



## Roll of Honour: **William Gordon Welchman**

### Name

Mr William Gordon Welchman

### Certificate of Service

[View online](#) [attached]

### Service

FO<sup>1</sup> Civilian

### Rank

TSAO<sup>2</sup>

### Summary of Service

Bletchley Park September 1939 - 1945. Hut 6,<sup>3</sup> Block D(6)<sup>4</sup> and Block F.<sup>5</sup> Head of Hut 6 Registration Section, later Head of Hut 6. From September 1943 Head of Machine Co-ordination and Development Section. From March 1944 Assistant Director (Machines and Mechanical Devices) (AD(Mch)).

### Commemorated On The Codebreakers Wall

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<sup>1</sup> Foreign Office.

<sup>2</sup> Temporary Senior Administrative Officer.

<sup>3</sup> Decrypted German Army and Air Force Enigma signals. Moved Block D in February 1943.

<sup>4</sup> Occupied by the Hut 3, Hut 6 and Hut 8 sections from February 1943.

<sup>5</sup> Completed August 1943, accommodated the Military and Air Sections, Newmanry and Testery. Demolished in 1987.

No

**University**

Cambridge - Trinity College, Sidney Sussex College (Fellow).

**Billeted**

Great Brickhill and Loughton.

**Gordon Welchman 1906 - 1985**

A brief biography, based on that formerly displayed in the 'Hall of Fame' in Bletchley Park mansion. - Attached in PDF

# Mr William Gordon Welchman



FO Civilian, TSAO

For service in support of the work of Bletchley Park during  
World War Two. We Also Served.

## Gordon Welchman

1906 – 1985

*A brief biography, based on that formerly displayed in the 'Hall of Fame' in Bletchley Park mansion.*

**Within a few weeks of the outbreak of World War 2, Gordon Welchman had reinvented a way of breaking Enigma, which he was then told Bletchley Park was already working on, having learnt about it from the Poles. Welchman then insisted that urgent action be taken to prepare for mass production as soon messages would be being read in large numbers. Edward Travis took notice, and successfully argued the case in Whitehall. Gordon was then appointed to lead the Enigma decryption team that was set up in Hut 6, following their success in reading Enigma in January 1940. He led his ever increasing team with great success. By 1943, every day it was breaking 20 or more keys and producing thousands of decrypts. In September 1943 he was given responsibility for mechanisation work across Bletchley Park.**

William Gordon Welchman was born on 15 June 1906 near Bristol. He was educated at Marlborough and Trinity College, Cambridge, achieving a double first in mathematics. He taught at Cheltenham for a year, before returning to Cambridge as a Fellow of Sidney Sussex College in 1929. He became an expert in geometrical mathematics, and Junior Dean of his college.

He was recruited to attend the **GCCS short-course in cryptology in 1938**. Welchman joined **Bletchley Park on Monday 4 September 1939**. He was assigned to work in the Research Section who was working to break the German Enigma machine codes under the Dilly Knox. Welchman was sent to Elmers School House to study 'traffic analysis', soon realising that it should be possible to break Enigma using the repeated encrypted indicator letters sent by the Germans to tell their Enigma operators how to set up their machines. But when he proposed this to Dilly Knox, he was told that they were already working to prepare the perforated-sheets to make use of this method, as they had learnt about it from the Poles.

**Welchman successfully lobbied Edward Travis** about the need to prepare for the flood of decrypts that they would soon be generating. Welchman was proposing a revolution in codebreaking, akin to the mass-production revolution. Soon after the first break at Bletchley Park was achieved on about the 20 January 1940, Hut 6 was set up to handle the decryption of German Army & Luftwaffe Enigma. It soon became apparent that Welchman was the natural leader of the Hut. He continued to lead the hut throughout all the months of the build-up, as Hut 6 expanded from a couple of dozen staff into a team of several hundred. By the time he was promoted away to look after all the mechanisation work of Bletchley Park, each day his hut was attacking 20 or more Enigma keys and producing several thousand decrypts a day. Initially they used the Zygalski sheet method, then the 'cillies', and after August 1940 cribs and the Bombes, for which Welchman had proposed a vital modification. The decrypts they produced were a major part of the Bletchley Park success.

Welchman had proved himself a man of vision, an outstandingly capable organiser and manager, as well as a creative ideas man. He seems to have got on well with almost everyone at Bletchley Park. **After the war, Welchman went to work in the USA on defence data handling projects at the fore-front of the digital revolution.** In 1982 he published his *The Hut 6 Story* to official disapproval but much public acclaim. He died on 8 October 1985 in Massachusetts, USA. Sir Stuart Milner-Barry, his deputy & successor in Hut 6, has said 'if Gordon Welchman had not been there, I doubt if Ultra would have played the part it undoubtedly did in shortening the war'.

Soon after the end of the war he took Hugh Alexander's old post as Director of Research for the John Lewis partnership, but moved to the USA in 1948 to be at the heart of the fast developing digital revolution. He took a post at Massachusetts Institute of Technology, lecturing on the first computer course there, with spells at Remington Rand and Ferranti before coming back to the MIT non-profit spin off, the Mitre Corporation, who were working on a large scale air defence data handling project. Welchman acted as a sort of Chief Scientist, working for Mitre from 1962 until he formally retired in 1971, though he continued as a consultant to them until 1982. It was in that year that his famous book 'The Hut 6 Story' was published. Acting on the assumption that the publication of Freddie Winterbotham's 'The Ultra Secret' had removed the obligation to secrecy that he had maintained for 37 years, he was surprised by the official disapproval that greeted the book's publication, which included the removal of his security clearance.

# William Gordon Welchman

**Born: 15 June 1906 in Fishponds, near Bristol, England**  
**Died: 8 October 1985 in Newburyport, Massachusetts, USA**



Click the picture above  
to see a larger version

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**Gordon Welchman's** parents were William Welchman (1866-1954) and Elizabeth Marshall Griffith. William was a priest who, after undertaking missionary work abroad, returned to England and became a country vicar. He eventually became archdeacon of Bristol. His wife Elizabeth was the daughter of a priest, the Revd Edward Moule Griffith. Gordon was the youngest of his parents three children. In 1920 he won a scholarship to Marlborough College, an independent boys' school founded in 1843 in Marlborough, Wiltshire. He entered Marlborough College in 1920 where his teachers soon recognised his outstanding talent for mathematics. In 1925 he won a scholarship to Trinity College, Cambridge, to read mathematics.

Welchman matriculated at Cambridge in 1925 where he studied the mathematical tripos. He was ranked first class in part one of the tripos in 1926 and again first class in part two in 1928. He left Cambridge for a year spending 1928-29 as a mathematics teacher in Cheltenham. He then returned to Cambridge in 1929 when offered a fellowship by Sidney Sussex College. He published *Foci of Systems of Spaces* in the *Journal* of the London Mathematical Society in 1932 and, two years later, in September 1934, submitted a 45-page paper *Special Scrolls and Involutions on Canonical Curves* to the *Proceedings* of the **London Mathematical Society**. This major paper was published in 1936. Welchman begins the Introduction as follows:-

*There is at present no satisfactory general theory of special ruled surfaces, or scrolls, and the main object of this paper is to develop the theory of certain fundamental scrolls from which all special scrolls may be obtained by projection.*

In 1937 Welchman married Katharine Hodgson, the daughter of Francis Faith Hodgson who was a captain in the Indian army. Katharine was a professional musician and Gordon and Katharine Welchman had a son and two daughters. Welchman's career was progressing well. He was dean of Sidney Sussex College and he was writing a book entitled *Introduction to Algebraic Geometry*. However, his career took a very different path due to the countries of Europe moving towards war.

Adolf Hitler had become Chancellor of Germany in 1933 and quickly begun to build up the German armed forces. In March 1938 German troops had marched into Austria and later that year Germany was given the Sudetenland in the Munich Agreement. Although some, like Neville Chamberlain the British Prime Minister,

were still trying to avoid a war, others believed that war was inevitable. One who was convinced that war was imminent was Alastair Denniston who was the head of the British Government Code and Cypher School. Denniston had been involved with codebreaking during World War I but he realised that times had changed and different skills would be needed of his codebreakers. In World War I codebreakers were recruited from expert linguists but now he believed that mathematicians were needed [5]:-

*He visited Oxford and Cambridge searching for willing and bright recruits. This was a fairly challenging task since, as Denniston noted, "it was naturally at that time impossible to give details of the work" that these recruits would be required to carry out. One recipient of the letters sent out to lecturers at these two universities was Gordon Welchman.*

As one of the first to be recruited to Bletchley Park where the codebreaking operations were being conducted, Welchman played important roles in recruiting fellow mathematicians and in making significant breakthroughs in the coding operations within the first few months of the war [4]:-

*Welchman, assigned by Dillwyn Knox on arrival at Bletchley Park to comparatively low-level research on call signs, quickly realized that he and his few colleagues were dealing with an entire communication system that would serve the needs of the German ground and air forces. It was the development of traffic analysis which was his greatest contribution, but in these early months he made two startling breakthroughs in enabling Enigma-coded signals to be read.*

At Bletchley Park there were various Huts which worked on different aspects of decoding. This way of organising operations was made in a proposal by Welchman. He was made responsible for setting up and organising Hut 6 which had the task of breaking the German Army and Air Force codes [5]:-

*He made lists of anything he believed to be of interest and gradually worked his way through the masses of messages that he had been sent. He was also presented with a very small collection of decoded Enigma messages (no more than three days worth). These he found particularly helpful, as they gave an illustration of the types of messages that the Germans were likely to transmit, the polite manner in which they addressed each other, and the style of their signature at the conclusion of the message, which would always include their full title and name. Furthermore, Welchman realised that a particular design flaw of the Enigma machine meant that a letter could never be encrypted as itself. He further realised that if A was encrypted as B for example, then B would be encrypted as A. This was massively important as it reduced the number of combinations of encryptions significantly.*

[Alan Turing](#) worked in Hut 8 which dealt with breaking the German Navy codes. He designed the Bombe, an early form of computer, to look at all possible settings of the Enigma machine sending the message. Welchman made a very significant contribution to reducing the number of possibilities that had to be considered by the Bombe and greatly enhanced its usefulness. In October 1941 he was one of four who wrote to the British Prime Minister, Winston Churchill, requesting more resources for the codebreaking work at Bletchley Park. The other three who signed the letter were [Alan Turing](#), [Hugh Alexander](#) and Stuart Milner-Barry. Churchill's response to the letter was the now famous comment "Action this Day".

After the war ended Welchman did not return to academic life but instead was appointed as director of research for the John Lewis Partnership. In 1946 he was honoured for his contributions during the war when he was given an OBE (Order of the British Empire). However, he decided to move to the United States where he felt he could use the computing skills that he had developed during his time at Bletchley Park. He moved to the United States in 1948 and he taught the first computing course at the Massachusetts Institute of Technology. He then took jobs at Remington Rand and Ferranti.

We noted above that Welchman had been writing the book *Introduction to Algebraic Geometry* when he was recruited to the codebreaking operations at Bletchley Park. Welchman aimed to write a book which would:-

*... help some students to appreciate the volumes on 'Principles of Geometry' by Professor [H F Baker](#).*



The book was eventually published in 1950, probably more than ten years later than it would have appeared had World War II not interrupted his career. Temple Rice Hollcroft (1889-1967), professor at Wells College, writes in a review:-

*This is a treatise on algebraic projective geometry of the plane with extensions to higher dimensions. Designed as an introduction to more advanced work, the author applies "to the more elementary problems the types of reasoning that are used in advanced work." ... The book is well written, the expositions clear and ample. The printing is excellent and the formulas well displayed. The methods are almost entirely algebraic except for a few synthetic proofs ...*

Welchman divorced Katharine and married the artist Fannie Hillsmith in 1959. Fannie was the daughter of Clarence Hillsmith, a consulting engineer from New Hampshire. In 1962 he became an American citizen and, shortly after, took a job with the so-called MITRE Corporation. This:-

*... provides services in systems analysis, systems engineering and technical direction for U.S. Government Agencies and other public-interest organisations.*

Some of the work he undertook for MITRE is described in [5]:-

*Amongst other things, Welchman was involved in investigating the optimum design of battle field communication systems and found that many parallels could be drawn with his work at Bletchley Park, despite how great the advancements in technology had been in the years in between.*

His second marriage, like his first, ended in divorce. This was in 1971, the year that he retired but he remained as a consultant for MITRE. A year later, in 1972, he married Elisabeth Huber, the daughter of Anton Wilhelm Huber and Myrtle Octavia Hussey, who owned a sawmill and carpentry business in Bavaria. Myrtle Hussey was Welchman's second cousin. In 1974 he began writing about his work at Bletchley Park. The book he was writing was entitled *The Hut Six Story*. It was not published until 1982. Joel Greenberg, the author of Welchman's biography [2], describes Welchman's book:-

*That was the first book which actually explained how they did it. All the other books told the story about Bletchley Park, the fact that messages were decrypted on an industrial scale and all this intelligence was produced, there was lots of information about how it affected the outcome of World War Two, but nobody was allowed to or dared describe the process of how they actually did it. Welchman's book was the first and interestingly enough it probably remains the only serious book in print to describe technically how the Bombe worked and how Enigma messages were decrypted on an industrial scale. There were references to it in other books but not in the detail that Welchman went into.*

The publication of the book led to the Cabinet secretary, Sir Robert Armstrong, writing to the British Prime Minister, Margaret Thatcher:-

*A book entitled "The Hut Six Story", by Gordon Welchman, has been published in the United States and is due for publication in this country in June. Welchman was in charge of Hut 6 at Bletchley Park during the first part of the War. Hut 6 was responsible for the cryptanalysis of German Enigma traffic. The book goes into very considerable technical detail about the method developed for this work. Much of the information in the book is still classified in both the United Kingdom and the United States. Little World War II cryptanalysis information is directly relevant to present day exploitation. None of the revelations are directly damaging to UKUSA Sigint. There must however be some indirect damage, in the sense that so long as Signet and cryptanalysis are kept in the public eye by books of this sort, foreign COMSEC organisations will receive more funds and will be stimulated to greater efforts.*

The book was not banned but Welchman lost his US security clearance and was forbidden to discuss his book or his wartime work with the media. Three years after publication of the book, GCHQ Director Sir Peter



Marychurch sent Welchman a letter in which he accused him of damaging security. His last years were difficult ones - he had FBI agents parked outside his house and believed his phone was tapped.

About Welchman's motivation to write the book, Greenberg writes:-

*He became an American citizen in the early 1960s so he thought he was immune from prosecution. He knew that GCHQ weren't keen and that if he asked GCHQ they would say no. But he had other reasons for wanting to do it. It wasn't an ego trip and it wasn't about making a lot of money. ... He was 33 at the beginning of the war and, by Bletchley Park standards, that was middle aged. They were all so young. He'd recruited a lot of former students and he found some of his colleagues, had almost been disowned by their families. He just felt their story should be told and even if he didn't name or quote them, people would be more aware of the amazing things these people did. Welchman encountered suspicion himself, from his wife's family, who were senior military figures. They saw him out of uniform, at the age of 33, and Welchman was not able to tell them what contribution he was making to the war effort.*

Finally, let us quote Leonie Field's summary of Welchman's Prologue from *The Hut Six Story* [5]:-

*In his prologue to The Hut Six Story Welchman says that the lessons that should be taken from his story are firstly that protection against theft, enemy infiltration, sabotage and so on are just as important as protection against the enemy breaking your own codes. Secondly, he makes the point that studying the flaws in the use of the Enigma machine that he himself exploited highlights the importance of adequate training and monitoring of all those who work within the system of battle field communications. He emphasises the lesson that can be learned of the importance of close cooperation between military sectors. Lastly, and most importantly, he stresses that those in charge of current day security systems must remain mindful of future technological advancements in the present day. He believed that there was an important warning in the fact that the Germans believed the Enigma code to be entirely unbreakable and therefore put far too much faith in its insusceptibility to enemy cryptanalysis. They had not planned for the invention of the bombe, a brand new electromechanical device.*

Welchman's character and interests are described by Robin Denniston in [4]:-

*Welchman had an acute analytical mind, boundless drive and enthusiasm, but rather limited imagination. At a crucial moment in the Second World War he brought together discrete ideas and divergent pieces of evidence to produce a total policy framework. As a man, though not always easy for his colleagues to communicate with, he was admired, trusted, and liked, for his great charm as well as intelligence and kindness. ... He loved mountains, for climbing and skiing. He was an avid gardener and a keen amateur musician.*

**Article by:** *J J O'Connor and E F Robertson*

**List of References** (6 books/articles)

**Mathematicians born in the same country**

**Other Web sites**

1. [Dictionary of National Biography](#)
2. [Mathematical Genealogy Project](#)
3. [MathSciNet Author profile](#)
4. [zbMATH entry](#)

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