

Alan Turing

Alan Turing was a 20th century English mathematician who made pioneering contributions in the theory and design of electronic digital computers. His ideas in the fields of logic and pure mathematics have become the basis of operation for millions of computers in worldwide use today. His contribution during the Second World War led to the breaking of almost all German military codes and a significant advantage to the Allied forces. He has also made an impact on the gay community, for he was an unashamed homosexual in a time when community attitudes treated this behaviour as criminal.

Alan Mathison Turing was born on the 23rd of June 1912. His father was a member of the Indian Civil Service, and it was during a period of leave in England that Alan was born. His parents returned to India shortly afterwards and Alan and his brother John were raised by a retired Army couple. Their childhood consisted of occasional visits from both of their parents, and it was not until Alan was 14 that the family lived together in England.

Turing had a fascination for science as a child and this fascination was encouraged by his mother, leading to deep studies of Einstein's theories of relativity. He had a public school education and passed well in all subjects. His vast intellectual ability meant that he was isolated from others, including his parents. His one intellectual companion during his last years of high school, Christopher Morcom, became Turing's first homosexual love, although the relationship was not physical.

In 1931 Turing gained a mathematics scholarship at King's college within Cambridge University after some indecision as to the direction of his future study. He had gone into voluntary hibernation as a result of Christopher's recent death. The

new environment at Cambridge suited him, for he was allowed his independence to be left alone and concentrate on his new love—mathematics. He studied quantum mechanics and mathematical logic as well as developing an anti-war attitude, joining the Cambridge Anti-War Council. He started a sexual relationship with a fellow mathematical scholar, James Atkins, and this relationship lasted for several years.

In 1935 Turing was elected as a Fellow of King's College. While working with little interest on his studies, he thought of an answer to the third of David Hilbert's questions on the nature of mathematics—*was mathematics decidable?* By this Hilbert, a German mathematician, was asking if there existed a definite method which could, in principle, be applied to any mathematical assertion, and which was guaranteed to produce a correct decision as to whether that assertion was true. The first two questions—*was mathematics complete?* and *was mathematics consistent?*—had been proved to be false by Kurt Gödel, a Czech mathematician.

Turing solved Hilbert's *Entscheidungsproblem* (the problem of mathematics) by using an idea suggested by M. H. A. Newman, one of his lecturers at Cambridge. Newman was an expert in the branch of mathematics known as topology, an abstract form of geometry, and he suggested that the definite method required by Hilbert could be achieved using a mechanical process. Turing thought of the manual typewriter as a mechanical process and, extending its number of functions, created the concept of a "super-typewriter" which could be used to either prove or disprove Hilbert's theorem that mathematics was decidable. The resulting machine, the Turing machine, was his most significant contribution to human knowledge, as was his 1936 paper containing the idea of the machine, "On Computable Numbers, with an Application to the *Entscheidungsproblem*".

Not only did the invention of the Turing machine completely disprove Hilbert's theorem on what mathematics was, it also became the theoretical basis for the first digital computers that were designed and built in the 1940s. Consider one reference to the "super-typewriter" in computers today: the `CR` and `LF` (carriage return & line feed) control characters that are used in all text file formats (including HTML) have their origins as typewriter operations.

Turing's result that the Hilbert *Entscheidungsproblem* was unsolvable appeared in publication on almost the same day as that of Alonzo Church, an American logician (one who studies the science of reasoning) at Princeton University. Church's method was different to Turing's, and Newman asked Church if he would use Turing's talent's by working with him. Turing was accepted at Princeton and he continued his mathematical studies there, completing a Ph.D. in 1938.

After this Turing returned to King's College at Cambridge and, becoming increasingly interested in recent code making and breaking developments, was recruited to the British "Government Code and Cipher School" (GC and CS) in 1939 as their first mathematician. The purpose of GC and CS was to ensure Allied superiority in the area of cryptanalysis—the deciphering of what has been concealed in code. During WWII Turing played a significant role in breaking German military codes, known as Enigma. He also developed statistical methods that gained Allied tactical superiority during the war. While at GC and CS, Turing had a relationship with fellow cryptanalyst Joan Clarke that deepened into an engagement. Turing admitted to her that their relationship probably wouldn't work as a result of his homosexual tendencies, and within a few months he broke off the engagement.

After the end of the Second World War in 1945, Turing started to think about the brain

in connection with the concepts used for the Turing machine. He reasoned that such a "machine" as the brain could be used for many different tasks and yet the machines that were made to crack German codes had to be custom designed for each specific problem. He had a vision of a Universal Turing Machine that could solve any given problem by being given instructions on how to do so. Using electronic components he saw how such a machine could be constructed using the ideas in his 1936 *Computable Numbers* paper. Various American projects at this time were also using electronic components to construct machines to perform specific tasks. The superior resources of the Americans meant that they were able to propose and eventually construct working machines such as the ENIAC and the EDVAC before the British.

J. R. Womersley, superintendent of the recently created Mathematics Division of the National Physical Laboratory (NPL), was aware of Turing's research and wanted him to join the NPL staff. Turing accepted in June 1945 and used the appointment as an opportunity to construct his Universal Turing Machine. He made a proposal to the NPL with details of his machine, which he called the Automatic Computing Engine (ACE). The proposal was accepted and Turing continued to provide detail as to the design, construction and use of the ACE.

Progress in the ACE project slowed to a stop as the bureaucratic nature of the NPL resisted Turing's idealistic attitude towards getting things done. This attitude was developed during the war when there was unity as a result of a common enemy present - the Germans. That forced a plan on government work, but now in peacetime there was no necessary plan and consequently the rapid completion of projects such as the ACE was a low priority. Media coverage at the time did little to help, for the media saw new technology as the

saviour for Britain's post-war problems. The imminent success of the ACE project was seized upon as a prime example of Britain's glorious future. The reality was very different, for after certain managerial decisions Turing left the project altogether.

In late 1947 Turing resumed his position as a Fellow of King's College at Cambridge. Here he had another homosexual lover, Neville Johnson. During the following year Turing was asked if he wanted to take an appointment at the University of Manchester to direct their fast-moving computer construction. He decided to take the appointment and officially resigned from the NPL. The design and development of the Manchester machine had been decided by others and the ideas implemented were contrary to Turing's methods. He withdrew as much as possible from any administrative responsibility and looked forward to actually using the machine once it was working.

Turing's interests turned to methods for creating machine thought and a method for testing if a machine could indeed think - the Turing Test. His papers on this subject are widely acknowledged as the foundation for research in artificial intelligence, an increasingly useful branch of computer science. His contributions in this area of knowledge cannot be overestimated. He also discovered a new field in biology for which computers are used, morphogenesis, which is concerned with the development of pattern and form in living organisms. His reason for studying such a branch of biology was to show how a regular pattern can emerge as a symmetric structure grows and develops into a strongly unsymmetric structure. His work in this area was left unfinished.

Turing bought a house in a University town near Manchester. Whilst taking part in discussions on artificial intelligence at the university, he desired another homosexual companion to replace Johnson who was now working elsewhere. He found one in Arnold Murray and he became a sexual as well as intellectual companion. After a burglary at his house, both Turing and Murray were discovered to be committing a criminal offence - an act of gross indecency with someone of the same sex. Homosexuality at this time was a crime and they were both charged in court. Turing's attitude of pleading guilty but showing no guilt for his actions has made him a hero of the gay community as a pioneer for attitudes that were later to become mainstream.

Turing chose to undergo hormonal treatment to "cure" him of homosexuality rather than serve a prison term so that he could continue his study. This treatment led to a deep depression and eventual suicide. Aged 41, on the 7th of June 1954, Alan Turing dipped an apple into a jar of cyanide, took several bites, and died. His body was cremated and the ashes dispersed in the crematorium gardens.

References

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