operate nor maintain.

Fifth—Closely related to its maintainability, the equipment must be such that it can be logistically supported. It must not overburden our supply system with a large number of peculiar parts or make excessive use of critical materials.

Sixth and last, but by no means least—The equipment cost must be such that we can afford it in the quantities needed to meet the requirement. Excessive cost can very well mean that a vital operational requirement cannot be met. In other words, excessive cost can price the Navy's material readiness in a particular area out of the market.

I am glad to note that the Bureau of Ships' Value Engineering Program places a much needed emphasis on the cost factor, while at the same time, requiring that the essential characteristics of the equipment not be adversely affected.

The Bureau of Ships' Value Engineering Program is primarily a technical and contractural matter between the Bureau of Ships and its contractors. The benefits resulting from this program are, however, of vital interest to the Chief of Naval Operations, who, as I have indicated, has paramount responsibility for all matters affecting the military effectiveness of the Navy.

### *Lines of Communication*

As I see it, there are two lines of communications required for effective value engineering:

First—between the office of the Chief of Naval Operations and the Office of the Chief of the appropriate bureau—in this case, the Bureau of Ships. The operational requirements are set forth by the Chief of Naval

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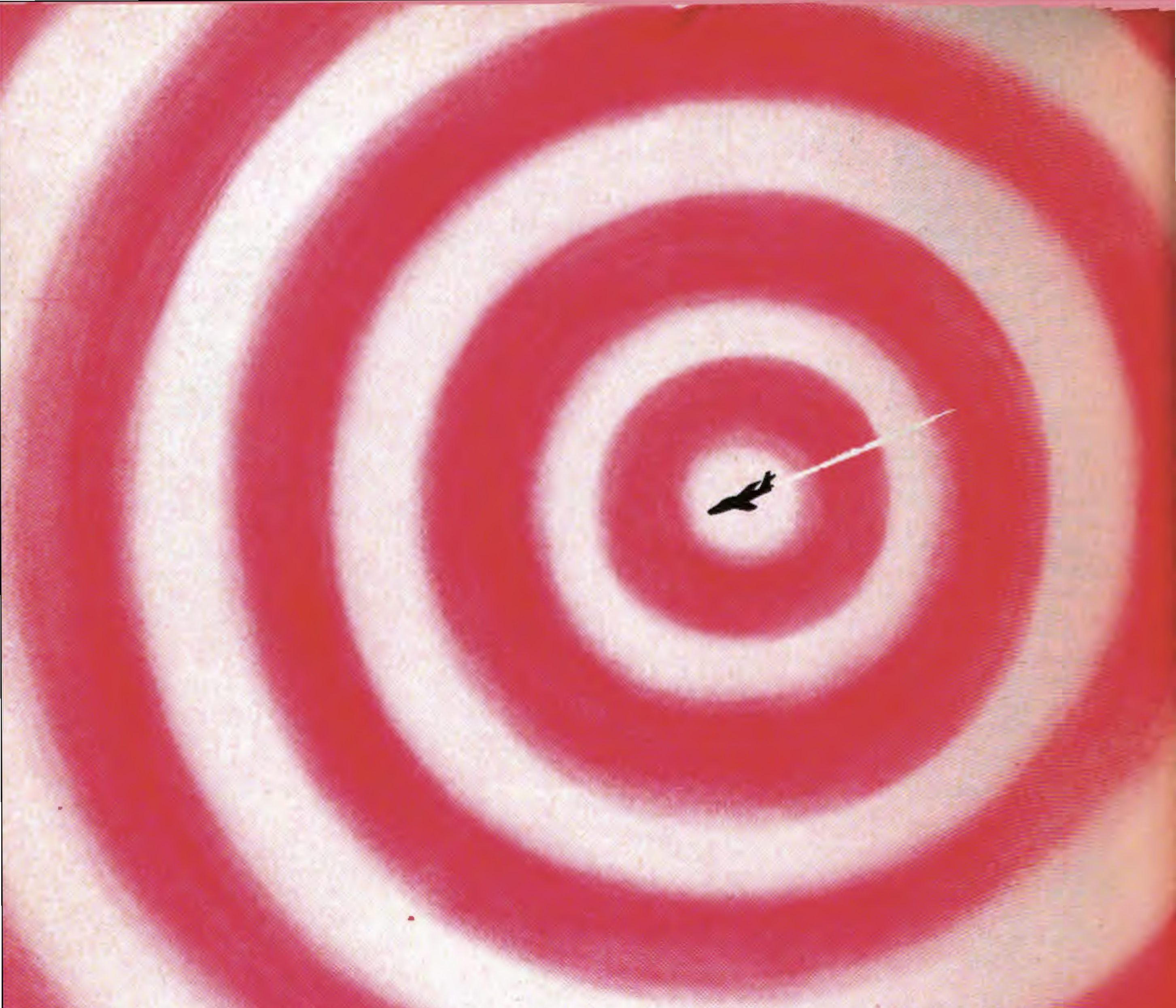

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# SIGNAL·GRAM

## — GOVERNMENT —

**NAUTILUS NOSES UNDER ICE** The nuclear-powered Submarine NAUTILUS has scored another first by spending five and a half days under the Arctic ice pack, traveling a distance of more than a thousand miles. The cruise was made to obtain data on under-ice conditions, oceanographic studies of currents and on cold weather operations of equipment and machinery. As a result of this experiment, it is predicted that trips of longer duration under the polar ice cap will become an actuality.

**BATTERY VEST** A new battery designated for Army use can be worn as a vest. The flexible battery supplies power for a soldier's portable radio receiver and transmitter and works especially well in cold regions where a conventional battery's life-span is very short. The battery is made of two panels, each with a number of dry cells spaced and insulated from each other, but connected to make up the battery itself. The dry cells are heat-sealed in a waterproof polyethylene plastic and mounted on the vest-like garment.

**AF RELEASES COMMUNICATIONS-ELECTRONICS DATA** The U.S. Air Force's volume of communications-electronics data is now being converted into a series of short manuals containing information on basic concepts, planning systems and operating practices. Known as Air University Project 4736, the program is expected to require from 12 to 18 months and is being undertaken by Maxwell Air Force Base of Alabama.

**ROTI MARK II** The Air Force is using a recording-optical-tracking-instrument to photograph missiles in the earlier stages of their flight. Designated ROTI Mark II, the device begins its tracking duties following launching operations at the Missile Test Center, Cape Canaveral, Florida. This instrument is one of a series of systems designed, developed and built by Perkin-Elmer Corp., Norwalk, Connecticut. (A prototype model was a cover feature of the August issue of SIGNAL.)

**CONTRACTS: ARMY:** Western Electric Co., continued development work on the NIKE-ZEUS, $5,086,481; Telecomputing Corp., Whittaker Gyro Division, gyros, $138,621; General Electric Co., digital computation operation, $257,913. **NAVY:** Lockheed Aircraft Corp., continued development on POLARIS, $62,100,000; Admiral Corporation, production of electronics equipment, $1,196,000; Stromberg-Carlson, tactical air navigation system test equipment, $3,740,000. **AIR FORCE:** Hughes Aircraft Co., electronics equipment, $4,194,320; Bendix Aviation Corp., components of compass systems, spares and ground support equipment, $1,532,639; Remington Rand, Univac computers for TITAN, $24,000,000.

## — INDUSTRY —

**TOP DEFENSE CONTRACTOR IN U.S.** The Boeing Airplane Company has displaced the General Motors Corporation as the No. 1 dollar value defense contractor. A report issued by the Pentagon, covering the six and a half years ending last December 31, showed the airplane producer in the top position for the first time, but followed closely by the motor car manufacturer.

**RADAR PATENT** After 20 years, a patent for significant military and commercial radar developments has been granted to International Telephone and Telegraph Corporation. Awarded on an invention by P.F.M. Gloess, a French scientist formerly with IT&T's Paris laboratories, the patent covers the practical form of radar generally used today on ships, airplanes and for defense purposes. It is known as plan position indicator (PPI) radar. The disposition of an entire fleet of ships can be shown on the face of a cathode-ray tube and the exact position directly read from the distance and angular scales on the tube. The invention similarly will show the contour of land ahead of and below an airplane, will draw a picture of the coastline for a ship approaching at night or in fog, or will reveal the position of attacking aircraft or missiles.

EXCHANGING VIDEO TAPE PATENTS An agreement for the exchange of patent licenses covering video tape recording and reproducing systems for black-and-white and color has been signed between Radio Corp. of America and Ampex Corp. These systems enable the recording on magnetic tape of scenes, information and sound for later reproduction, not only for television broadcasts, but also for other professional and commercial purposes.

CREI COURSE A new course, "Control Systems Engineering Technology," is being conducted at Capitol Radio Engineering Institute of Washington, D.C. The session concerns the combined relationship of servos, computers and radar in their varying applications of pulse techniques. Students successfully completing the course at the residence school will be awarded an Associate Degree in Applied Science.

3-DIMENSIONAL COLOR TV The first closed-circuit 3-D color TV system, developed by General Electric Co., of Syracuse, N.Y., allows remote servicing of reactors used in the development of a nuclear aircraft propulsion system. Including the first use of color TV with stereo, the system permits use of color-coded parts in reactor components and provides the degree of precise depth perception required for the correct positioning. The system is not currently feasible for the living room.

## — GENERAL —

THE NEW $ LOOK On October 1, a new U.S. dollar bill went into circulation—the first of new design in 22 years. Identification marks are: 1) The legend "In God We Trust" on the back of the bill is a new addition. 2) "Series 1957A" is designated under the seal on the face of the bill. 3) The portrait of George Washington appears a little changed. 4) The signature of the new Secretary of the Treasury, Robert B. Anderson, appears for the first time.

IRIA An Infrared Information and Analysis Center has been established at The University of Michigan's Engineering Research Institute. Purpose of the agency is the "collection, analysis and proper dissemination" of information about infrared research and technology with particular emphasis on military technology. All data that will advance this program is collected with particular attention to acquisition of up-to-date contractor reports. Analyzed for content and value and catalogued according to type of research or technology discussed, the information enables IRIA to provide contractors with proper information concerning a specific development or with evaluative surveys of broad trends of research and development.

NATO SCHOLARSHIP FUND A bipartisan group of American legislators unanimously decided to triple the scope of a proposed NATO science talent development plan to meet the Soviet threat of the "Sputnik age." The original plan which called for creation of an annual NATO scholarship fund of $2 million has been increased to approximately $6 million, which would provide for about 600 new doctorates in the science field a year. The United States presently grants about 450 such degrees annually and the other NATO members combined somewhat fewer.

AIR CONTROL POSTPONED Civil Aeronautics Administration planned to take over control of all airspace above 24,000 feet on November 1, 1957, but postponed it until 1 December. The Navy and Air Force felt that they had too little time to put new rules into effect. At present, the Navy and Air Force are the main users of the upper air space, but the CAA also plans to assume traffic control of commercial jets.

PUBLICATION NEWS Interscience Publishers, Inc., has recently taken over the distribution of the publications of the Microwave Research Institute of Brooklyn Polytech. A listing of the books available may be obtained by writing to 250 Fifth Avenue, N.Y. 1, N.Y. These publications include the Symposia Series, edited by Jerome Fox, as well as the Handbooks of Microwave and Electronic Measurements.

CALLING ALL "HAMS" The annual Single Sideband Dinner will be held during the IRE Convention, Tuesday, March 25, 1958 at the Hotel New Yorker. Tickets are $7.50 each and can be obtained from: The Single Sideband Amateur Radio Assn., Inc.—267 Madison Avenue—New York 16, New York.

THE FOURTH NATIONAL SYMPOSIUM ON RELIABILITY AND QUALITY CONTROL will be held January 6, 7 and 8, 1958, at the Hotel Statler in Washington, D.C. Some 50 outstanding authorities in the field of quality control and reliability will present a "Report to the Nation" on the progress in reliability, covering fields of reliability in the electronics industry. The symposium is sponsored by IRE.

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## Value Engineering

*(Continued from page 27)*

Operations. The technical bureau develops equipment and systems to meet these requirements. Close coordination must be maintained to insure that the requirement is realistic and economically feasible of accomplishment, and that the development is proceeding toward the desired goal.

Second—between the bureau and the contractor. Here also close coordination must be maintained to insure that the equipment specification is realistic and feasible of accomplishment without excess cost, and that the work, whether design, development or production, is proceeding toward the desired goal and toward the scheduled delivery date.

### *Benefits*

In my opinion, one of the primary benefits that may come from this program is that a contractor will be encouraged to question a provision of a bureau specification that may appear unrealistic, unnecessary or excessively costly. In turn, the bureau should feel encouraged to use the communication line to Office of the Chief of Naval Operations to question an unrealistic or super-expensive provision in a requirement or development characteristic. I think it will be found that some of the provisions may not be as sacred as they may have seemed in the past.

One other aspect I would like to mention, since it is particularly pertinent in my own field, communications. The communications problem of the military services is not unlike that in the commercial communications field in many respects. Therefore, whenever it is practicable to do so, it makes sense and is good value engineering for us to adapt our operational requirements to existing commercial designs or production. In so doing, we save money and we get a good commercially tested and approved product, with readily available spare parts. This concept is not only applicable in point-to-point communications (where our equipment and problems are very similar to those of commercial communications), but also, to some degree, even to the more difficult area of shipboard communications. For example, in order to attain a capability that could be met in time in no other way, the Navy recently bought a quantity of commercial off-the-shelf communications equipment. While this equipment does not fully meet military standards, it has performed surprisingly well, with reasonable reliability, and it is relatively inexpensive. The highly competitive commercial communications field is a good proving ground for this kind of equipment, both for performance and dollar value.

### *Disseminating Information*

Value engineering is a relatively new factor in Navy-industry relations. It is imperative, therefore, that more and more information on value engineering be disseminated so that the Navy and industry, together, may benefit from its many applications through better understanding of the Navy's goals.

* * *

## Looking Forward to the Future

*(Continued from page 20)*

The data link subsystem consists of the various means of communications used in transmitting instantaneously, to a central station, the information collected by devices in manned or unmanned (drone) aircraft from distances equivalent to the ranges of our modern weapons.

The processing subsystem will employ automatic data processing equipment, tailored to fit evaluation, collation and storage requirements at all military echelons, Field Army to battle group.

The display subsystem is that portion of the surveillance system used to display to the commander and his staff useable information or intelligence in an effective manner commensurate with the requirements at his headquarters.

A very important portion of combat surveillance functions is target acquisition. Research and development continues to be active in this field to improve the target acquisition and location capability to enable modern weapons of the LaCrosse, Honest John, Corporal, Sergeant and Redstone class to fire upon a target with first round hit or kill and to the limit of their ranges under all weather and visual conditions.

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# STOCKPILE issue

STOCKPILE

Never in the history of our country have the "5 Big M's"—Money, Man power, Materials, Manufacturing and Management—in national security and their interrelationship with the military, psychological, economic and educational factors been as important as they are today. The stockpiling of this information among other information in the communications and electronics field is indicative of the objectives of the Armed Forces Communications and Electronics Association. This is the background and the thinking behind SIGNAL's special "Stockpile Issue" coming in January, 1958—a publication which should interest everyone.

THE EDITOR

BY LEE LEVITT

# Engelhard Industries

Milton M. Waller,
Military Services
Division Head

APPLYING THE FACILITIES AND kills of a widely diversified group f metals and electrical manufacturng firms to military research and evelopment is the complex task of Engelhard Industries' newly formed Military Service Division, headed by Milton M. Waller.

Headquartered in Newark, N. J., Engelhard Industries has ten manuacturing subsidiaries in the United States—Baker & Co., D. E. Makepeace Co., The American Platinum Works, The H. A. Wilson Company, Hanovia Chemical & Mfg. Co., Amersil Co., Irvington Smelting & Refining Works, National Electric Instrument Co., Azoplate Inc. and Charles Engelhard, Inc. It also has a substantial interest in Nuclear Corporation of America and extensive operations in Canada and overseas.

These firms design and manufacture a wide range of precision equipment with military applications—ammeters, transformers, galvanometers, anemometers, electrical contact subassemblies, timers, ultraviolet meters, ignitors, mechanical fuses, cathodic anti-corrosion systems for ships, boiler level gauges, crystal mixers, duplexers, waveguides, quartz cavities and delay lines, gas-discharge lamps of many kinds, thermocouples, resistance thermometers, optical devices, gas analysis systems, gas generators and purifiers, antennas, rupture discs, spinnerettes, and uranium-reactor components, radioactive isotopes and many other items.

In addition, they produce such basic materials as metal strip, tubing, wire, clad and laminated metals, brazing alloys and fluxes, electrical contact materials, thermostatic bimetal, constant-modulus alloys, chemical catalysts and optically clear quartz.

Offhand, it might appear relatively simple to steer an industrial organization with these capabilities into the main stream of military research and development. It is not quite that easy, however, according to Mr. Waller.

"To begin with, the fundamental philosophy of military research is different," he says. "The Armed Forces do not take the 'marketing' approach our people are accustomed to encountering in straight commercial sales. The emphasis is on stringent specifications, foolproof operation under every conceivable condition, and ease of maintenance, rather than upon potential markets and end price."

He hastens to explain that he has found the Federal Government and its prime contractors to be quite cost-conscious, but in a different way from private companies.

"In straight commercial operations, cost is not only important, but often utterly controlling—no matter how good it is, the product may be unable to find a market if it passes out of a certain cost bracket. In other words, the aim is to produce as good a product as possible within a certain cost. In most military contracts, however, the aim is to develop as cheaply as possible a product which meets certain inflexible specifications. The difference between the two approaches is slight in some cases, but in others it is of great practical importance."

He points out that some companies—notably those closely connected with the aircraft industry—grew up on military contracts, so that their engineers are imbued with the spirit of military research. "Most of the Engelhard companies, however, reached maturity long before World War II, and, although they have handled many Government contracts over the past 20 years, they have never devoted themselves primarily to work of this kind. Thus, there is definite need for a coordinating agency between them and the Armed Forces."

The sales staffs of the various companies handle by themselves all Government contracts for more or less standard items. The Military Service Division handles only those jobs "where there is no product as yet—in which the whole idea is to come up with something new. If, after research and development, the item becomes standard, the Division drops out of the picture."

One of Mr. Waller's problems is the very diversity of the Engelhard family, and the fact that the companies' operations overlap to a certain extent. His office must decide which company should handle what project. Sometimes the job is split between several of them.

Once the Military Service Division has the details on a proposed contract, it helps the chosen Engelhard company or companies develop a detailed proposal, and submits this through the proper governmental channels. After the contract is awarded, the Division handles all paper work and coordinates all communication between Engelhard scientists and the procuring agency. On "crash" jobs, it helps secure letters of intent or other documents which will speed things up. Thus, the military agency and/or major contractor does not have to deal with salesmen or engineers who do not understand their procedures and problems, and Engelhard research personnel are freed of responsibility for negotiation.

Since the Division was set up 18 months ago, it has secured and managed some 400 projects. Many were direct contracts with the Armed Forces. Others were subcontracts from such companies as General Electric, Sperry, Western Electric, Convair and Eastman Kodak.

A mechanical engineer with a Master's Degree in Industrial Engineering, Mr. Waller has served with various Engelhard companies for 15 years. At one time, he headed the Instrument Division of Baker & Co. He coordinated Engelhard's military contract work on an impromptu basis for several years before the Division was set up officially.

The Division now has offices in Newark, Washington, Dayton and Boston. The Newark office handles most of the subcontracts. The Boston office works with the Air Force's Rome (N.Y.) and Cambridge (Mass.) Air Development Centers, and the Dayton office with the Wright ADC. The Washington office handles work

*(Continued on page 47)*

# Army Requirements in Basic and Applied Electronic Research

***by Dr. H. J. Merrill, U.S. Army Signal Engineering Laboratories, Fort Monmouth, N.J.***

THE ARMY SIGNAL CORPS HAS enjoyed a long and profitable association with the commercial world since the inception of the modern Corps at the dawn of the electronic age. In many cases, its activity has been the ferment that has contributed to our country's electronic growth. In an attempt to maintain contact in the expanding economic horizons of our world, it has been necessary to accelerate the development of communications. We point with justifiable pride to the Signal Corps' role in the development of wire telegraph, radio, meteorological systems, aviation, radar, computer techniques, and the "Missile Master," all of which have contributed to the growth patterns of industry.

The association of commercial interests with the Department of Defense, assisted greatly by the pressure of forceful military leaders, is the most responsible factor in the acceptance of the research philosophy and the prosecution of a large relative effort in research and development. This acceptance of the application of research has made possible the recent industrial expansion of our country. A new industrial revolution, much more drastic than the old one and loaded with implications of a vast changing world, has taken place since the beginning of the Korean War in June 1950. Our horizons have expanded at an accelerated pace due to the generous application of research to everyday problems. It is a change which may be described scientifically as a change in research methods. We now have access to electronic computers which permit the solution of problems unhampered by the setting of limitations in the boundary conditions which we formerly needed in order to perform the mathematical processes. This in itself explains our ability to extend our research many orders of magnitude beyond standard conditions. We become scientific explorers in a vast new area beyond our standard environment. The new industrial revolution represents a substantial effort in research and great initial foresightedness in its application to our problems.

### *Revolution in Army Adaptations*

The Signal Corps is a technical service for the Army, which is the user or recipient of the military research. The Army is also going through a revolution. All students of tactics and strategy see the vital importance of the right sort of an Army in any future conflict. To be effective in this industrial age, the Army has to develop new concepts and new organizations in which an army unit has the capability for sustained combat air transportability and battlefield mobility. According to the *Army Information Digest*, the new Army must be based on these four principles: First, adaptability to the requirements of the atomic battlefield; second, utilization of equipment at the higher echelon; third, recognition of increased span of control, which is possible through modern signal communications, and fourth, adaptation to the new and better material as it is developed.

The Army's future battle area will have a greater breadth and depth and the units will be dispersed in smaller groups to avoid presenting large targets to enemy atomic weapons. The application of personnel will be drastically changed to fit the technological changes. Since fire power has increased out of proporation with other capabilities, more effort will be applied to mobility and communication. Although the number of combat troops will be greatly reduced, the Signal Unit, along with other support troops, will be enlarged. Upon examination of the four principles mentioned before, the importance of electronics and communications is apparent. They are prime factors in each of the four principles. Implementation of the new Army presents a great challenge in providing the surveillance, the communications and information for the tactical and strategic disposition of the units.

These then are the specific problems of the electronic requirements in the Army which are primarily in the areas of communication and control. Since a communication or control system always requires some type of intelligence as an input, the electronic problem is closely allied with other problems of accomplishing the mission of the Army. In this age, the input and output systems are primarily interested in electronic techniques. It should be borne in mind that there are forms of intelligence other than voice communication which now affect the communication load and spectrum. We are faced with the dilemma that wire transmission is fixed and difficult to maintain, but at the same time radio presents difficulties in the problems of interference and propagation.

### *Keystone to Increased Capacity*

Basic research coupled with imagination are needed to develop new communications. We cannot achieve them by a routine exploitation of existing techniques. New reliability must be provided in order to link mobile units. Greater communication capacity must be provided for the additional intelligence load. Applied research is required to develop antennas that will be less bulky and will transmit in narrower beams. Also, applied research is needed to use better the modes of propagation that have been established.

The new mobile Army must see eyond the horizon because the cen-rs of the Army units will be disersed in depth. The Army must aintain an electronic surveillance by ispecting the surrounding area for nemy movements and must mainain control of a large area from hese localized centers. The developent of area weapons has now progessed to the point that weapon conrol of great areas is possible. Unortunately, surveillance control has ot kept pace with this development. gain, considerable imagination nust be expressed in our basic reearch and brand new surveillance echniques must be devised. The roblem of maintaining surveillance ontrol is complicated by the necesity of developing location devices vhich will be capable of recognizing nd identifying the target at the ame time. Most conventional surveilance devices require line-of-sight. However, in the new Army, we have he necessity of extending our horizons far beyond line-of-sight. This is a challenging problem.

In the establishment of new basic research and especially in applied research, the keystone often becomes the development of new components and devices. A considerable effort, therefore, is required to maintain the research and development of new components and devices. Actually, the military has sponsored much of the tremendous effort devoted to components and interest in this field is increasing daily. Although the development of solid-state devices such as transistors, which are useable at higher frequencies and temperatures, is actively sponsored, further extensions must be accomplished. The activities in nuclear and atomic resonance in the development of the MASER (Microwave Amplification by Stimulated Emission of Radiation) give promise of new communication techniques, although I am sure that we cannot predict at the present time just what turn these developments will take. It is certainly a rich field, a product of basic research which, in the next five to ten years, will have most gratifying applications. In connection with the electromagnetic spectrum, the laboratories also have an interest in the development of detectors in the radiac field, and possibly some applications of gamma radiation and neutron energy may be applied to our communication and surveillance problems.

The complex and far-reaching supply lines of the modern Army require that logistic information be made available from the factory to the supply services to the combat unit. The problem of supplying replacement parts and expendable supplies has always been extremely difficult to solve under combat conditions. To cite an example, in World War II, we had considerable complaints from the field to the effect that replacement supplies were not available for our sound ranging equipment. This was surprising because we had shipped great quantities overseas. Finally, we sent an engineer over to trace these supplies. He finally reached a point in the Netherlands where, according to the records, the supplies were stored. He queried the harried Supply Officer who said, yes, he had them, then took our engineer out to a pile of boxes 100 feet high, 100 yards wide and a mile long and said, "They are in there." As you may well imagine, the loading of such supply pipe lines becomes very expensive and to make it worse, does not fulfill its function. With the development of modern comunications and transportation and the application of new electronic data processing systems, we look forward in our applied research to eliminating static supply depots and cutting down on the quantity of depots required, thereby making the supplies more rapidly available.

### *Man Power, Mobility and Money*

We are interested in computer activities as a great assistance and saver of man power in our basic and applied research activities. We are also looking forward to the development of special purpose computers for solving our surveillance and communication problems. As the trend in the growth of electronic instrumentation increases, and as the electromagnetic spectrum is more fully utilized, the problems of electromagnetic space become magnified, the problem of reliability is increased, and the ability to take countermeasures against the system increases. Our interest in countermeasures and counter-countermeasures is easily recognized. With the expansion of electronic technology in other countries, the problem takes on increased seriousness.

The Signal Corps, both in its internal program and through external contracts, has had a long-term interest in meteorological instrumentation. Although cognizant long-range meteorological forecasts reside with the Air Force, the effects of meteorological conditions become more important insofar as they affect Army mobility, surveillance, and long-range fire power.

There is an increasing requirement to establish a local area forecasting ability and a better understanding of the local effect due to mass meteorological movements. In establishing the use of meteorological data, it becomes apparent that a knowledge of the mass meteorological conditions is more important than a single local meteorological measurement. There is an increasing awareness of the effect of mass effects so that true meteorological corrections can be made for local fire control purposes. There is great opportunity to establish meteorological measurements by using ground-based instruments rather than by sending up sounding instruments into the atmosphere by balloons or rockets. For instance, a radar study of the ionospheric motion may be related to the weather by using the results thereof to determine the position of weather fronts and to determine the mass weather effects.

Considering the principles of the new Army and the areas of responsibility of the Signal Corps, we may develop the objectives of the future basic and applied research, although we should not speak too finely of an objective with respect to basic research.

One of the first considerations and one of the most troublesome problems is the saving of man power. Studies have proved that the man with the high IQ makes the best combat soldier. Unfortunately, this is practically an impossible situation for there are not enough high IQ men to go around. Our ultimate objective is to furnish equipment which saves this man power. Obviously, it is not satisfactory to have equipment which replaces one soldier if it takes one engineer to keep it operating.

The next requirement is to provide instruments that will perform functions for which there is nothing available at the present time. We need to extend the spectrum of time and space for each area of interest of the battlefield in the expanded concept. One of the most neglected things in the Army has been mobility. We need to be able to move our combat troops quickly, and to know where they are and what they are doing. While the movement of the troops is not an electronic responsibility, it is the big responsibility of electronics and of communications, to know where the combat units are, what they are doing, and to see that they get the required support. In recent maneuvers that I attended, in which large numbers of tanks were employed, it became quite apparent that we are going to have insoluble difficulties with that old reliable telephone line, for tanks are very efficient wire collectors. They can wind miles on their treads with no effort at all.

Finally, there is the economic problem which is also of great importance commercially, that is, electronic equipment must make things cheaper. It must be more efficient and save at all points in the supply line, in production, and in material and labor costs. General Gavin, our Chief of Research and Development in the Army, in describing basic and applied research, stated: "A majority of work is executed by contract with industry, universities, and non-profit organizations. A lesser portion of the research and development effort is performed within Army laboratories in order to maintain the level of competence for effective quality control of contracts, and to carry out such functions as requirements formulation, development planning, feasibility determination, testing, and evaluation." Under this charter from our Chief, I would like to comment that research and development at the present time is not efficient, and costs are too high. Defense industry must accept its part of the responsibility for the national budget. Although there are many responsible contractors, there are also those who do not appear to accept contractual commitments seriously. Many of the proposals and activities submitted for approval are repetitive and inconsequential. Often, when in the course of a contract it appears that nothing of consequence will develop, it becomes unduly costly to get an agreement to terminate the activity.

### *Avenues to Avoid*

For a long time the Signal Corps was a salient for the use of fixed-price contracts in the Government. Because of defects in the fixed-price instrument, cost-plus-fixed-fee contracts have been written. However, it appears that we have jumped from the fire. In the first place, many of the bids received do not even come close to representing the final cost of the contract. It is embarrassing for a unit in our laboratory with a three billion dollar budget to receive a three-quarter million dollar over-run on a one-quarter million dollar contract. (This actually happened.) The other defect is the almost universal failure to meet specified contractual delivery dates. Although the cost-plus-fixed-fee contract allows greater contract flexibility, it does not have the right kind of incentive. It would be better to have a positive incentive, which pays a bonus for superior performance, instead of the negative incentive which allows a poor performance to continue indefinitely.

Those of us old enough to remember back before the Korean War may recall that the country developed a surplus of engineers because of a cutback in research effort. This must not happen again. Since basic research is very long term, we should profit by history's example and plan for the future; we cannot let the effort lag or fluctuate. Some method of funding must be found whether it is from the Federal budget or otherwise. Research funded directly by the Federal Government has found application in all facets of industrial production; our economy has been reaping the benefits of the research and development program. The profits have been most gratifying not only in their military application but also in the innumerable applications of the research to our everyday living.

With the above statement of requirements and needs, it will probably interest you to learn the methods by which the programs of basic and applied research are carried out. The Signal Corps maintains a small internal basic research program in which investigations are made to acquaint our personnel with new developments in the field, and to contribute as much to that field as our capabilities will allow. The Signal Corps also carries on an internal applied research program largely for the same purpose. The laboratories have also served as a crash facility and have participated in newly established investigation efforts in connection with such things as the atomic bomb, guided missile activity, Arctic propagation and meteorological research. It has participated on a crash basis in various Army maneuvers in which an attempt was made to establish requirements by demonstrating in the field new techniques which may be applicable to the Army problem.

One of the most rewarding activities with respect to basic research has been participation with the Air Force and the Navy in joint research contracts placed largely with universities. The extension of these joint contracts to other organizations has been taking place recently.

Most of the basic research and much applied research is carried out with commercial concerns. Contracts are often placed initially on a competitive basis, although it is difficult to establish a real competitive situation on the basis of a loosely drawn specification, as is usually the case with research specifications. On a competitive bid, an attempt is made to evaluate the quality and amount of manpower applied to the immediate problem under consideration.

The problem of fulfilling the objectives which have been outlined requires the application of energy and imagination. Too many contracts which have been labeled "Study" are carried out where one tends to forget that study is the tool of research, not the end. The end of basic research is invention, classification and exploration. We are getting too many tools and not enough end-production invention. The basic research is a long-term proposition which finally is the only instrument that will lead to the solution of our problems. If we don't apply continuity of effort to the long term problems, we will find our energy dissipated in a series of interim steps in which the advance from step to step is not significant. The fundamental factors that make for research growth are the thoughts and the ideas. In the words of Schiller, "It is the spirit itself which fills the body."

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# POMSEE Puts Them To Work

### *by J. R. Jackson, RCA Service Co., Inc.*

THE NAVY, LIKE OTHER MILITARY services, is faced with the modern-day maintenance problem resulting from complex equipment and the need for correspondingly longer training schedules. The percentage of time that must be spent in training to attain maintenance proficiency on any electronic equipment is high. Therefore, only a short time remains during an enlistment when a man's services can be used operationally.

A simplified maintenance plan for shipboard electronics equipment is being used successfully by the Bureau of Ships. The POMSEE program (Performance, Operation, and Maintenance Standards for Electronics Equipment) has been developed and evaluated as an answer to the maintenance problem.

### *The Basic Plan*

Since a large percentage of maintenance man-hours is spent in checking and testing electronics equipment, the use of relatively unskilled personnel for this work seems logical. Thus, a greater percentage of the time of experienced personnel could be released for troubleshooting, critical adjustment, and the final setting up after repair. Also, with more time available, the experienced engineer could work more efficiently.

POMSEE enables relatively untrained personnel to be utilized by setting up Performance Standard Sheets and Maintenance Standards Manuals for each equipment. It also enables engineering personnel to make checks at any time to determine if the equipment is operating as it should. It also sets up a series of preventive maintenance routines to be carried out at periodic intervals to assure continued normal operation of the equipment. POMSEE material encompasses for each equipment a Performance Standard Sheet, and a Maintenance Standards Book (Part I, test procedures and maintenance references; Part II, preventive maintenance check-off).

In essence, the maintenance thinking is done by engineers who are familiar with maintenance procedures and with particular equipments. The results of their efforts are set down in chart and picture form. Personnel unfamiliar with the particular equipment can nevertheless carry out much of the testing that is required, using this information.

### *Performance Standard Sheet*

The purpose of the Performance Standard Sheet is to indicate the equipment's expected operational capability. This is accomplished by taking a specific series of technical measurements contained in the Maintenance Standards Book, Part I, the results of which may be used for reference when determining the condition of the equipment during future tests.

These tests and measurements are made at significant points of the equipment. The tests are grouped according to functional sections—that is, all the electrical circuits and mechanical parts that act together to perform a specific function, such as transmitting, receiving, and so forth.

### *Maintenance Standards — Part I*

This section establishes a series of maintenance standards tests that can be recorded in simple tabular form. Starting with the simplest basic test, such as checking the input voltage, it includes a progressive series of tests in logical sequence covering the entire equipment.

On the test chart, the first of five columns shows the "step" or test number. The second column, headed "Action Required," states briefly the purpose of the test. The third column, "Preliminary Action," states how to set up the test: "Connect multimeter to terminals 1 and 3 of T101." The fourth column is headed "Read Indication On," which is self-explanatory.

The last column, "Maintenance Standard," provides space for recording the actual reading. Limits for guidance are listed for each reading.

On the page opposite the test chart in the Maintenance Standards Book, Part I, is a line drawing of the equipment or unit with call-outs numbered for each "step" or test number of the chart. The test equipment is shown connected just as described in the test chart, or the controls or meters of the basic equipment itself are indicated when described in the chart.

When the illustration does not show the exact connections clearly, blow-ups of the area in the chasis are shown so that full visual understanding is possible.

### *Maintenance Standards—Part II*

The purpose of the second section of the Maintenance Standards Manual is to provide maintenance personnel with systematic and efficient preventive maintenance instructions for a specific equipment. The format is similar to Part I.

Steps are included or references are made to steps contained in Maintenance Standards, Part I, for periodic accomplishment and are designated as routine or technical. Routine steps are identified on the applicable page. To lighten the load of the technician, the routine steps may be performed by operating personnel.

Usually, the first step in Part II is the daily routine of placing the equipment in full operation. Next is a series of weekly checks including certain maintenance standard checks, followed by adjustments, inspection and cleaning operations.

The monthly routine usually includes complete inspection for mechanical faults, cleaning and tightening of insulators and bushings, cleaning of chassis and so forth.

The quarterly checks include, in the case of a receiver for example, such items as testing sensitivity and bandwidths of the various circuits, checking signal-to-noise ratio, adjusting wave traps and checking circuit alignment.

Following each series of tests in the manual—daily, weekly, monthly, quarterly—is a date chart covering a period of 2 years. Pertinent readings and the initials of the person making the tests are to be entered in these charts.

### *Use of Manuals and Sheets*

Performance standard measurements are accomplished in the field for an individual equipment upon receipt of the Performance Standard Sheet and Maintenance Standards, Part I. After equipment overhaul or after accomplishment of major field changes, these measurements are again made.

After an over-all checking and peaking of sections, the prescribed tests and measurements of the Performance Standard Sheet are made and the results entered in the spaces provided in the Maintenance Standards, Part I. The technician follows up with his portion—the remainder of the Part I measurements and the preventive maintenance instructions of Part II.

POMSEE thus provides a logical series of test procedures that can be carried out by electronics personnel not necessarily experienced in the particular equipment involved. It does not attempt to get into the why, what or how of corrective maintenance since these subjects are already covered by the technical manuals and other publications.

POMSEE does provide the indications of normal operation capability and shows the functional section involved when abnormal operation is present. It provides the simplified steps necessary to assure continued normal operation. If the records show that readings for a particular step vary progressively in the same direction every time a check is made, there is a definite indication of improper operation, and corrective measures must be taken.

POMSEE manuals and sheets have been, are being, or will be prepared under contract for most of the electronic equipment under cognizance of the Bureau of Ships. As new equipment procurements are made, POMSEE manuals and performance standard sheets will be prepared simultaneously.

Based on past performance, POMSEE is assured of continued success in the Fleet.

# AFCEA Group Members

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***isted below are the firms who are group members of the Armed Forces Communications and Electronics Association. By the embership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of s key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.***

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# Chapter News

### Arizona

The chapter's annual elections were held in September with Arthur H. Mudgett, Chief Technical Planner, USAEPG, re-elected president.

The other officers were named as follows: vice president—Lt. Col. Leonard F. Walker, Technical Operations, USAEPG; secretary-treasurer — Dr. James C. Coe, Chief Engineer, Science Division, USAEPG; directors—Col. Edmund T. Bullock, Deputy Commanding Officer for Technical Program, USAEPG; William S. Marks, Jr., Chief Scientist, USAEPG; Forrest G. Hogg, USAEPG Resident Representative for Motorola, Inc.; William W. Lord, Manager, Tucson Office, Defense Products Group, American Machine & Foundry Company.

### Augusta-Fort Gordon

Mr. John S. Siegel, Vice President and General Manager for Georgia, of the Southern Bell Telephone and Telegraph Company, was the guest speaker at the October 17th meeting.

Stating that one of the basic precepts of the American way of life is the manner in which it has let business operate, "both through customs and laws," Mr. Siegel went on to point out that "when business becomes big, it is a sign of success—not a sign that big business is bad."

**Augusta-Fort Gordon**—Shown during the October meeting are, left to right David r. Gibbs, USA Signal Training Center, Ft. Gordon; Col. Braxton E. Small, c president; Joseph S. Siegel, Vice President and General Manager, for Georgia, of S Bell Tel. and Tel. Co.; Charles M. Eberhart, General Commercial Manager, Souther Tel. and Tel. Co.; Col. Erling J. Foss, Chief of Staff, USA Signal Training Center, and Gibson, Augusta District Manager, Southern Bell Tel. and Tel. Co.

He reminded his audience that this is one of the few countries in the world where all the people can participate in its great industrial enterprises. Mr. Siegel, a 1938 graduate of the University of Kansas, who started his career with the Bell system by digging post holes, brought a chuckle from his audience when he remarked that "telephony is a fascinating business—even when you have to figure out how deep a hole should be."

### Baltimore

Chapter members met at Fort George G. Meade on October 12th and viewed exhibits representing a cross-section of the latest Army equipment which had been held over from the Second Army's birthday celebration. Col. Timothy H. McKenzie, Signal Officer of the Second Army, was host for the occasion.

The program began with a luncheon-meeting at the Officers Club. Guests were introduced by chapter president Henry B. Yarbrough as follows: Wilfred B. Goulett, AFCEA Exe Vice President, and Mrs. Goulett: William G. Shaffer; L. Harriss I son, president of the Washington ter; CWO James C. Hawley and ert T. McArthur of the Bureau of Department of the Navy; James of Minneapolis, and James H. Ke a former president of the Cl chapter and now a member of th timore chapter.

**Baltimore** — Pictured here are some of the chapter members and guests viewing the Hawk missile displayed at the October 12th meeting, held at Fort Meade. Mrs. John A. Shipley, recording secretary for the chapter, is credited with taking the photograph.

Among the items of interest i Army equipment display were: copters ranging in size from "Bubble" to a jeep carrier; n field television chain; calibratio —used to calibrate all field r men's instruments; a display sh miniaturization of transformers. tors and capacitors; tactical equipment used at Army Corps mobile photo laboratory; mobile type system. Also exhibited were els or mock-ups of five missiles— John. Hawk. Hercules. Honest and Corporal.

### Chicago

The Kickoff Dinner for the 1 chapter year was held on Sept 26th at Hallicrafters Company. cago. Preceding the annual d Hallicrafter's President and Cha of the Board, William J. Hallig former National President of AFC hosted a cocktail party for the than 150 members and their who were present. Henry J. McD chapter president, presided over business session.

With the applications of single band suppressed carrier mode of t mission being rapidly applied to frequency radio circuits, it was f that the main technical discussic

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As we enter our 31st year, CREI has in effective operation, group training programs with organizations representing the cream—and including the vanguard—of the electronics and aeronautical industries. Our active student body includes 5,000 students in the Armed Services, in both enlisted ratings and commissioned ranks. Leading companies regularly visit CREI to select graduating students for the better-than-average technical jobs. Graduates of years back can be found in positions of great responsibility throughout industry and the military services.

We pledge ourselves to increasing effort, so that we may continue to warrant the confidence of the great industry whose every challenge it has been our privilege to meet.

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**Fort Monmouth**—Brig. Gen. Earle F. Cook, Commanding General, U.S. Army Signal Engineering Labs. at Ft. Monmouth, N.J. (center), is shown greeting Ralph O. Hutchison, American Machine and Foundry Company executive, who was the guest speaker at the October dinner-meeting of the chapter. Looking on is Halsey Hubbard, chapter president.

the evening was devoted to this subject. Fritz A. Franke, Manager of Communications Products for Hallicrafters, was the moderator of a panel composed of Peter P. Pichetto, U.S. Army Signal Communications Engineering Agency, Washington, D.C.; Edward A. Beane and Ralph H. Wickersham of the Electronic Supply Office, U.S. Navy, Great Lakes, Illinois.

Brig. Gen. H. F. Gregory, Commander of the U.S. Air Force Office of Scientific Research, Washington, D.C., was the featured speaker at the October 24th meeting, which was held at the offices and plant of Bell & Gossett Company, Morton Grove. William E. Peugh, Sales Manager of the Electronics Division, chairmanned the presentation of the Bell & Gossett story. Mr. Moore told the history of the company and described its products.

Oliver F. Johnson, Manager of Bell & Gossett's Electronics Division, introduced General Gregory, whose brilliant speech, "Exploratory Research in Electronics," stressed the importance of utilizing the latest discoveries of basic research as soon as possible. Examples such as the use of solid-state devices cryogenic circuits, and the MASER technique were cited. The complete text of General Gregory's talk will appear in a later issue.

**London**—Pictured at the September chapter meeting are, front row, left to right: Lt. Col. J. T. Tyler, USAF, chapter president; Maj. C. L. Bachtel, USA; Sir Reginal Payne-Gallwey, and Comdr. C. G. Mayer. Back row, left to right: Capt. H W. Gipple, USAF; Maj. F. E. Stant, USAF; Mr. L. T. Hinton; Col. J. A. Plihal, USAF; Mr. T. E. Goldup; Mr. A. E. Tyler

In the introductory speech, Mr. Johnson pointed out that General Gregory's office was responsible for the USAF rocket "Farside" which set an altitude record of 4,000 miles the day before the meeting. Mr. Johnson also related that General Gregory directed almost all of the USAF development leading to a practical helicopter. General Gregory is as well known in diplomatic circles as in scientific, having spent four years as Air Attaché in Paris.

### *Fort Monmouth*

Ralph O. Hutchison, Assistant to the Vice President, Atomic Energy Division, American Machine and Foundry Company, addressed members and guests at the chapter's October 17th meeting.

Mr. Hutchison's talk, given after the business session and dinner in Gibbs Hall Officers Club, was on peacetime uses of atomic energy.

### *London*

The chapter's September 24th meeting at the Columbia Club Hotel heard three guest speakers on diverse topics as follows: Colonel J. A. Plihal, until recently the Director of Communication-Electronics for the Tactical Air Command located at Langley Air Force Base, and now assigned as Director, Communications-Electronics, Headquarters Third Air Force, who spoke on the problems encountered in tactical communications.

Mr. John C. G. Gilbert next discussed his experiences as the master of ceremonies of the BBC television panel. "Inventors Club." He had many amusing incidents to relate, most of which had happened to him while interviewing people for appearance on his television program.

Major Bert E. Dowdy, USAF, Commander of the 303d Tactical Reconnaissance Squadron of the 66th Tactical Reconnaissance Wing at Sembach, Germany, was on tactical reconnaissance photography in the Air Force and covered in detail the history of aerial photography and its application to the Armed Forces requirement up to

(Continued on page 46)

**New York**—Pictured at the October 23rd meeting are left to right: Walter Kirsch, Fairchild Camera and Instrument Corporation; Co M. A. Ellins, Commandant, Mitchell Air Force Base; Bill Madigan, President of Madigan Corporation, Brig. General Royal Hatch, Jr., D uty to Lt. Gen. Hall, CONAC, Air National Guard, Mitchell Air Force Base; Major de Seversky, principal speaker for the Ben Oliver, chapter president, Walter Watts, past National AFCEA President and an Executive Vice President of RCA; Admiral Frits present AFCEA National President, and Captain Wilfred B. Goulett, AFCEA Executive Vice President.

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**"Recollections of Early Experiments in Radio Astronomy"** by G. Reber, Hawaii.

**"Radar Echoes From the Moon at a Wave Length of 10 cm"** by B. S. Yaplee, et al, N. R. L.

**"Excitation of the Hydrogen 21 cm Line"** by G. B. Field, Princeton.

**"Extra Galactic 21 cm Line Studies"** by H. S. Heeschen, Greenbank Nat. Obs., N. H. Dieter, Harvard.

**"Radio Stars and the Milky Way at 440 mc"** by N. G. Roman & B. Yaplee, N. R. L.

**"A High Resolution Radio Telescope for Use at 3.5 M"** by B. Y. Mills, et al, Australia.

**"The Sydney 19.7 Mc/s Radio Telescope"** by C. A. Shain, Australia.

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the present date. He utilized visual aids and briefing charts to show various methods and types of aerial photography, assorted cameras equipped and how it is mounted in the aircraft, as well as the different types of pictures from different altitudes and positions.

Rome Daily

**Rome-Utica** — Dr. John R. Pierce, left, Bell Telephone Laboratories scientist, is conversing with, from his left: Maj. Clifton L. Nicholson, Assistant Chief of the Laboratory, Rome Air Development Center; E. Mark Wolf, Assistant Chief Engineer a Cable Corp., and Fred W. May, Rome Sales Manager of General Cable Corp. Dr. discussed outer space travel at the October 16th meeting of the chapter.

### *New York*

The chapter's October 23rd meeting heard an address on "Electronic Combat Power," by the noted aviation pioneer and inventor, Major Alexander P. de Seversky.

Prior to the meeting, held at the Belmont Plaza Hotel, members and guests assembled for cocktails and dinner. The guests at the head table introduced by chapter president B. H. Oliver, Jr., included Rear Admiral F. R. Furth, AFCEA National President; Capt. Wilfred B. Goulett, USN (Ret.), the new AFCEA Executive Vice President; Brig. Gen. Royal Hatch, Jr., Deputy for Air National Guard Affairs, and Col. M. A. Elkins, Commanding Officer of Mitchell Air Force Base.

Major de Seversky discussed the continued development of air power since World War II. He pointed out that nuclear weapons are getting more powerful and smaller, which serves to increase the fire power of the Armed Forces, but that the method of delivery will decide the issue rather than the type of weapons used. He stressed the supremacy of the Air Force in its mobility throughout the world.

The speaker defined air power as the ability to assert its will by air mobility and further said that air power is also space power, extending from the earth to infinity. In this concept, the control of the air is the control of space and, therefore, aircraft, missiles, rockets, etc., are interchangeable. Major de Seversky stated that, in his opinion, one Air Force instead of three military departments is essential to our national defense and that all efforts should be directed to increasing our elec developments, including counte sures against hostile air powe space missiles.

### *Pittsburgh*

On October 17th, chapter me were guests of Saxonburg Cer manufacturers of precision cer Chapter president George Ad who is General Manager of Saxo Ceramics, was host for the ev The program included a conducte of the plant's facilities and a hour.

An added feature of the meetin a specially arranged tour of the by Carnegie Tech cyclotron in tion at Saxonburg. Guides wer vided to explain the operation atom smasher and to answer the erous questions of the AFCEA

### *Rome-Utica*

The chapter's October 16th m was reported in the Rome *Daily tinel* as follows: "A follow-up cussion of travel in outer space a night's meeting of the Rome Chapter, Armed Forces Communic and Electronics Association, is s uled for January when the speake be Major David G. Simons.

"He is the Air Force officer wh summer soloed in a balloon at a altitude of more than 100,000 about 19 miles—and thereby, it lieved, proved it is safe for man to outer space.

"Instructors and students, Utica College, Rome and Utica schools and the Mohawk Valley nical Institute, were among the 26 sons present at last night's slide trated lecture by Dr. John R. Pi Bell Telephone scientist, on the ceptions and misconceptions of problems of space travel.

"His talk, given at the Griffiss Officers Club, embraced the space vel of science fiction stories and the experiments of recent years in which mice and monkeys were sent 80 miles aloft, 'and when picked up seemed to be none the worse.'

"If the research animals can do it," continued Dr. Pierce, "men can presumably follow.' However, he cited the human form as the chief drawback. It is likely to be the weakest link in the chain' leading to space travel, indicated Dr. Pierce.

"He said, 'The human body is not adapted to conditions in a near vacuum.'

"Dr. Pierce, Director of Research for Electrical Communications at the Bell Telephone Laboratories, referred to the space travel problems anticipated by ingenious' science fiction authors—such hazards as those presented by meteors and cosmic rays, and how air pressure would swell an ill-designed space suit into helpless rigidity.

"He pointed out that while today it is possible to transmit a television signal to the moon, and even to the planet Mars, man's probing of nature and the consequent determining of laws of science have turned up additional space travel problems.

"Dr. Pierce said these laws reveal, among other things, that it is 'unbearably hot' inside the orbit of the planet Venus, and that space travel beyond the orbit of Mars is 'terribly hilly' as contrasted to smooth flight.

"His talk was supplemented by colored slides illustrating a voyage from the earth to the moon, Mars and to the planet Saturn."

### *Sacramento*

A social get-together held at the MARS building, Sacramento Signal Depot, on September 30th, opened the chapter's activities for 1957-58. During an informal business session, members discussed program subjects for future meetings.

Guest speaker at the October 21st meeting was Dr. R. W. Gerdel, Chief of the Climatic and Environmental Research Branch of the U.S. Army, Snow, Ice and Perma-Frost Research Establishment, Wilmette, Illinois, who gave an informal lecture on military operations in the Arctic installations in the northernmost reaches of Canada. He also discussed "The City Built Under the Ice in Greenland" and related projects.

Dr. Gerdel augmented his discussion with a large collection of color projection slides.

The meeting was held at the Officers Mess of the Depot and was preceded by a cocktail hour.

### *San Juan*

The September 26th meeting, held at Fort Brooke Officers' Club, was devoted to a discussion of how the chapter could assist the Commonwealth of Puerto Rico in initiating a ommend a positive program of chaptechnical training program in its vocational school system. Mr. A. L. Alicea of the Department of Education, present as a guest of the chapter, stated that the Commonwealth wished to institute a program of training for technical positions for communications and allied industries but that the Department of Education needed advice and assistance in initiating and conducting such a course.

The following committee was appointed to study the matter and recommend a positive program of chapter assistance: Eugene Klein, FCC, chairman pro tem; John Golden, RCA Communications, acting chairman; George Alich, CAA; Kinne Prachel, Prachel's TV Service; Jaime Acosta, Radiotelephone Communicators; and Gerard Lavergne, Puerto Rico Telephone Company.

Recommendations made by the committee were submitted to the October 24th chapter meeting and were approved for transmittal to the Commonwealth Department of Education. The principal recommendation concerned the shortage of qualified instructors to conduct the technical training. The chapter recommended a practical program of recruiting qualified instructors from the electronic industries and communications system in Puerto Rico. Another recommendation was that such training be aimed at obtaining a suitable FCC license at first, with options to change at a later date to telephone, telegraph or wire communications work.

Chapter President Wyman S. Borden announced his imminent transfer to Mexico City and tendered his resignation from office. He was given a unanimous vote of appreciation for his service to the chapter. Captain Gifford Grange, USN, Commanding Officer of the Naval Communication Station and vice president of the chapter, succeeded to the presidency. Mr. James P. Fitzwilliam, past president, was appointed to fill the vice-presidential vacancy.

Special guests at the October meeting were: Dr. Amador Cobas, radioisotope scientist at the University of Puerto Rico; Maj. Earl McCain, USAF, and six Air Force and Civil Air Patrol officers who were in Puerto Rico for the October 26th AF/CAP SARCAP, a fully-simulated search and rescue mission sponsored by the Air Force.

### *Tinker-Oklahoma City*

The October 15th meeting was sponsored by the Southwestern Bell Telephone Company, with Clarence C. Flora of the engineering department, as the guest speaker.

Mr. Flora's subject was "Distant Early Warning Radar and Communications Projects in the Arctic." His presentation was illustrated by an outstanding collection of color slides and covered the early planning and logistics build-up for "Project DEW Line."

Included among the guests were members of the Oklahoma City chapter, American Institute of Electrical Engineers.

### *Washington*

A complete progress report of the U.S. earth satellite program was given by Dr. Homer E. Newell, Jr., of the Naval Research Laboratory at the regular luncheon meeting on November 5th at the Willard Hotel. Total attendance was four hundred and fifty.

Dr. Newell is the Science Program Coordinator for PROJECT VANGUARD at the U.S. Naval Research Laboratory. He discussed various scientific uses of any earth satellite, and gave detailed information concerning the experiments to be performed with U.S. satellites as part of the International Geophysical Year.

Seated at the head table were: Dr. Newell; Hugh Odishaw, Executive Director, U.S. National Committee for the International Geophysical Year; Capt. Wilfred B. Goulett, AFCEA Executive Vice President, and the following chapter officials: L. Harriss Robinson of Motorola, president; vice presidents—Maj. Gen. Emil Lenzner, Deputy Chief Signal Officer; Brig. Gen. Bernard M. Wootton, Deputy Director, Communications-Electronics, USAF, and Ralph A. Irwin of Westinghouse Electric; secretary-treasurer — John R. O'Brien of Hoffman Laboratories; program chairman — John F. Gilbarte of Admiral Corporation.

## Engelhard Industries

(Continued from page 33)

from Army, Navy and Coast Guard research agencies.

One of Mr. Waller's biggest problems has been that of securing qualified personnel. He says he has spent a year and a half looking for two men. "Our men work at the engineering level, so sales experience is not important; on the other hand, pure technical proficiency also is of little value. What we need are men capable of grasping the military veiwpoint and of working simultaneously in a number of highly technical fields. They must be able and willing to pick up a completely new subject every few months—constant study is required." He adds that it takes several years for even the most highly qualified man to become proficient in this work.

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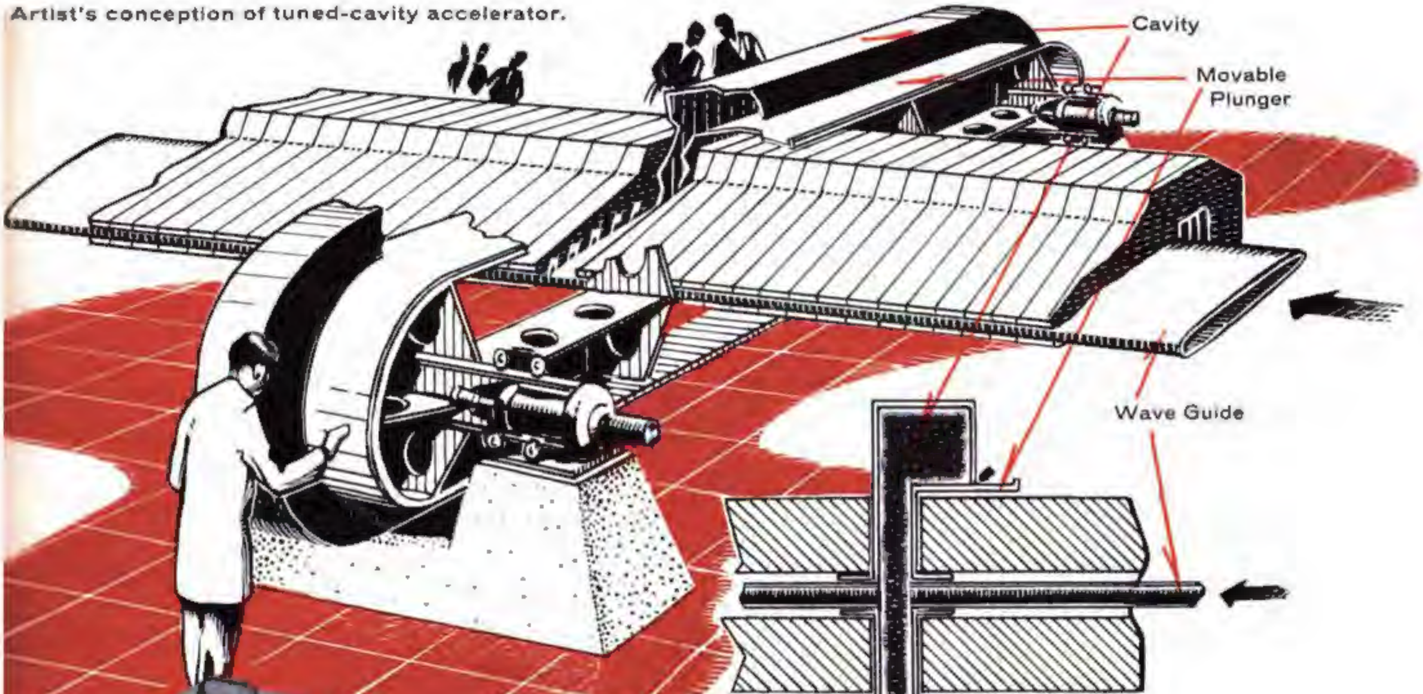
Artist's conception of tuned-cavity accelerator.



Setup used during accelerator development. Sweep Drive operates G-R Unit Oscillator while Type 1263-A Amplitude-Regulating Power Supply ($280) maintains constant oscillator output during sweeping. Constant output is obtained by comparing output signal with a reference voltage and applying a rapid correction voltage to oscillator plate supply.

# G-R Sweep Drive Aids in Design of World's Largest Mechanically-Tuned Cavity

Research scientists at Iowa State College have developed a model of what will probably be the world's largest mechanically-tuned cavity. The cavity, designed for operation between 30 and 200 Mc, may serve as the r-f accelerator for a 15-25 billion electron-volt proton synchrotron. The cavity was designed under a project conducted by the Midwest Universities Research Association, a group of midwestern universities organized for the purpose of developing this new nuclear research device.

During development, the General Radio Sweep Drive proved indispensable for determining the effects of design changes in cavity models. The Sweep Drive was coupled to a G-R Unit Oscillator which excited the cavity over a broad frequency range. The cavity output signal was rectified and applied to an oscilloscope with a long-persistence screen. With this setup, cavity response could be panoramically displayed, making cavity resonances at various modes of oscillation clearly discernable and measurable.

Whether testing accelerators or amplifiers, the Sweep Drive cuts testing time without reducing accuracy. It extends the usefulness of manually-operated equipment such as oscillators, signal generators, receivers, and analyzers. It's a time-saver, labor-saver, and cost-saver all rolled-in-one.

### G-R Type 1750-A Sweep Drive

**Wide Range of Speeds** — 0.5 to 5 cps, reciprocating motion.

**Sweep Arc** — adjustable from 30° to 300°.

**Center-Position of Sweep Arc** — adjustable to any position — not affected by sweep arc.

**Universal Coupling System** — four adjustable spider-like arms readily attach to knobs and dials 1" to 4" in diameter and to ¼" and ⅜" shafts — shaft height also adjustable.

**Limit-Switch Circuit** — disconnects and brakes motor if preset limits of shaft travel are accidentally exceeded.

**CRO Deflection Circuit** — provides voltage proportional to shaft angle for CRO horizontal-deflection plates.

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