HUT 8 and ITS CODE BREAKERS

Andrew Hodges, the biographer of Alan Turing, took this picture of Bletchley Park huts as they appeared in 1998. He describes the photo: "Hut Eight, where Alan Turing worked on the naval Enigma, is in the centre of the picture. To the left is Hut Six (Army and Air Force signals). To the right is Hut One." For more of Hodge's background information on Station X and Turing, visit his "Alan Turing: The Enigma" website.

Code breakers assigned to Hut 8 were charged with cracking Germany's naval Engima code. It was the most-difficult job of all at Bletchely Park (also known as Station X).

The first "huts" were built at Bletchley Park during 1939. Before that, however, a handful of people in pre-war Britain - using the valuable information and Enigma replicas which the Poles had provided - were already trying to understand and break Germany's coding system.

Much of that early work was done at the Government Codes & Ciphers School (GC&CS) located, during 1938, in London. Alfred Dillwyn ("Dilly") Knox was an early code breaker; so was Peter Twinn. In September of 1939, they were joined by Gordon Welchman, who was later in charge of Hut 6.

Historical records tell us that Hut 8 (which is shaded in this site view) was likely built in early 1940. Its first occupant was the GC&CS group working on Germany's naval Enigma code.

Who were the people working in Hut 8?

- In 1940, Welchman recruited Joan Clarke with whom he'd been very impressed while Joan was a math student at Cambridge University.

- Shaun Wylie joined Hut 8 in February of 1941.

- Hugh Alexander, Britain's national chess champion, joined in March of 1941.

- Jack Good became a part of the Hut 8 team in May of 1941.

- Peter Hilton joined the team in January of 1942.

All of these individuals were highly intelligent people who were among Britain's brightest math minds at the time.

And then there was Alan Turing. His 1936 paper, "On Computable Numbers" - which he wrote, as a student, while working on his PhD at Princeton - became a cornerstone of today's "digital age."

What did Turing mean by "computable numbers?"

> *The "computable" numbers may be described briefly as the real numbers whose expressions as a decimal are calculable by finite means... a number is computable if its decimal can be written down by a machine.* (See the first paragraph of Turing's paper, online via Oxford University.)

It was that paper, among other things, which caused British government officials to recruit Turing (from Cambridge) to work at Bleachley Park.

And ... it was in working-up that paper where Turing's mathematical musings led him to envision a machine in which *symbols*, representing *instructions*, were no different from *symbols* representing *numbers*.

In other words ... Turing imagined today's computers before today's technology even existed.

Turing's biographer, Andrew Hodges, describes the impact of Turing's "Computable Numbers" paper with these words:

> *It is now almost impossible to read Turing's 1936 work without thinking of a Turing machine as a computer program, and the Universal Turing Machine as the computer on which different programs can be run...*
>
> *We are now so familiar with the idea of the computer as a fixed piece of hardware, requiring only fresh software to make it do entirely different things, that it is hard to imagine the world without it.*
>
> *But Turing imagined the Universal Turing Machine ten years before it could be implemented in electronics.*
>
> *Now you can use your computer to simulate the working of a Turing machine, and so see on the screen what in 1936 was only possible in Turing's imagination. This is no accident! — the whole point is that the computer embodies the principle of a Universal Turing machine, which can simulate any Turing machine.*
>
> *It was also essential to Turing's 1936 work that a Turing machine could be thought of as data to be read and manipulated by another Turing machine — this is the principle of the modifiable stored program on which all computing now depends.*

With Turing, Stewart Menzies had the perfect person to head the Hut 8 code-breaking team.

See Alignments to State and Common Core standards for this story online at:
http://www.awesomestories.com/asset/AcademicAlignment/HUT-8-and-ITS-CODE-BREAKERS-The-Imitation-Game

See Learning Tasks for this story online at:
http://www.awesomestories.com/asset/AcademicActivities/HUT-8-and-ITS-CODE-BREAKERS-The-Imitation-Game

Questions 2 Ponder

Is It Moral to Deprive Our Enemies of Life-Giving Supplies?

To win WWII, using his strategy of constantly sinking merchant ships bound for Britain, Germany's Admiral Donitz knew he was depriving British people, including children, of life-giving supplies. Is that moral, or not moral, in war time?

Is depriving Britain of supplies, during WWII, the same as imposing economic sanctions on countries during the 21st century? Why, or why not?

Would your answer be different if Britain was not at war with Germany? Why, or why not?

Is Winning, at Any Cost, a Moral Objective?

Does Admiral Donitz' strategy of winning the war by sinking as many Allied supply ships as possible - thereby potentially starving Germany's enemies in Europe - make sense from a war-winning perspective? Why, or why not?

Should the "need to win," whether in war or otherwise, be tempered by a moral component? When does the moral component apply and when might it not apply (if ever)?

On the 1st of May, 1915, Germany attacked the above-pictured USS *Gulflight*, in error - causing the death of three Americans. Does the mistaken belief that the ship was British remove Germany's responsibility (moral or otherwise) for the unprovoked attack? Why (or why not)?

Media Stream

Bletchley Park Overview

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Gordon Welchman - A Station X Star

Gordon Welchman was 33 years old in 1939. A brilliant mathematician, he was a fellow of Sidney Sussex College (at Cambridge University). He would play a *very* significant role at Bletchley Park during its code-breaking years.

During the early part of 1939, Welchman attended courses in cryptography at the Government Code and Cypher School. As an academic, Welchman knew other potential codebreakers, and he became very good at recruiting for GC&CS.

Beyond his professional work, what was Welchman like as a man? In his book *The Secret Life of Bletchley Park*, Sinclair McKay describes Welchman as:

...a dazzlingly clever 33-year-old mathematics lecturer... - a handsome fellow with an extremely neat moustache - [who] swiftly proved to be an assiduous, enthusiastic and fantastically ambitious recruiting officer. (See McKay at page 19.)

After the war broke out, for example, Welchman recruited a young woman named Joan Clarke (portrayed in the film, "The Imitation Game," by Keira Knightly). Clarke had just achieved a double first in Math, at Cambridge's Newnham College and, during the summer of 1940, Welchman tapped her to work at Bletchley's Hut 8. (See McKay at page 194.)

Welchman also played a key role in helping Alan Turing to create his electro-mechanical machine—known as the "Bombe"—when Turing's first iteration of the machine did not perform the way its creator had hoped.

Image of Gordon Welchman, online via Spartacus Educational.

View this asset at: http://www.awesomestories.com/asset/view/Gordon-Welchman-A-Station-X-Star

Hugh Alexander - The Imitation Game

Hugh Alexander—whose full name was Conel Hugh O'Donel Alexander—was already famous by the time he came to Bletchley Park in 1940. He was Britain's charismatic chess champion before he arrived at Station X.

How did Hugh Alexander become part of the Hut-8 code-breaking team? He was recruited by his friend, Stuart Milner-Barry.

Gordon Welchman (who became head of Hut 6) recalls how that happened in his book, *The Hut Six Story: Breaking the Enigma Codes* (published, by M & M Baldwin in 1997):

For my part, I quite shamelessly recruited friends and former students. Stuart Milner-Barry had been in my year at Trinity College, Cambridge, studying classics while I studied mathematics.

He was not enjoying being a stockbroker, and was persuaded to join me at Bletchley Park. He arrived around January 1940, when the Hut 6 organization was about thirty strong, bringing with him the largest pipes I have ever seen smoked.

Stuart in turn recruited his friend, Hugh Alexander [seen, hereafter, as he appeared in 1939], who had been a mathematician at Kings College, Cambridge, and was then Director of Research in the John Lewis Partnership, a large group of department stores.

They [Milner-Barry and Alexander] brought us unusual distinction in chess: Alexander was the British Chess Champion, while Milner-Barry had often played for England and was chess correspondent for the London Times.

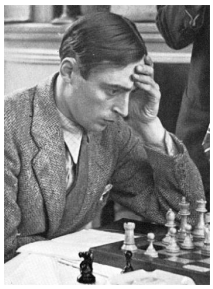
After serving for a time at Hut 6 (the Military and Air Sections), Hugh was assigned to Hut 8 (in March of 1941) where he was Alan Turing's deputy.

An excellent administrator, with very good diplomacy skills, Hugh eventually became head of Hut 8, after Turing began working on other matters (such as research requiring abstract thinking) at Bletchley Park. (See Alan Turing: The Enigma - The Centenary Edition, by Andrew Hodges, at page 227.)

Alexander also left Hut 8, around the end of 1943, to head-up "one of the Japanese Naval High-grade sections." (See "In Memoriam: Conel Hugh O'Donel Alexander," by Hugh Denham, a senior official at Government Communications Headquarters in 1975.)

The war caused Alexander to set-aside his competitive chess-playing days for many years. What was he like, as a chess player and as a person?

Conel Hugh O'Donel Alexander was one of the most charismatic players of his time, full of a positive nervous energy that galvanised all who came into contact with him. The war imposed a seven-year break in what would have been his prime years as a player, but his work at Bletchley Park in charge of Hut 8 was invaluable.



His post-war chess career is well documented; player, columnist, author, administrator, all alongside his day job at GCHQ [Government Communications Headquarters] in Cheltenham. He became champion again in 1956 (Blackpool), but soon after he retired from tournament play, as he felt he wasn't doing himself justice at the board, and his other roles took over.

He died in 1975 and his posthumous biography was a joint work by Milner-Barry, Golombek and Hartston. (See "British Championships, Past and Present," at Chess Base.)

In "The Imitation Game," a film featuring the work of Bletchley Park code breakers during WWII, the role of Hugh Alexander is played by Matthew Goode (seen, below, in a still-shot from the film). The real Hugh Alexander was born on the 19th of April, 1909, in the Irish city of Cork. When he went to King's College, Cambridge, he took a first in math.

People liked Hugh, and he liked people. In his Memorial piece about his friend and colleague, Hugh Denham uses these words:

...He had retained an almost boyish zest throughout life - was always totally absorbed in what he was telling you, or, more often than not, in what you were telling him.

Hugh Alexander died young, at the age of 64. Stuart Milner-Barry, the friend who'd recruited Hugh to be part of Bletchley Park's code-breaking team, used these words in his eulogy:

One could have wished for nothing else but that vivid and vigorous presence, that quick, clear and energetic mind, the passion for intellectual argument, the practical kindness and spontaneous understanding with the young - all this will be sadly missed. To have been so close a friend for 50 years is indeed good fortune.

The image of Hugh Alexander, depicted at the top of this page, shows him at a chess tournament in 1938 (at Brighton). Hereafter, via Spartacus Educational, we see him and his friend Stuart Milner-Barry playing against each other, later in their lives.

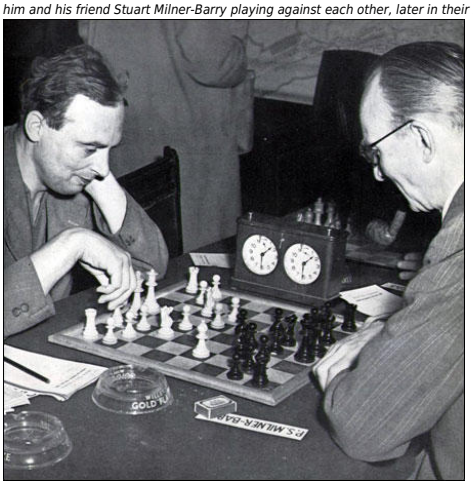


Image of Hugh Alexander, at a chess tournament in Brighton during 1938, is online via Chess Base.

View this asset at: http://www.awesomestories.com/asset/view/Hugh-Alexander-The-Imitation-Game

Alan Turing - Early Years

Andrew Hodges, who wrote a biography of Alan Turing (called *Alan Turing: The Enigma*, published in 1983), also authored a short biography of his subject for the *British Dictionary of National Biography* (published in 1995).

The following excerpts, from Hodges' *National Biography* entry, help us to understand Alan Turing's early life.

PART 1 — THE ORIGINS OF ALAN TURING

Alan Mathison Turing was born on 23 June 1912, the second and last child (after his brother John) of Julius Mathison and Ethel Sara Turing.

The unusual name of Turing placed him in a distinctive family tree of English gentry, far from rich but determinedly upper-middle-class in the peculiar sense of the English class system.

His father Julius had entered the Indian Civil Service, serving in the Madras Presidency, and had there met and married Ethel Sara Stoney. She was the daughter of the chief engineer of the Madras railways, who came from an Anglo-Irish family of somewhat similar social status.

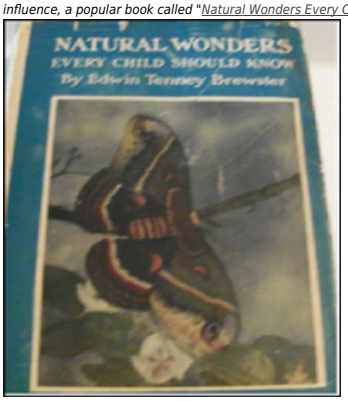
Although conceived in British India, most likely in the town of Chatrapur, Alan Turing was born in a nursing home in Paddington, London.

...

Alan Turing's story was not one of family or tradition but of an isolated and autonomous mind.

Alan Turing shared with his brother a childhood rigidly determined by the demands of class and the exile in India of his parents. Until his father's retirement from India in 1926, Alan Turing and his elder brother John were fostered in various English homes where nothing encouraged expression, originality, or discovery.

Science for him was an extra-curricular passion, first shown in primitive chemistry experiments. But he was given, and read, later commenting on its seminal influence, a popular book called "Natural Wonders Every Child Should Know."



His boyhood scientific interests were a trial to his mother whose perpetual terror was that he would not be acceptable to the English Public School. ["Public schools," in Britain, are called "private schools" in America. Eton and Harrow are examples of British public schools.] At twelve he expressed his conscious fascination with using "the thing that is commonest in nature and with the least waste of energy," presentiment of a life seeking freshly minted answers to fundamental questions.

Despite this, he was successfully entered for Sherborne School. The headmaster soon reported: "If he is to be solely a Scientific Specialist, he is wasting his time at a Public School." The assessment of his establishment was almost correct.

Despite these restrictions in his life, Alan still pursued his personal interests. One of those interests was Einstein's theory of relativity.

Making private notes about Einstein's theory, while still a school boy, Turing was beginning his own intellectual journey. That journey would ultimately put him in contention for "Person of the Century" as the 20th century came to a close.

Image of Alan Turing, as a young boy, online via Andrew Hodges' website called "The Alan Turing Internet Scrapbook."

View this asset at: http://www.awesomestories.com/asset/view/Alan-Turing-Early-Years

Alan Turing and Christopher Morcom

What kind of student was Alan Turing? What did his parents and teachers expect of him, while he was in school? Did he have any close friends? If so, who were they? Andrew Hodges—whose biography *Alan Turing: The Enigma* is a very helpful source of information about the Station X genius—has also written a brief biography for the *British Dictionary of National Biography* (published in 1995). Hereafter is an excerpt from "Part 2" of that shortened version.

PART 2 — MATTER AND SPIRIT

Turing's private notes on the theory of relativity [that is, Einstein's theory of relativity] showed a degree-level appreciation, yet he was almost prevented from taking the School Certificate lest he shame the school with failure.

But it appears that the stimulus for effective communication and competition came only from contact with another very able youth, a year ahead of him at Sherborne [the school which Alan attended] to whom Alan Turing found himself powerfully attracted in 1928.

He, Christopher Morcom, gave Turing a vital period of intellectual companionship — which ended with Morcom's sudden death [of bovine tuberculosis which he'd contracted, years earlier, "from drinking infected cows' milk"] in February 1930 [on the 13th of that month].

Turing's conviction that he must now do what Morcom could not, apparently sustained him through a long crisis. For three years at least, as we know from his letters to Morcom's mother, his thoughts turned to the question of how the human mind, and Christopher's mind in particular, was embodied in matter; and whether accordingly it could be released from matter by death.

This question led him deeper into the area of twentieth century physics, first helped by A. S. Eddington's book The Nature of the Physical World, wondering whether quantum-mechanical theory affected the traditional problem of mind and matter.

As an undergraduate at King's College, Cambridge from 1931, he entered a world more encouraging to free-ranging thought. His 1932 reading of the then new work of von Neumann on the logical foundations of quantum mechanics, helped the transition from emotional to rigorous intellectual enquiry. At the same time, this was when his homosexuality became a definitive part of his identity.

The special ambience of King's College gave him a first real home. His association with the so-called anti-War movement of 1933 did not develop into Marxism, nor into the pacifism of his friend and occasional lover James Atkins, then a fellow undergraduate mathematician, later musician. He was closer in thought to the liberal-left economists J. M. Keynes and A. C. Pigou. His relaxations were found ... in rowing, running, and later in sailing a small boat.

Turing's progress seemed assured. A distinguished degree in 1934 followed by a Fellowship of King's College in 1935 and a Smith's Prize in 1936 for work on probability theory, and he might then have seemed on course for a successful career as a mildly eccentric King's don engaged in pure mathematics.

His uniqueness of mind, however, drove him in a direction none could have foreseen.

By 1933 Turing had already introduced himself to Russell and Whitehead's Principia Mathematica and so to the then arcane area of mathematical logic. Bertrand Russell had thought of logic as a solid foundation for mathematical truth, but many questions had since been raised about how truth could be captured by any formalism.

In particular, in 1931 Gödel had shattered Russell's picture by showing the incompleteness of mathematics: the existence of true statements about numbers which could not be proved by the formal application of set rules of deduction.

In 1935, Turing learnt from the lecture course of the Cambridge topologist M. H. A. Newman that a further question, posed by Hilbert, still lay open. It was the question of Decidability, the Entscheidungsproblem ["decision problem"]. Could there exist, at least in principle, a definite method or process by which it could be decided whether any given mathematical assertion was provable?

To answer such a question needed a definition of 'method' which would be not only precise but compelling. This is what Turing supplied.

He analysed what could be achieved by a person performing a methodical process, and seizing on the idea of something done 'mechanically,' expressed the analysis in terms of a theoretical machine able to perform certain precisely defined elementary operations on symbols on paper tape.

He presented convincing arguments that the scope of such a machine was sufficient to encompass everything that would count as a 'definite method.' Daringly he included an argument based on the transitions between 'states of mind' of a human being performing a mental process.

In short ... Turing began to anticipate computers and artificial intelligence long-before 20th-century technology made such things actionable in the real world.

Images of Alan Turing and Christopher Morcom, as students at Sherborne School, online via Andrew Hodges' "The Alan Turing Internet Scrapbook." Image of Alan Turing running a race, also online via "The Alan Turing Internet Scrapbook."

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