HOMOSEXUAL MATHEMATICIAN WHO RESCUED THE WORLD STILL DIED IN DISGRACE

ALAN TURING

MANJUNATH.R

"THE BRUTAL LIFE AND TRAGIC DEATH OF ALAN TURING"

Homosexual Mathematician

Who Rescued The World Still Died In Disgrace

"The only true wisdom is in knowing you know nothing."

— Socrates

Manjunath.R

#16/1, 8th Main Road, Shivanagar, Rajajinagar, Bangalore560010, Karnataka, India

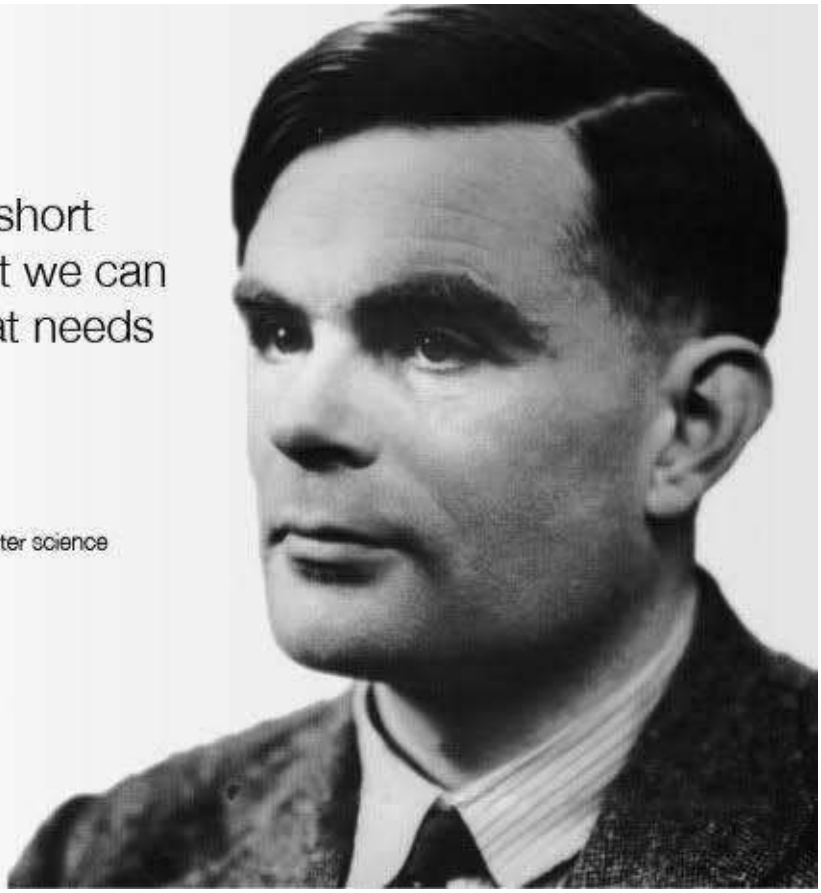
*Corresponding Author Email: manjunath5496@gmail.com

*Website: http://www.myw3schools.com/

"We can only see a short distance ahead, but we can see plenty there that needs to be done."

~ Alan Turing

the father of modern computer science



Homosexual Mathematician Who Rescued The World Still Died In Disgrace

The Brutal Life And Tragic Death Of Alan Turing

Alan Mathison Turing — English mathematician, logician and philosopher who made important advancements in the field of computer theory and who contributed important logical analyses of computer processes. In an unfortunate end to his prolific career, Turing was arrested in 1952 after British authorities found out he was having a relationship with another man. Under British law, homosexuality was a crime, and it resulted in Turing losing his security clearance to continue his work at **Bletchley Park**. Rather than face a life in prison, Turing accepted treatment of regular estrogen injections, which were believed to neutralize libido. On 8 June 1954, Turing died of potassium cyanide poisoning while conducting electrolysis experiments. The cyanide was found on a half eaten apple beside him. An inquest concluded that it was self-administered but his mother always maintained that it was an accident. In 2013, a bill was passed offering statutory pardon to Turing for offences under section 11 of the **Criminal Law Amendment Act** 1885. In 2016, the law (known as **Turing's law**) was widened to retroactively pardon all men who were convicted under the historical legislation of gross indecency.

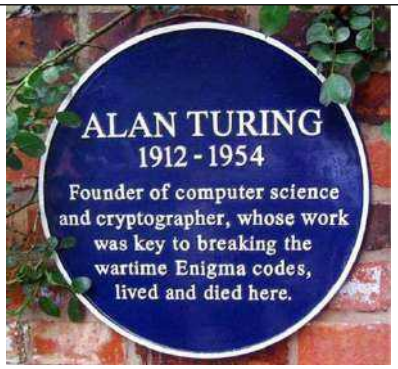
He Couldn't Tell Anyone What He Had Done During The War

He Knew What It Was Like To Be An Outcast, So He Sponsored A Refugee During The War

His **Homosexuality** Was Considered A Possible Security Breach

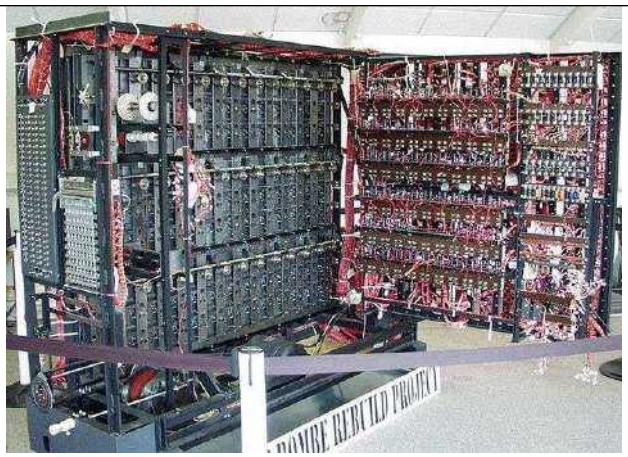
His Homosexuality Almost **Landed Him In Jail**

Despite His **War-Hero Status**, The British Government Chemically Castrated Him

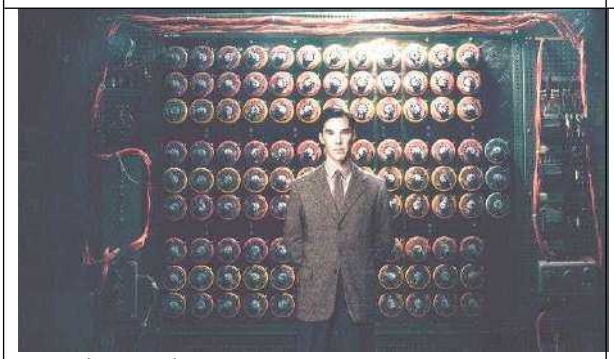


He Most Likely Took His **Own Life** Using A Cyanide-Laced Apple

He Was **Posthumously Pardoned** And Had A Law Named After Him

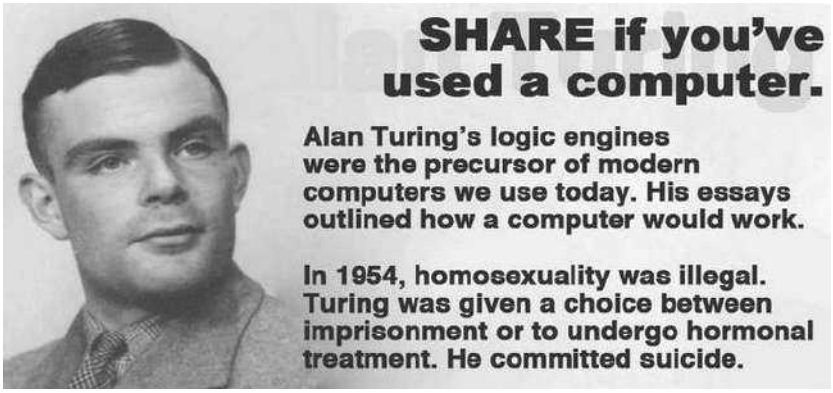


He **Single-Handedly Blew** The Lid Open On Computer Algorithms, But Did Not Live To Reap The Rewards



His Work **Saved Millions Of Lives** In WWII, Just Not His Own

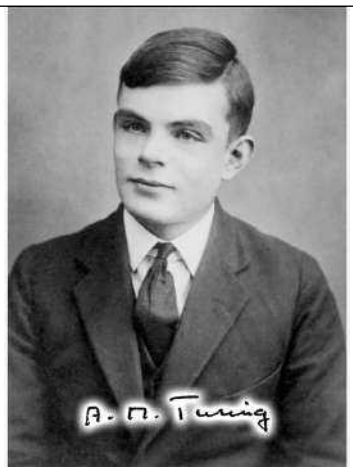
The **Turing Test** Is Still The Ultimate Computering AI Test

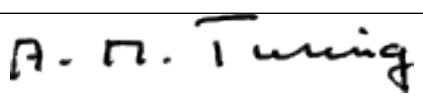


Alan Turing: Creator of modern computing

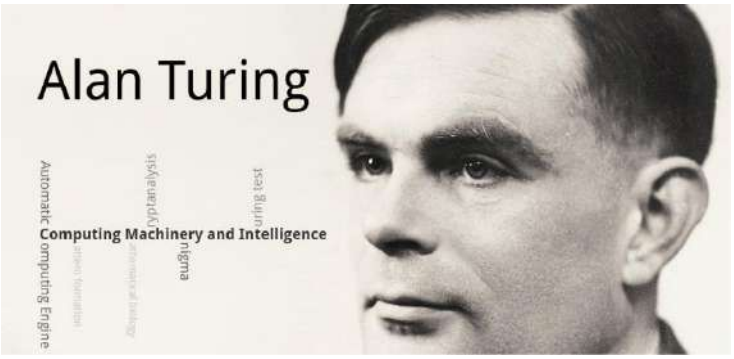
"Alan Mathison Turing – **Homosexual mathematician**, British pioneering computer scientist, theoretical biologist, logician and philosopher who made important advancements in the field of computer theory and who made significant contributions to mathematics, cryptanalysis, logic, philosophy, and mathematical biology and also to the new areas later named computer science, cognitive science, artificial intelligence, and artificial life – and whose code-breaking genius saved the world from **Nazi domination**. In an unfortunate end to his prolific career, Turing (a man who should have been a hero of the free world and idolized next to **Galileo** and **Newton** in the history books) was arrested in 1952 after British authorities found out he was having a relationship with another man. Under British law, homosexuality was a crime, and it resulted in Turing losing his security clearance to continue his work at **Bletchley Park**. Rather than face a life in prison, Turing (the one who laid down the mathematical foundation for all computer science) accepted treatment of regular estrogen injections, which were believed to neutralize libido. On 8 June 1954, Turing (one of the world's greatest geniuses and a man ahead of his time) died of potassium cyanide poisoning while conducting electrolysis experiments. The cyanide was found on a half eaten apple beside him. An inquest concluded that it was **self-administered** but his mother always maintained that it was an accident. The inventor of the modern digital computer was lost forever, and one of the greatest minds in the history of computing died in shame and disgrace. His insight was brilliant, and, beyond his contributions to the idea of the modern computer and artificial intelligence, he was a hero who came to a tragic end. In 2013, a bill was passed offering statutory pardon to Turing for offences under section 11 of the Criminal Law Amendment Act 1885. In 2016, the law (known as Turing's law) was

widened to retroactively pardon all men who were convicted under the historical legislation of gross indecency."

	**Alan Turing (1912 - 1954)** **BRITISH MATHEMATICIAN AND LOGICIAN**
BORN:	23 June 1912 Maida Vale, London, England
DIED:	7 June 1954 (aged 41) Wilmslow, Cheshire, England
CAUSE OF DEATH:	Cyanide poisoning
RESTING PLACE:	Ashes scattered near Woking Crematorium
RESIDENCE:	Wilmslow, Cheshire, England
EDUCATION:	• King's College, Cambridge (BA, MA) • Princeton University (PhD)
KNOWN FOR:	• Cryptanalysis of the Enigma • Turing's proof • Turing machine • Turing test • Unorganized machine • LU decomposition
AWARDS:	Smith's Prize (1936)

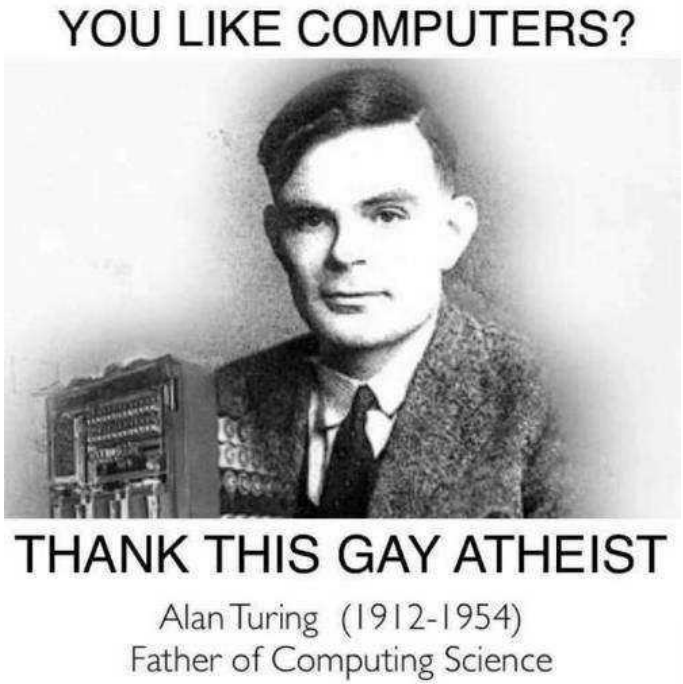
SCIENTIFIC CAREER:	
Fields:	• Logic • Mathematics • Cryptanalysis • Computer science • Mathematical and theoretical biology
Institutions:	• University of Manchester • Government Code and Cypher School • National Physical Laboratory
Thesis:	Systems of Logic Based on Ordinals (1938)
Doctoral advisor: Alonzo Church	
Doctoral students:	Robin Gandy
Influences:	Max Newman
Signature:	

ALAN TURING – TIMELINE



- **1912 (23 June):** Birth, Paddington, London.
- **1926-31:** Sherborne School.
- **1930:** Death of friend Christopher Morcom.
- **1931-34:** Undergraduate at King's College, Cambridge University.
- **1932-35:** Quantum mechanics, probability, logic. Fellow of King's College, Cambridge.
- **1936:** The Turing machine, computability, universal machine.
- **1936-38:** Princeton University. Ph.D. Logic, algebra, number theory.
- **1938-39:** Return to Cambridge. Introduced to German Enigma cipher machine.
- **1939-40:** The Bombe, machine for Enigma decryption.
- **1939-42:** Breaking of U-boat Enigma, saving battle of the Atlantic.
- **1943-45:** Chief Anglo-American crypto consultant. Electronic work.
- **1945:** National Physical Laboratory, London.
- **1946:** Computer and software design leading the world.
- **1947-48:** Programming, neural nets, and artificial intelligence.
- **1948:** Manchester University, first serious mathematical use of a computer.
- **1950:** The Turing Test for machine intelligence.
- **1951:** Elected FRS. Non-linear theory of biological growth.
- **1952:** Arrested as a homosexual, loss of security clearance.
- **1953-54:** Unfinished work in biology and physics.
- **1954 (7 June):** Death (suicide) by cyanide poisoning, Wilmslow, Cheshire.

This man was a national treasure and we hounded him to his death... I'm looking for an apology from the British government because that's where I think the wrong was done. But Turing is clearly someone of international stature. ***– John Graham-Cumming, computer scientist***



WHO WAS HE?

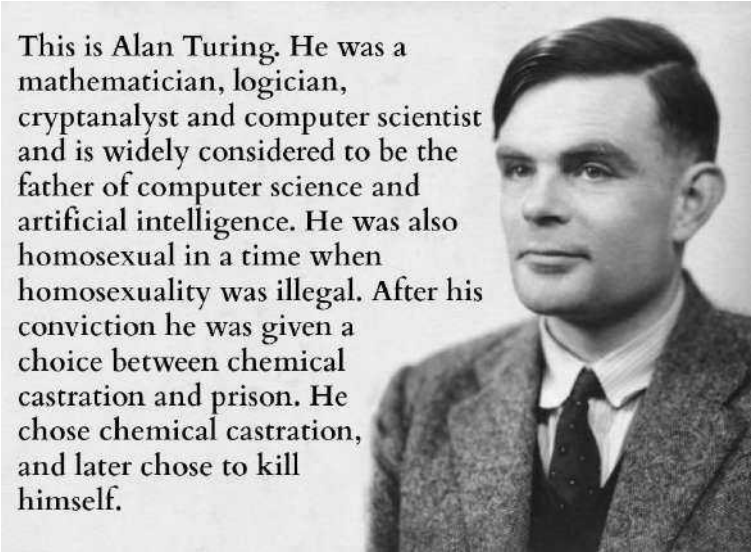
Alan Mathison Turing OBE FRS (23 June 1912 – 7 June 1954, often called the father of modern computing) was a brilliant English mathematician, computer scientist, logician, cryptanalyst, philosopher and theoretical biologist. Turing (considered one of the 20th century's most important people) was highly influential in the development of theoretical computer science, providing a formalisation of the idea of the modern computer and artificial intelligence – and concepts of algorithm and computation with the Turing machine, which can be considered a model of a general-purpose computer. British mathematician and author **Andrew Hodges**

describes the significance of Turing machine in this way:

"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. 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."

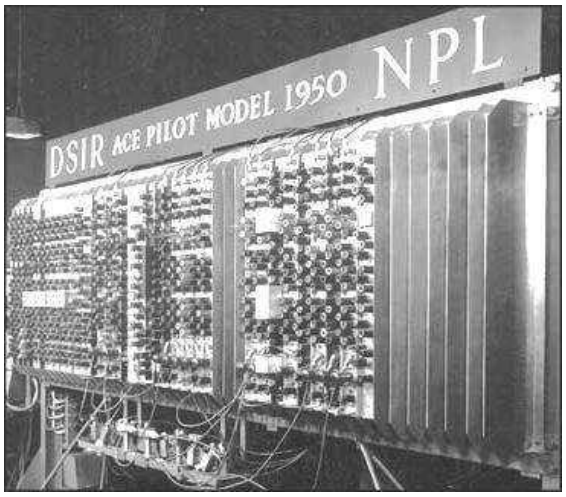
Turing (**a celebrated twentieth century British mathematician**) is widely considered to be the father of theoretical computer science and artificial intelligence. Despite these accomplishments, the story of Alan Turing is one of the most disgraceful episodes of modern civilization. A man who should have been a code-breaking hero of the free world and idolized next to Galileo and Newton in the history books was instead hounded to a permanent cessation of all vital functions

because of religion-inspired homophobia. Alan Turing was not a well known figure during his lifetime. But today he is famous for being an eccentric yet passionate Brilliant mathematician, who conceived modern computing and played a crucial part in the Allied victory over Nazi Germany in WW2.



During the Second World War, Turing worked for the **Government Code and Cypher School** (GC&CS) at Bletchley Park, Britain's codebreaking centre that produced Ultra intelligence. For a time he led Hut 8, the section that was responsible for German naval cryptanalysis. Here, he devised a number of techniques for speeding the breaking of German ciphers, including improvements to the pre-war Polish bombe method, an electromechanical machine that could find settings for the Enigma machine.

Turing played a pivotal role in cracking intercepted coded messages that enabled the Allies to defeat the Nazis in many crucial engagements, including the Battle of the Atlantic, and in so doing helped win the war. Counterfactual history is difficult with respect to the effect Ultra intelligence had on the length of the war, but at the upper end it has been estimated that this work shortened the war in Europe by more than two years and saved over 14 million lives.



The Pilot Model of the Automatic Computing Engine at the National Physical Laboratory.

After the war, Turing worked at the **National Physical Laboratory**, where he designed the Automatic Computing Engine (a British early electronic stored-program computer), which was one of the first designs for a stored-program computer. In 1948, Turing joined Max Newman's Computing Machine Laboratory at the **Victoria University of Manchester**, where he helped develop the Manchester computers and became interested in mathematical biology. He wrote a paper on the chemical basis of morphogenesis (which served as a basic model in theoretical biology – and suggested that a system of chemical substances, called **morphogens**, reacting together and diffusing through a tissue, is adequate to account for the main phenomena of morphogenesis) and predicted oscillating chemical reactions such as the **Belousov–Zhabotinsky reaction** (which is one of a class of reactions that serve as a classical example of non-equilibrium thermodynamics, resulting in the establishment of a nonlinear chemical oscillator), first observed in the 1960s.

However, in early 1952 — after investigating a burglary at his home, police eventually noticed that Turing had a homosexual relationship with a 19 year-old man. Police arrested Turing and he (who literally saved the world from Nazi domination) was prosecuted for homosexual acts; the Labouchere Amendment had mandated that "**gross indecency**" was a criminal offence in the UK. The judge offered him a choice: spend one year behind bars or endure an experimental hormone treatment to "fix" his sexual orientation. Alan chose chemical castration treatment, with

DES (Diethylstilbestrol), as an alternative to prison. Turing (a victim of the discriminatory laws of the day) died in 1954, 16 days before his 42nd birthday, from **cyanide poisoning**. An inquest determined his death as a suicide, but it has been noted that the known evidence is also consistent with accidental poisoning. He sadly died too young, in tragic circumstances, a victim of the discriminatory laws of the day. It is often wondered how much further ahead computing would be, if he had lived. The 20th century had lost one its smartest people.

It took decades for Turing (who was a victim of mid-20th Century attitudes to homosexuality – and who was chemically castrated before dying at the age of 41) to receive the respect in death that he never received in life. On September 10, 2009, following an Internet campaign and high profile support from public figures such as **Stephen Fry** and **Richard Dawkins**, British Prime Minister Gordon Brown issued a public apology to Turing's memory on behalf of the British government for "**the appalling way he was treated**":

> *Thousands of people have come together to demand justice for Alan Turing and recognition of the appalling way he was treated. While Turing was dealt with under the law of the time and we can't put the clock back, his treatment was of course utterly unfair and I am pleased to have the chance to say how deeply sorry I and we all are for what happened to him … So on behalf of the British government, and all those who live freely thanks to Alan's work I am very proud to say: we're sorry, you deserved so much better.*

Queen Elizabeth II granted Turing a posthumous pardon in 2013. The Alan Turing law is now an informal term for a 2017 law in the United Kingdom that retroactively pardoned man cautioned or convicted under historical legislation that outlawed homosexual acts. **Codebreaker**, a feature-length drama **documentary aired on 21 November 2011 by Channel 4** about the life of Alan Turing, examined Turing's extraordinary life, tragic death, and enduring legacy. Despite the Turing's role in shaping our modern world, most people were unaware of his story. This film helped change that fact. Despite his brilliance, what happened to Alan Turing is one of history's

great tragedies. When Time magazine published its list of the 100 most important people of the twentieth century, they included Alan Turing in that list and said of him:

"The fact remains that everyone who taps at a keyboard, opening a spreadsheet or a word-processing program, is working on an incarnation of a Turing machine."

Of his many important papers, the most well known are:

- **On Computable Numbers, with an Application to the Entscheidungsproblem** (28 May 1936) in which Alan Turing first outlined his idea of a Universal Machine which could tackle any mathematical problem and which became known as the Turing Machine.

- **Computing Machinery and Intelligence (1950)** in which Alan Turing first proposes the Turing test to decide whether a computer can be called intelligent or not.

Childhood and Early Life

- Two years before the outbreak of the **First World War** — Alan Mathison Turing (who was the first to conceive of the fundamental principle of the **modern computer** — the idea of controlling a computing machine's operations by means of coded instructions, stored in the machine's "**memory**") was born to Julius Mathison and Ethel Sara on June 23, 1912, in Paddington, London. Julius was employed with the **'Indian Civil Service'**, and with his wife, he had another son, John. Just before he was born two tragedies had happened: **Captain Scott's Antarctic expedition** and the **sinking of the Titanic** on its maiden voyage across the Atlantic.

- **Discouraged at school**

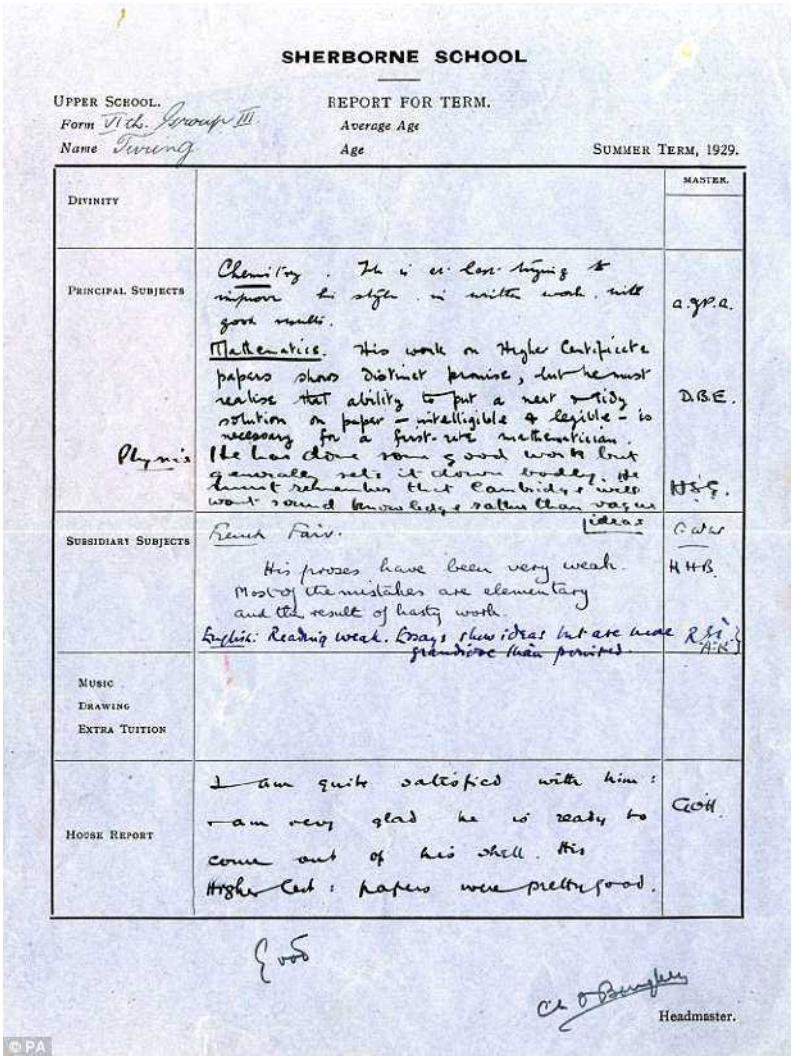
Alan spent much of his early life separated from his parents, as his father worked in the British administration of India. He pursued his elementary education from **'St Michael's',** later educated at **Hazelhurst Preparatory School**, an independent school in the village of Frant in **Sussex** (now East Sussex). In 1926, at the age of 13, he went on to **Sherborne School**, a classic English public school in the market town of **Sherborne** in Dorset. His teachers noticed he had an ingrained talent for math. But they found faults in how he expressed that ability. While they agreed he had a "distinct talent" for the subject, they also said that he didn't know how to make an "**intelligible and legible**" solution so people could understand it. Some of the academic staff at the school did not approve of Turing's inclination for mathematics and science as they considered classical studies to be more valuable. They even tried to discourage him from pursuing science. In fact, the **headmaster** wrote a letter to his parents discussing his situation that:

> *"If he is to be solely a Scientific Specialist, he is wasting his time at a Public School."*

However, it did not discourage Turing from studying what attracted his interest. He solved complex problems without even studying **elementary calculus** and he also studied advanced

modern scientific ideas, such as relativity, on his own, running far ahead of the school syllabus.

ALAN TURING -- REPORT CARD TEACHERS' COMMENTS, 1926 – 1931



SHERBORNE SCHOOL

UPPER SCHOOL. REPORT FOR TERM.
Form VI th. Group III. Average Age
Name Turing Age SUMMER TERM, 1929.

		MASTER.
DIVINITY		
PRINCIPAL SUBJECTS	Chemistry. He is at last trying to improve his style in written work, with good results. Mathematics. His work on Higher Certificate papers shows distinct promise, but he must realise that ability to put a neat + tidy solution on paper – intelligible & legible – is necessary for a first-rate mathematician. Physics He has done some good work but generally sets it down badly. He must remember that Cambridge wants work + sound knowledge rather than vague ideas	a.g.p.a. D.B.E. H.H.S.
SUBSIDIARY SUBJECTS	French Fair. His proses have been very weak. Most of the mistakes are elementary and the result of hasty work. English: Reading weak. Essays show ideas but are made grandiose than pointed.	C.d.w. H.H.B. R.H. A.R.
MUSIC DRAWING EXTRA TUITION		
HOUSE REPORT	I am quite satisfied with him: I am very glad he is ready to come out of his shell. His Higher Cert: papers were pretty good.	C.O.H.

Good

C. O. Bampfylde
Headmaster.

© PA

Subject: **Mathematics**

1926. *Works well. He is still very untidy. He must try to improve in this respect*

1927. *Very good. He has considerable powers of reasoning and should do well if he can quicken up a little and improve his style.*

____. *A very good term's work, but his style is dreadful and his paper always dirty.*

____. *Not very good. He spends a good deal of time apparently in investigations in advanced mathematics to the neglect of his elementary work. A sound ground work is essential in any subject. His work is dirty.*

____. *Despite absence he has done a really remarkable examination (1st paper). A mathematician I think.*

____ *I think he has been somewhat tidier, though there is still plenty of room for improvement. A keen & able mathematician.*

1928. *Easily the best mathematician in the set. His position is caused by untidiness and carelessness due largely to impatience to let on something great as soon as he has seen his way through a problem.*

____. *This term has been spent, & the next two terms will have to be spent, in filling in the many gaps in his knowledge & organizing it. He thinks very rapidly & is apt to be "brilliant", but unsound in some of his work. He is seldom defeated by a problem, but his methods are often crude, cumbersome & untidy. But thoroughness & polish will no doubt come in time.*

1929. *His work on Higher Certificate papers shows distinct promise, but he must realize that ability to put a neat & tidy solution on paper – intelligible & legible – is necessary for a first-rate mathematician.*

1930. *He has faced the uninspiring task of revision & consolidation of his previous knowledge with determination, and I think he has succeeded in improving his style of written work, which is more convincing & less sketchy than last year. If he does not get flustered & relapse into slip-shod work, he should do very well in the H.C. this year.*

____ *A really able mathematician. His trouble is his untidiness & poor style, but he has tried hard to improve in this. He sometimes fails over a simple problem by trying to do it by complicated methods, instead of by an elementary one.*

1931. *He has done some post-scholarship reading without encountering any serious difficulties. He should be able to take the Higher Certificate next July in his stride.*

____. *He has gone on with his reading as well as revising the elementary work for the Higher Certificate, & I expect him to get a Distinction with ease. He has my best wishes for an equally successful career at Cambridge.*

Subject: **Natural Science**

1926. *He is keen & has a natural bent for science, but his work is badly spoilt by extreme untidiness.*

Subject: **English.**

1926. *Without being lazy, he seems to do his work rather perfunctorily. I should like to see rather more life in him.*

1928. *His English work is becoming less feeble. He undoubtedly has brains, but is only slowly learning to apply them to subjects for which he has little interest.*

1930. *His reading is too deliberate. On paper he is usually sensible.*

Subject: **Chemistry**.

1930. I*f the questions suit him, he is certain of getting a scholarship: but I do not feel that his knowledge is sufficiently all-round to make him independent of luck in the examination.*

Subject: **Physics**.

1928 *He has done some quite good work by himself in my room. Good work.*

1930. *He has done some excellent work, mostly strict training for his scholarship examination. I can only hope Cambridge will think as well of him as I do.*

1931. *He continues to take a genuine interest in physics.*

House Report

1927 *He is frankly not one who fits comfortably for himself into the ordinary life of the place – on the whole I think he is tidier.*

____. *No doubt he is a strange mixture: trying to build a roof before he has laid the foundations. Having secured one privileged exemption, he is mistaken in acting as if idleness and indifference will procure further release from uncongenial subjects.*

____. *Rather more tidy: & the one paper I looked over of his was certainly better than I expected in neatness. He certainly has ideas & imagination.*

____. *I have seen cleaner productions than this specimen, even from him. No doubt he is very aggravating: &he should know by now that I don't care to find him boiling heaven knows what witches' brew by the aid of two guttering candles on a naked wooden window sill. However he has borne his afflictions very cheerfully: & undoubtedly has taken more trouble, e.g. with physical training. I am far from hopeless.*

1928. *Satisfactory. I am very glad that he is sociable & makes friends: & he seems unselfish in temper. He is certainly ambitious.*

1931. *He has had an interesting career, with varied experience: & brought it to a very successful close. I am grateful to him for his essentially loyal help: & I hope he will reap further reward at King's, both in work & friendships.*

- **A new home in Cambridge**

✓ After Sherborne, Turing (a founding father of artificial intelligence and of modern cognitive science) won a scholarship to King's College, Cambridge — and studied as an undergraduate from 1931 to 1934, where he was awarded first-class honours in mathematics.

✓ In 1935, at the age of 22, he was elected a fellow of King's College on the strength of a 21 dissertation in which he proved the central limit theorem. Unknown to the committee, the theorem had already been proven, in 1922, by Jarl Waldemar Lindeberg. Turing was already on track for a distinguished career in pure mathematics.

✓ **He Single-Handedly Blew The Lid Open On Computer Algorithms, But Did Not Live To Reap The Rewards**.

✓ In 1936, Turing published his paper "On Computable Numbers, with an Application to the Entscheidungsproblem". It was published in the Proceedings of the London Mathematical Society journal in two parts, the first on 30 November and the second on 23 December. In this paper, Turing reformulated Kurt Gödel's 1931 results on the limits of proof and computation, replacing Gödel's universal arithmetic-based formal language with the formal and simple hypothetical devices that became known as **'Turing machines'**. These machines were capable of calculating anything that can be quantified. The modern computer came into existence because of this assumption made by the young Turing.

✓ From September 1936 to July 1938, Turing spent most of his time studying under Church at Princeton University, in the second year as a **Jane Eliza Procter Visiting Fellow**. In addition to his purely mathematical work, he studied cryptology and also built three of

four stages of an electro-mechanical binary multiplier. In June 1938, he completed his PhD under von Neumann's supervision from the Department of Mathematics at Princeton; his dissertation, Systems of Logic Based on Ordinals, introduced the concept of ordinal logic and the notion of relative computing — played a significant role in introducing the ordinal logic**. John von Neumann** wanted to hire him as his postdoctoral assistant, but he went back to Cambridge — a year later Turing was involved in war work at Bletchley Park.

John von Neumann

Career

- After two years at Princeton, developing ideas about secret ciphers, Turing (who invented the idea of a "**Universal Machine**" that could decode and perform any set of instructions) returned to Britain and took up a part-time job at the **'Government Code and Cypher School'** ('GC&CS'), an organization that specialized in breaking war codes. Even with 12,000 people working three shifts around the clock at the British secret code deciphering facility at Bletchley Park, no one could break it. That's where Turing stepped in.

- **His Work Saved Millions Of Lives In WWII, Just Not His Own.**

In July 1939, the **Polish Cipher Bureau** passed on crucial information about the Enigma machine, which was used by the Germans to encipher all its military and naval signals. In

September 1939, Turing rapidly developed a new electromechanical machine (the "**Bombe**") capable of breaking Enigma messages on an industrial scale. Once the Enigma machine was cracked, 211 Bombe machines were built and ran around the clock. Turing was instrumental in creating a code-breaking machine called the Bombe. By the end of the war, the Bombe figured out everything that the German navy was saying. Turing's work at Bletchley Park was vital in ending the war. General **Dwight D. Eisenhower** told the British intelligence chief in July 1945 that the work done by Turing and his colleagues at Bletchley probably shortened the war by two years. Turing had saved millions of British and American lives. Unfortunately, it was not enough to save his own.

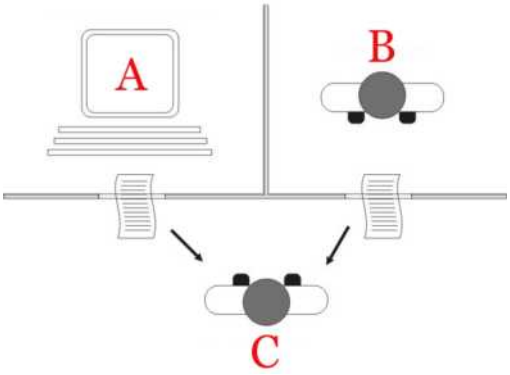
- In 1948, Turing (who was never fully recognized in his home country during his lifetime due to his homosexuality, which was then a crime in the UK) began working at the **'Computing Laboratory'** initiated by mathematician Max Newman, located in the **'University of Manchester'**. It was here that the former began showing an inclination towards mathematical biology.

- The same year, he also worked as a Lecturer at the University of Manchester (**Department of Mathematics**). During this time, with help from his friend, **D. G. Champernowne**, he began developing a chess program, which could be played on a computer that he had envisioned but not built.

- In 1948, he also stated the **'LU decomposition method'**, a pioneering technique which is presently used to solve matrices.

- The following year, he was promoted at the university to the post of Deputy Director of the **'Computing Laboratory'**. He developed a type of software named 'Manchester Mark 1', while continuing to research on abstract mathematics and artificial intelligence.

- **The Turing Test Is Still The Ultimate Computering AI Test**



In 1950, Turing came up with an important question: Can machines think? He developed the **'Turing Test'** — a way to test a **machine's ability** to demonstrate intelligence. The test is simple. A judge has a conversation over a teletype with a human and a machine, both of which he cannot see. If the judge cannot tell reliably which is which, the machine passes the test. The idea kicked off the study of **artificial intelligence** — and remains his best known work and was a key contribution to the field of Artificial Intelligence.

- ✓ When Turing was 39 years old in 1951, he turned to mathematical biology, finally published his masterpiece "**The Chemical Basis of Morphogenesis**" in January 1952. He also predicted oscillating chemical reactions such as the **Belousov–Zhabotinsky reaction**, first observed in the 1960s.

- **Major Works**

This scientist is known for having pioneered the concept of modern-day computers, by introducing the idea of a "**Turing Machine**", which is simple, and yet capable of solving any form of algorithms that can be measured and quantified.

- **Awards and Achievements**

- ✓ Alan was awarded the **'Smith's Prize'** in 1939, by the 'University of Cambridge', for his exceptional contribution in the field of applied mathematics.

- ✓ In 1945, this great mathematician was honored by King George VI, with the **'Most Excellent Order of the British Empire'**, for his services during the World War II.

Personal Life and Legacy

- While studying at the **'Sherborne School'**, Alan Turing fell in love with befriended classmate at Sherborne – a boy called **Christopher Morcom**. It was hopeless, unrequited love. The blossoming friendship abruptly ended when Morcom died of bovine tuberculosis.

- **Devastated but inspired by his friend's death**

The event caused Turing great sorrow. He coped with his grief by working that much harder on the topics of science and mathematics that he had shared with Morcom. In a letter to Morcom's mother Turing said:

> *I am sure I could not have found anywhere another companion so brilliant and yet so charming and unconceited. I regarded my interest in my work, and in such things as astronomy (to which he introduced me) as something to be shared with him and I think he felt a little the same about me ... I know I must put as much energy if not as much interest into my work as if he were alive, because that is what he would like me to do.*

A day before the third anniversary of **Morcom's death** (12 February, 1933), Alan wrote to **Morcom's mother**:

> *I expect you will be thinking of Chris when this reaches you. I shall too, and this letter is just to tell you that I shall be thinking of Chris and of you tomorrow. I am sure that he is as happy now as he was when he was here. Your affectionate Alan.*

Morcom's death was the cause of Turing's atheism and materialism. Turing wanted to believe that Christopher's mind somehow lived on. His emotional turmoil involved a scientific fascination with the problem of mind and brain. In a later letter, also written to **Morcom's mother**, Turing said:

> *Personally, I believe that spirit is really eternally connected with matter but certainly not by the same kind of body ... as regards the actual connection between spirit and body I consider that the body can hold on to a 'spirit', whilst the body is alive and awake the two are firmly connected. When the body is asleep I cannot guess what happens but when the body dies, the 'mechanism' of the body, holding the spirit is gone and the spirit finds a new body sooner or later, perhaps immediately.*

- **End of a brief engagement**

In 1941 — in the course of the exciting work of mastering the **German submarine communication system** — Turing had found himself attracted to a young mathematician and Bletchley cryptanalyst called Joan Clarke. He proposed to her, but immediately told her of his "**homosexual tendencies**", and the engagement soon ended. After this, he became more confident in developing his homosexual life.

- **Convicted for gross indecency**

  - ✓ All male homosexual activity was illegal until 1967 and — at the age of 39, Alan got into a affair with 19 years old young Manchester man called **Arnold Murray**. During a burglary investigation, personal details about his homosexuality came into light, and Alan was arrested on charges of indecency. When Turing was arrested for being gay, he couldn't tell the cops that he was the "**savior of England**," the guy who **Winston Churchill** had said **made the single biggest contribution to ending the**

war. Instead, they just treated him like some kind of pervert, and that was it. Perhaps his punishment would have been less dire if he could have told people what he had achieved.

- ✓ After conviction in 1952, he was given an option: he could go to prison or be put on a treatment of female hormones. The ingenious logician chose medication so that he could continue his scientific work at home.

- **He Most Likely Took His Own Life Using A Cyanide-Laced Apple**

Unable to be himself, his thoughts turned to ending his life. On June 8, 1954, Alan was found poisoned at home, and after the autopsy, it was concluded that he had taken his own life by consuming an apple that was laced with large quantities of **potassium cyanide**. Friends of Alan, along with his mother, thought he might have killed himself accidentally. They claimed he hadn't seemed depressed in the days and weeks leading up to his death. There was also the fact that he had been experimenting with cyanide in a personal laboratory before he died. Rather than think he could have used this poison to deliberately taint the apple, they thought that he had accidently gotten some on it and died.

- Several awards have been named after this mathematical genius, and many biographies have been penned, the most notable being by the **'Royal Society'**.

- A novel, **'Cryptonomicon'**, by American writer, Neal Stephenson, published in 1999, refers to this famous mathematician.

- The 2014 movie, **'The Imitation Game'**, was featured on Alan's life, with British actor Benedict Cumberbatch playing the mathematician's role.
- Several universities have named rooms, buildings, and even computer programs, after the distinguished mathematician.

The list of things named after Alan Turing:

- Alan Turing Building, Manchester, England
- Alan Turing Centenary Conference, Manchester, England
- Alan Turing Institute, London, England
- Alan Turing law
- Alan Turing Memorial, Manchester, England
- Alan Turing sculpture, Eugene, Oregon, United States
- Alan Turing statue, Bletchley Park, England
- Alan Turing: The Enigma
- Alan Turing Year
- The Annotated Turing
- Church–Turing thesis
- Church–Turing–Deutsch principle
- Good–Turing frequency estimation
- Object-Oriented Turing (programming language)
- Turing-acceptable language
- Turing Award
- Turing (cipher)

- Turing College, Kent, England
- Turing completeness
- Turing computability
- Turing degree
- Turing Foundation, Amsterdam, Netherlands
- Turing Gateway to Mathematics, Cambridge, England
- The Turing Guide
- Turing House School
- Turing Institute, Glasgow, Scotland
- Turing jump
- Turing Lecture
- Turing machine
- Turing Machine (band)
- Turing (microarchitecture)
- Turing OS
- Turing pattern
- Turing Pharmaceuticals
- Turing Phone
- Turing (programming language)
- Turing reduction
- Turing Robot, China
- Turing Robotic Industries, San Francisco, California, United States
- Turing switch

- Turing table
- Turing tarpit
- Turing test
- Turing's Method
- Turing's proof
- Turing's Wager
- Turing+ (programming language)
- Turingery
- Turingismus
- Turmite
- Turochamp

- **He Was Posthumously Pardoned And Had A Law Named After Him: A pardon from the Queen is a fitting tribute to an exceptional man**

In 2009, there was an online petition calling for an apology for how the British government had treated Turing. Then-Prime Minister **Gordon Brown** made an official public apology on behalf of the British government for "the appalling way he was treated". In December 2013, Alan Turing was granted a posthumous royal pardon, formally cancelling his criminal conviction. The "**Turing Law**" is now an informal term for a 2017 law in the United Kingdom that retroactively pardoned man cautioned or convicted under historical legislation that outlawed **homosexual acts**.

- **Trivia**

While working at Bletchley, this famous British mathematician, who was a talented **long-distance runner**, occasionally ran the 40 miles (64 km) to London when he was needed for meetings, and he was capable of world-class marathon standards. Turing tried out for the 1948 British Olympic team but he was hampered by an injury. His tryout time for the marathon was only 11 minutes slower than British silver **medallist** Thomas Richards' Olympic race time of 2 hours 35 minutes. He was **Walton Athletic Club's best runner**; a fact discovered when he passed the group while running alone.

VIEWS AND OPINIONS

> *Turing arguably made a greater contribution to defeating the Nazis than Eisenhower or Churchill. Thanks to Turing and his 'Ultra' colleagues at Bletchley Park, allied generals in the field were consistently, over long periods of the war, privy to detailed German plans before the German generals had time to implement them.*

— Richard Dawkins August 2009

> *It's still amazing to think that the family didn't even know what he did in the war until it came out in the 1970s.*

— Shuna Hunt, Alan Turing's middle niece, in an interview with Susan Watts September 2009

Thousands of people have come together to demand justice for Alan Turing and recognition of the appalling way he was treated. While Turing was dealt with under the law of the time and we can't put the clock back, his treatment was of course utterly unfair and I am pleased to have the chance to say how deeply sorry I, and we all are for what happened to him. So on behalf of the British Government, and all those who live freely thanks to Alan's work I am very proud to say: we're sorry, you deserved so much better.

— Gordon Brown 10 September 2009

... He was dishonourably persecuted during his life, today let us wipe that national shame clean by honouring him properly.

— Rt. Hon. Chris Smith MP

It was a good thing the authorities hadn't known Turing was a homosexual during the war, because if they had, they would have fired him – and we would have lost.

— Professor Jack Good, wartime colleague of Alan Turing

Uncle Alan was very, very kind, very generous, untidy, rather unkempt... but he was always very generous and used to give us lovely presents....he was a very deserving person. He was very, very kind, very truthful and quiet and unassuming. I think he was somebody special.

— Inagh Payne, Alan Turing's oldest niece, in a BBC interview 7th September, 2009

> *It [a Teddy Bear] was called Porgy. He bought it for himself when he was an adult, and it used to sit in the chair when he was at Cambridge. He used to practise his lectures in front of Porgy.*

— Shuna Hunt, Alan Turing's middle niece, in an interview with Susan Watts September 2009

> *The fact remains that everyone who taps at a keyboard, opening a spreadsheet or a word-processing program, is working on an incarnation of a Turing machine.*

— Time Magazine

> *It is atrocious that we don't recognize this man and the only way to do so is to apologize to him. This man was a national treasure and we hounded him to his death... I'm looking for an apology from the British government because that's where I think the wrong was done. But Turing is clearly someone of international stature.*

— John Graham-Cumming, computer scientist

> *I hope he will not fall between two stools. If he is to stay at public school, he must aim at becoming educated. If he is to be solely a Scientific Specialist, he is wasting his time at a public school.*

— Headmaster, Sherborne School

> *In the first week of June each year he would get a bad attack of hay fever, and he would cycle to the office wearing a service gas mask to keep the pollen off. His bicycle had a fault: the chain would come off at regular intervals. Instead of having it mended he would count the number of times the pedals went round and would get off the bicycle in time to adjust the chain by hand. Another eccentricities is that he chained his mug to the radiator pipes to prevent it being stolen.*

— Irving John, cryptologist

> *There should be no question in anyone's mind that Turing's work was the biggest factor in Hut 8's success. In the early days, he was the only cryptographer who thought the problem worth tackling and not only was he primarily responsible for the main theoretical work within the Hut, but he also shared with Welchman and Keen the chief credit for the invention of the bombe. It is always difficult to say that anyone is 'absolutely indispensable', but if anyone was indispensable to Hut 8, it was Turing. The pioneer's work always tends to be forgotten when experience and routine later make everything seem easy and many of us in Hut 8 felt that the magnitude of Turing's contribution was never fully realised by the outside world.*

— Hugh Alexander, Irish-born British cryptanalyst

> *But it was a lovely sunny day and Alan was in a cheerful mood and off we went... Then he thought it would be a good idea to go to the Pleasure Beach at Blackpool. We found a fortune-teller's tent and Alan said he'd like to go in so we waited around for him to come back... And this sunny, cheerful visage had shrunk into a pale, shaking, horror-stricken face. Something had happened. We don't know what the fortune-teller said but he obviously was deeply unhappy. I think that was probably the last time we saw him before we heard of his suicide.*

— Barbara, Greenbaums' daughter

ALAN TURING QUOTES

"Sometimes it is the people no one can imagine anything of who do the things no one can imagine."

— Alan Turing

"We can only see a short distance ahead, but we can see plenty there that needs to be done."

— Alan Turing, Computing machinery and intelligence

"I'm afraid that the following syllogism may be used by some in the future.
Turing believes machines think
Turing lies with men
Therefore machines do not think

Yours in distress,
Alan"

— Alan Turing

"I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted."

— Alan Turing, Computing machinery and intelligence

"Those who can imagine anything, can create the impossible."

— Alan Turing

"Sometimes it is the people who no one imagines anything of who do the things that no one can imagine."

— Alan Turing

"If a machine is expected to be infallible, it cannot also be intelligent."

— Alan Turing

"Finding such a person makes everyone else appear so ordinary…and if anything happens to him, you've got nothing left but to return to the ordinary world, and a kind of isolation that never existed before."

— Alan Turing

"The original question, 'Can machines think?' I believe to be too meaningless to deserve discussion."

— Alan Turing, Mechanical Intelligence: Collected Works of A.M. Turing

"A very large part of space-time must be investigated, if reliable results are to be obtained."

— Alan Turing

"Sometimes it is the people no one imagines anything of who do the things that no one can imagine."

— Alan Turing

"Do you know why people like violence? It is because it feels good. Humans find violence deeply satisfying. But remove the satisfaction, and the act becomes hollow."

— Alan Turing

"It is possible to invent a single machine which can be used to compute any computable sequence."

— Alan Turing

"We are not interested in the fact that the brain has the consistency of cold porridge."

— Alan Turing

"It is not possible to produce a set of rules purporting to describe what a man should do in every conceivable set of circumstances."

— Alan Turing, Computing machinery and intelligence

"The works and customs of mankind do not seem to be very suitable material to which to apply scientific induction."

— Alan Turing, Computing machinery and intelligence

"We like to believe that Man is in some subtle way superior to the rest of creation. It is best if he can be shown to be necessarily superior, for then there is no danger of him losing his commanding position."

— Alan Turing, Computing machinery and intelligence

"Can machines think?"... The new form of the problem can be described in terms of a game which we call the "imitation game." It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart front the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either "X is A and Y is B" or "X is B and Y is A." The interrogator is allowed to put questions to A and B... We now ask the question, "What will happen when a machine takes the part of A in this game?" Will the interrogator decide wrongly as often when the game is played

like this as he does when the game is played between a man and a woman? These questions replace our original, "Can machines think?"

— Alan Turing, Computing machinery and intelligence

"I've now got myself into the kind of trouble that I have always considered to be quite a possibility for me, though I have usually rated it at about 10:1 against. I shall shortly be pleading guilty to a charge of sexual offences with a young man. The story of how it all came to be found out is a long and fascinating one, which I shall have to make into a short story one day, but haven't the time to tell you now. No doubt I shall emerge from it all a different man, but quite who I've not found out."

— Alan Turing

"The popular view that scientists proceed inexorably from well-established fact to well-established fact, never being influenced by any unproved conjecture, is quite mistaken. Provided it is made clear which are proved facts and which are conjectures, no harm can result. Conjectures are of great importance since they suggest useful lines of research."

— Alan Turing, Alan Turing: The Enigma

Turing, age 5

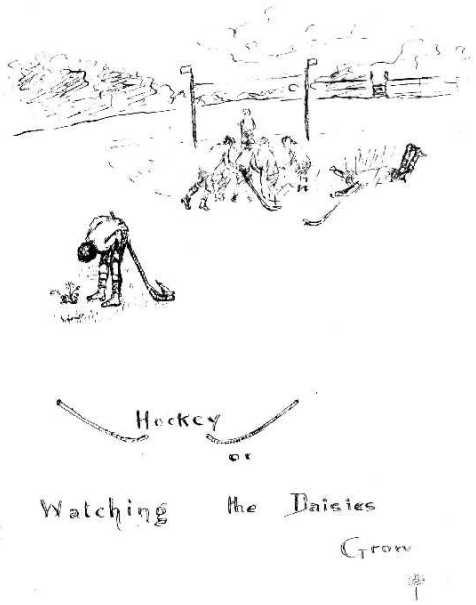
Turing starts his school education at the age of six at St. Michael's School

Alan Turing as a boy

Alan Turing with his mother Ethel Sara Turing

Alan Turing with his mother and brother on a beach on the South Coast of England in 1913

Alan and his elder brother John



Drawing of Alan Turing by his mother, at his preparatory school, Hazelhurst, Sussex, 1923

Preparatory school, Hazelhurst

Turing and friends on a Cornish beach, April 1930

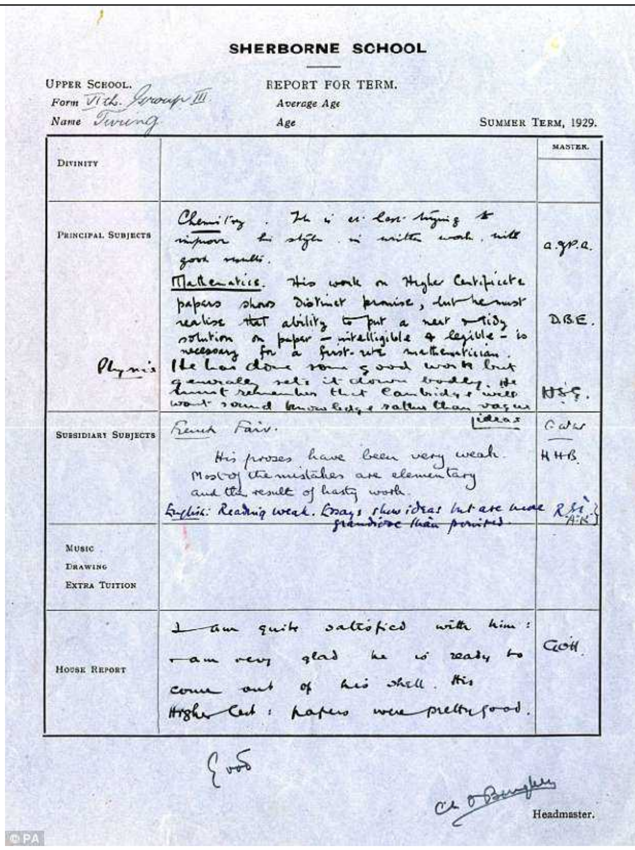
Alan Turing, second from right, with (L-R) Hogg, Geoffrey OHanlon (housemaster) and White

Alan Turing with school friends, Robin and John Wainwright and Hugh Highet

Turing in a photo from his days at the Sherborne School

Alan Turing, aged 15, at Westcott House, Sherborne School

Sherborne School



SHERBORNE SCHOOL

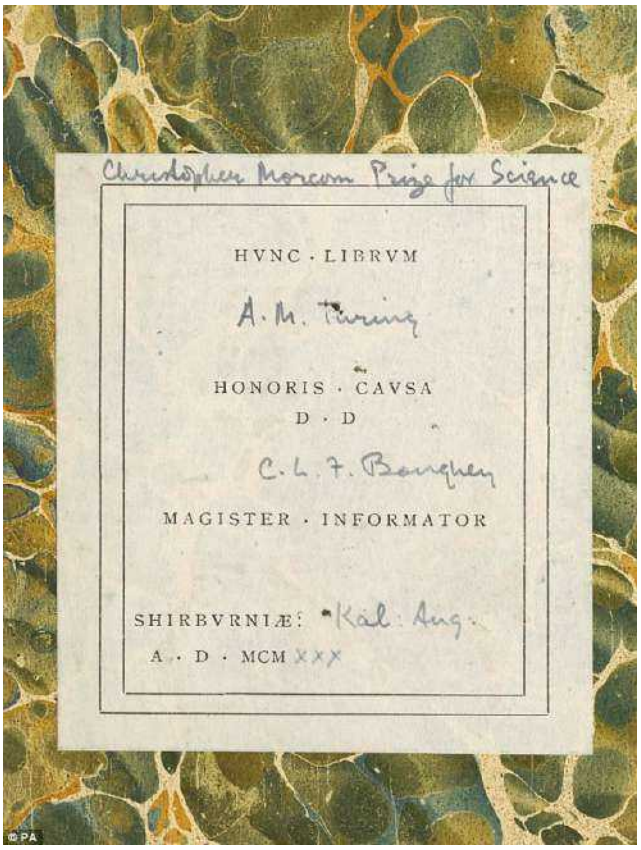
UPPER SCHOOL. REPORT FOR TERM.
Form VIth. Group III Average Age
Name Turing Age SUMMER TERM, 1929.

		MASTER.
DIVINITY		
PRINCIPAL SUBJECTS	Chemistry. He is not trying to improve his style in written work, with good results. Mathematics. His work on Higher Certificate papers shows distinct promise, but he must realise that ability to put a neat & tidy solution on paper – intelligible & legible – is necessary for a first-rate mathematician. Physics: He has done some good work but generally sets it down badly. He must remember that Cambridge will want sound knowledge rather than vague ideas	A.G.P.A. D.B.E. H.S.G.
SUBSIDIARY SUBJECTS	French Fair. His proses have been very weak. Most of the mistakes are elementary and the result of hasty work. English: Reading weak. Essays shew ideas but are more grandiose than pointed.	G.W.W. H.H.B. R.S.I. A.K.
MUSIC DRAWING EXTRA TUITION		
HOUSE REPORT	I am quite satisfied with him: I am very glad he is ready to come out of his shell. His Higher Cert: papers were pretty good.	G.O.H.

Good

C.L. O'Bungley
Headmaster.

Alan Turing's school report when he was 16-years-old



This is the copy of the school prize which Turing chose in honour of his 'first love' Christopher Morcom

Christopher Morcom with his parents in 1929

Turing, age 18, next to Ben Davis, head of Mathematics at Sherborne School

Young Alan Turing.

Alan Turing aged 19, bathing on the island of Sark

Alan Turing in his early 20s

Turing running

Turing reading

Turing (right) and Mermagen in their last year at Sherborne

Alan Turing in 1934

Hut 8, where Turing's Naval Enigma section was based

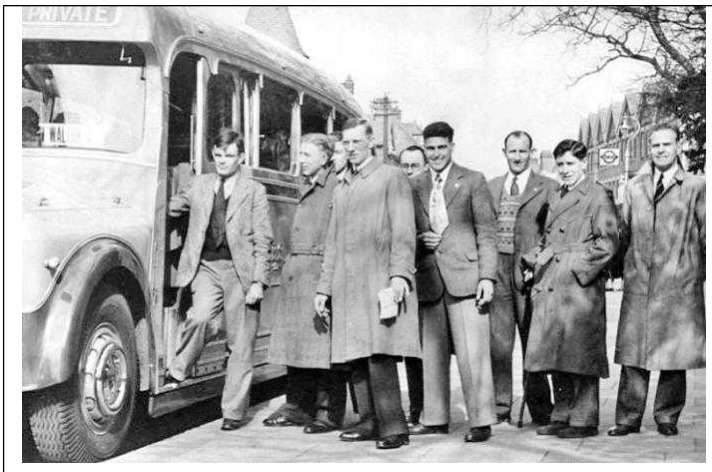
The young Alan Turing in more innocent times

As a fellow at King's, Cambridge

On the right is a rare snapshot of Alan Turing in a seminar at Princeton at this period

Princeton University

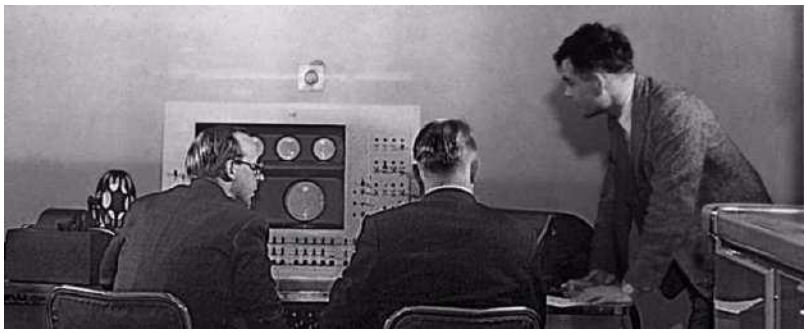
Alan Turing in a boat just before the Second World War



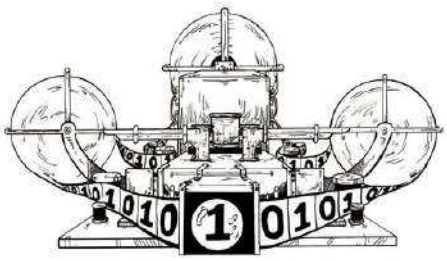
Alan Turing (far left) on a bus

Alan Turing in a garden in Dene Road, Guildford in 1928

Ratio Club at Cambridge 1952, Giles Brindley (yellow), Donald MacKay (red), Alan Turing (green)

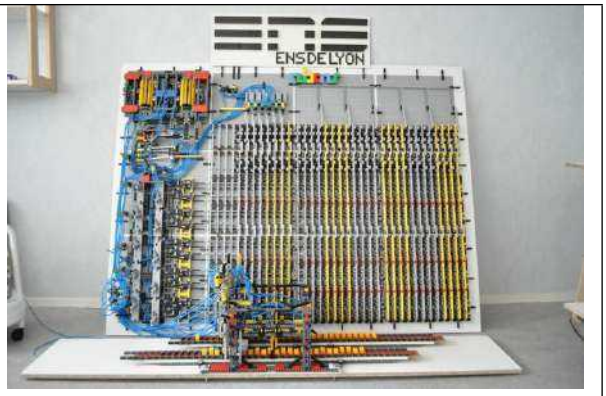


Alan Turing (right) stands next to the Ferranti Mark I

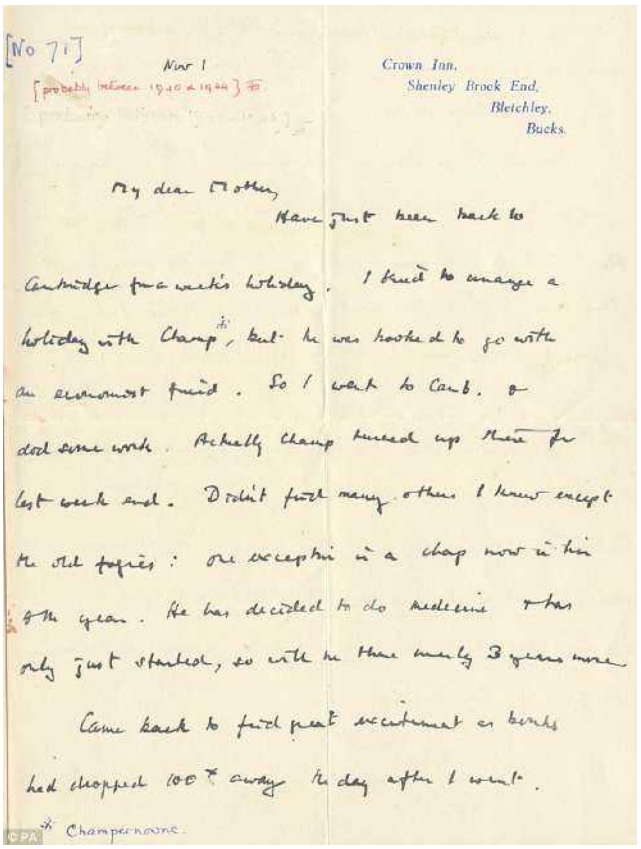


Conceptualization of the Turing Machine invented by Turing in 1936

Mechanical Wooden Turing Machine



This is a Turing machine built from Legos. It's a theoretical machine Turing designed for computing in the late 30s



[No 71]
Nov 1
[probably between 1940 & 1944] Fri

Crown Inn,
Shenley Brook End,
Bletchley,
Bucks.

My dear Mother,

Have just been back to Cambridge for a week's holiday. I tried to arrange a holiday with Champ*, but he was hooked to go with an economist friend. So I went to Camb. & did some work. Actually Champ turned up there for last week end. Didn't find many others I knew except the old fogies: one exception is a chap now in his 4th year. He has decided to do medicine & has only just started, so with me there merely 3 years more.

Came back to find great excitement as bricks had dropped 100 ft away the day after I went.

* Champernowne.

© PA

A letter which Alan Turing sent to his mother

© PA

Despite his death being ruled suicide, Turing's mother said it was 'quite probably' his death from cyanide poisoning was a mistake

Alan Turing memorial − Manchester

Turing lived the last years of his life at this home in Wilmslow, Cheshire near Manchester. He took his own life at this house on June 7, 1954

	Turing led the Naval Enigma codebreaking efforts from this office in Hut 8. The building at Bletchley Park has been fully restored

Hut 8 at Bletchley Park is the building Turing worked in during the early years of World War II. Turing was instrumental in breaking the German naval Enigma code

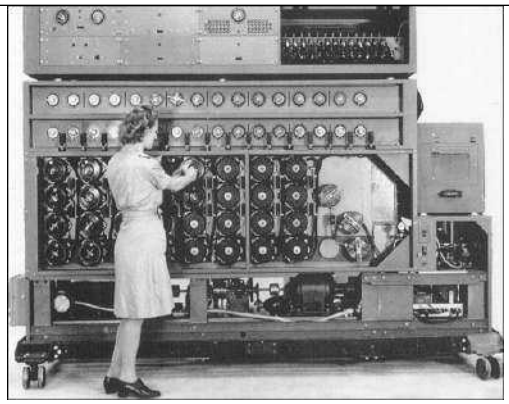
In 1931, Turing began his studies at King's College, Cambridge

	Two cottages in the stable yard at Bletchley Park. Turing worked here in 1939 and 1940, before moving to Hut 8

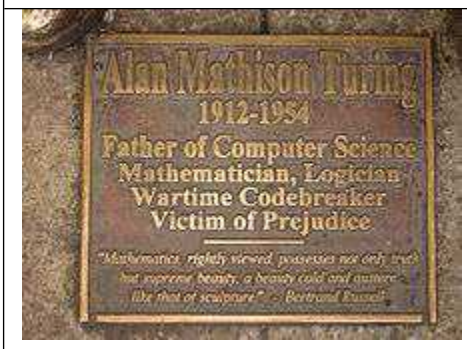
Alan Turing's OBE currently held in Sherborne School archives

Photograph of Alan Turing statue at University of Surrey

Turing's statue at Bletchley Park (made of layers of stacked slate, shown from the chest up)



Bombe machine, a code-breaking machine, originally developed by Alan Turing and others, used during World War II

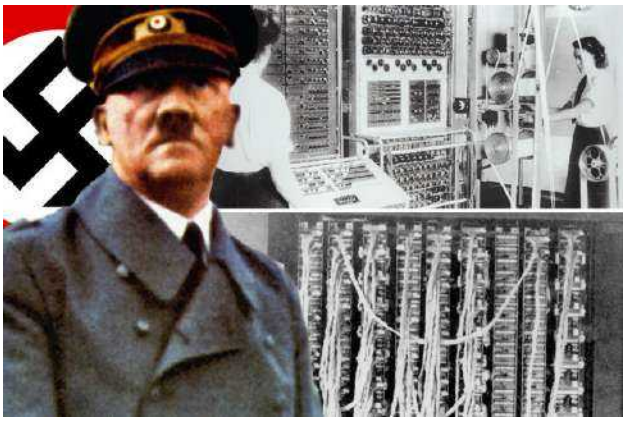


Turing memorial statue plaque in Sackville Park, Manchester

Welsh codebreaker Mair Russell-Jones recognised Alan Turing's genius at an early age at Bletchley Park

During World War II, Bletchley Park housed the UK's code breaking efforts against the Axis powers. Turing worked here

Turing was recruited to the National Physical Laboratory in 1945



Alan Turing's codebreakers decoding of the Enigma Machine helped win World War II

John Bucchen

THE OLD POST

ILLUSTRATED WEEKLY NEWSPAPER

Est. 1908 | Wednesday, June 23, 1942 | Price 5¢

WWII: Germany's Codes Cracked

Speech Encipher in the Works

In a mission codenamed "Delilah", a handheld, voice encipherment device has been in development at the Secret Service's Radio Headquarters in Buckinghamshire, England. Looking to electronically encipher speech, Allied researchers have been working tirelessly to create a product for long-distance use overseas. As of yet, the transmissions have been unable to pass military testing, but leading researchers are confident the technology will be perfected before the conclusion of the war. If implemented, this device could

Turingery Spoils German Plans

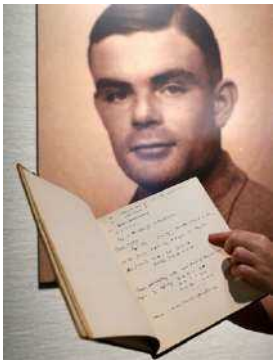
Although a physical machine has yet to be created, Alan Turing has uncovered a manual method in which the Lorenz cipher can be broken. Nicknamed "Turingery", this process is derived from a code-breaking strategy known as wheel breaking, which analyses imprint imperfections from active cams on the wheels of the German encryption machine. The Allies are now capable of translating the Germans' encoded messages produced by the SZ40 and SZ42, two of their often used rotor stream cipher machines.

Turing-Welchman Bombe Delivers

Previously unable to decisively decode German messages through their Enigma system, English logician and computer scientist Alan Turing has collaborated efforts with mathematician Gordon Welchman in an attempt to alleviate this pressing issue. Serving as a more effective version of the Polish's creation, The Turing-Welchman bombe is currently an integral part of the Allied attack on Axis cryptology. Now two years since the first installation on March 18, 1940, there are now over 50 in operation throughout the US and Western Europe. Government officials estimate that as many as two hundred could be created to meet the needs of the war.

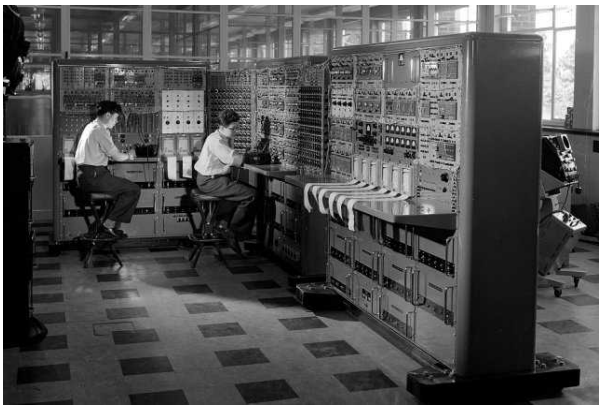
ALAN TURING: Bletchley Park will reopen as the National College of Cyber Security

U-BOATS: Breaking the Enigma code allowed Brit ships to evade German U-boats



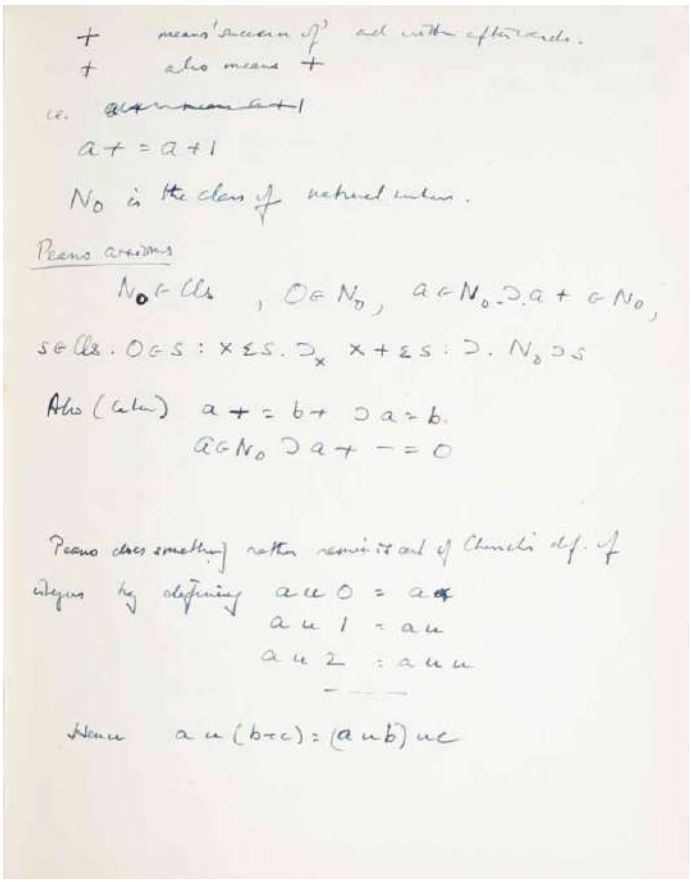
A page from the notebook of British mathematician and pioneer in computer science Alan Turing, displayed in front of his portrait during an auction preview in Hong Kong

Cassandra Hatton, senior specialist in fine books and manuscripts and director of the history of science from Bonhams auction house, shows a notebook of British mathematician and pioneer in computer science Alan Turing, during an auction preview in Hong Kong



The DEUCE: Digital Electronic Universal Computing Engine, was the first commercially produced digital model and was developed from earlier plans by Alan Turing

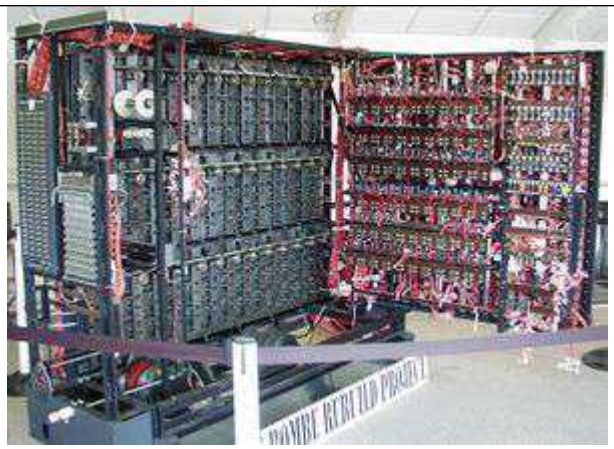
A rare manuscript belonging to British mathematician and code breaker Alan Turing displayed in Hong Kong on March 19, 2015



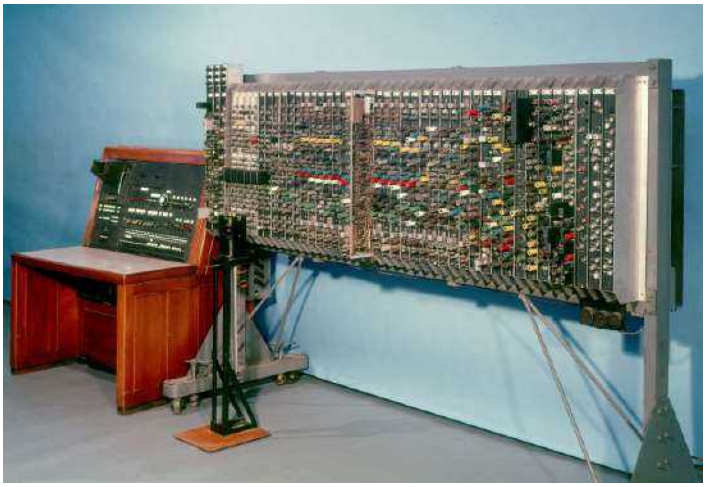
A page from the notebook of codebreaker Alan Turing seen at Bonham's auction house during an auction in New York, on April 13, 2015. The paper, in which he details his work on the foundations of mathematical notation and computer science

Bonham's senior specialist Cassandra Hatton discusses a working Enigma cipher machine that along with the 1942 56-page notebook belonging to codebreaker Alan Turing

A working Enigma cipher machine

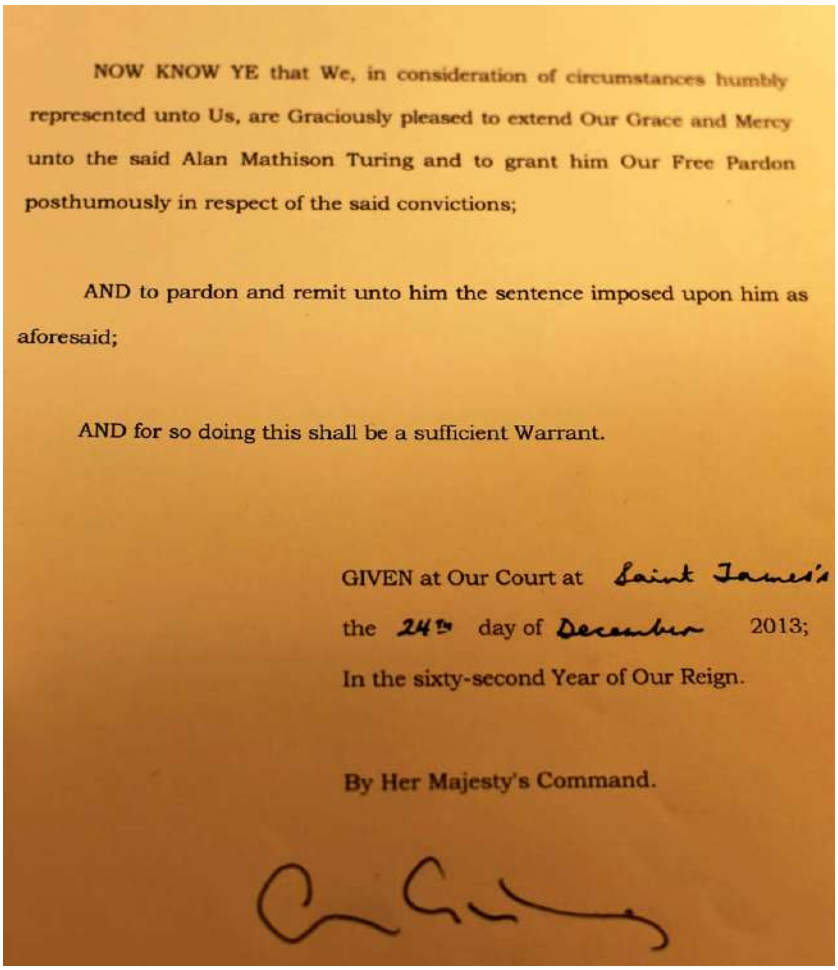


A rebuild of a machine made by Alan Turing



Britain's earliest stored program computers designed by the mathematician Alan Turing (1912−1954) at NPL between 1945 and 1947

The Queen visits Bletchley Park and studies an Enigma machine. She grants Turing a royal pardon on 23 December 2013



NOW KNOW YE that We, in consideration of circumstances humbly represented unto Us, are Graciously pleased to extend Our Grace and Mercy unto the said Alan Mathison Turing and to grant him Our Free Pardon posthumously in respect of the said convictions;

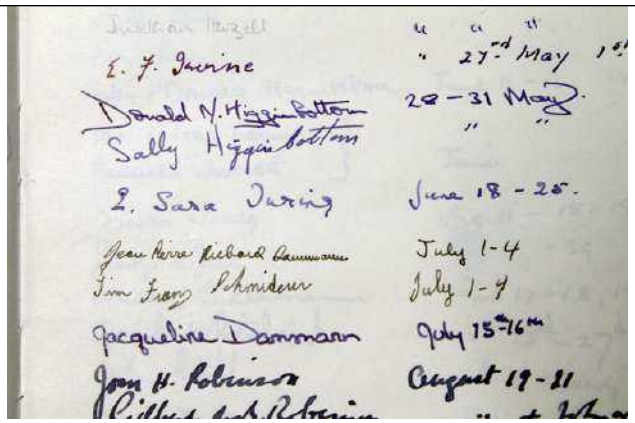
AND to pardon and remit unto him the sentence imposed upon him as aforesaid;

AND for so doing this shall be a sufficient Warrant.

GIVEN at Our Court at Saint James's
the 24th day of December 2013;
In the sixty-second Year of Our Reign.

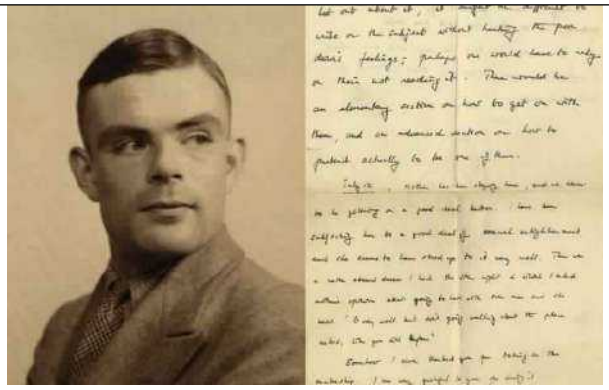
By Her Majesty's Command.

Alan Turing's Royal Pardon (UK Government)

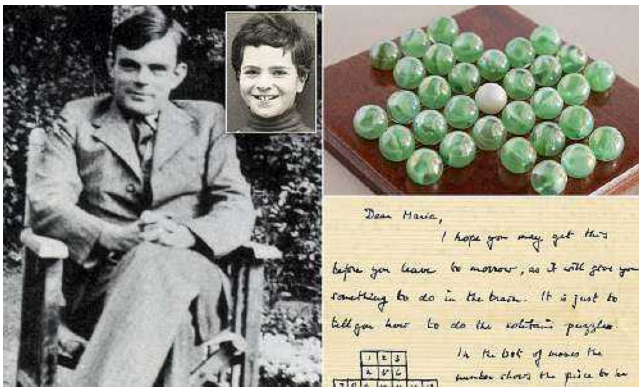


Signature of Alan Turing's mother Sara, from when she visited after his death

Alan Turing Stamp

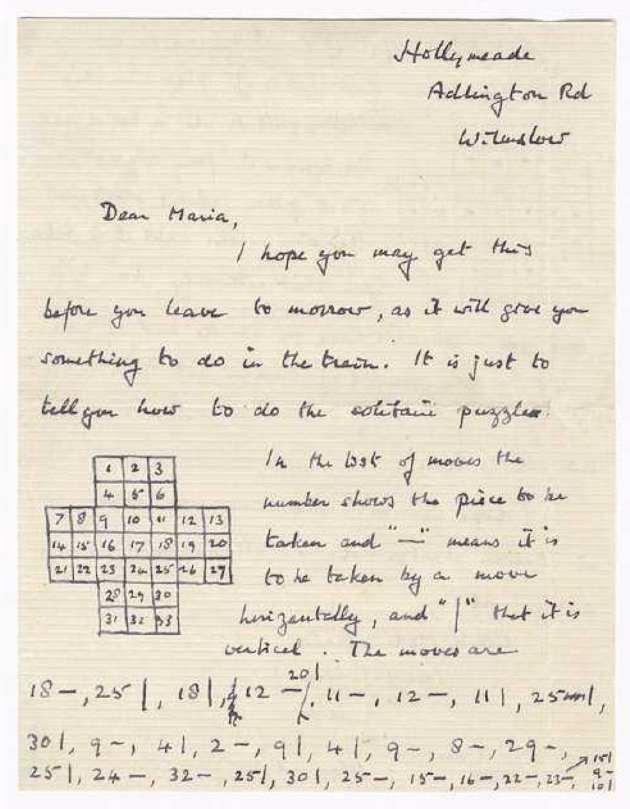


Alan Turing Letter Reveal Turmoil Over Sexuality, 'Gay Cure' Hormone Therapy



Dear Maria,
I hope you may get this
before you leave to morrow, as it will give you
something to do in the train. It is just to
tell you how to do the solitaire puzzles.
In the list of moves the
number shows the piece to be

Letter Alan Turing wrote to Maria Greenbaum in July 1953 with his advice for playing Solitaire

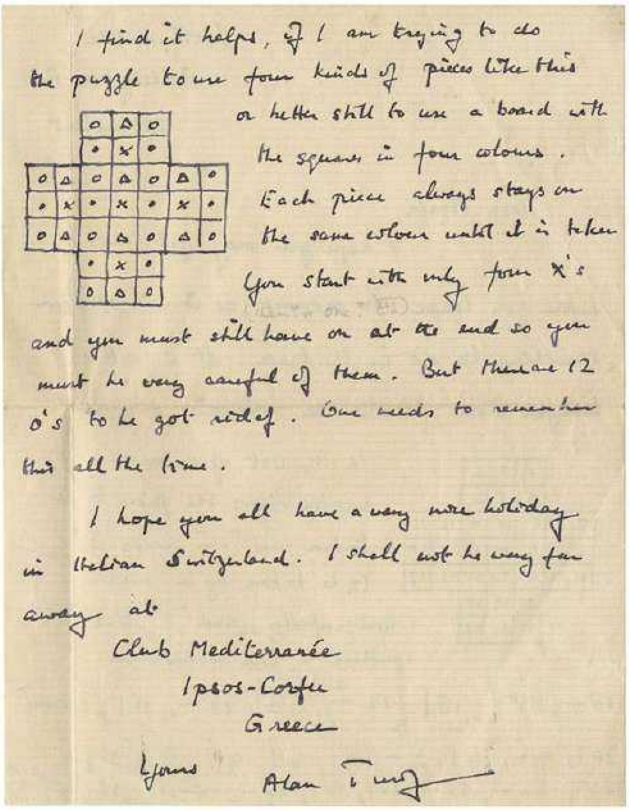


Hollymeade
Adlington Rd
Wilmslow

Dear Maria,
I hope you may get this
before you leave to morrow, as it will give you
something to do in the train. It is just to
tell you how to do the solitaire puzzles.

In the list of moves the
number shows the piece to be
taken and "—" means it is
to be taken by a move
horizontally, and "|" that it is
vertical. The moves are
18—, 25|, 18|, 12—, 20|, 11—, 12—, 11|, 25—|,
30|, 9—, 41, 2—, 9|, 4|, 9—, 8—, 29—,
25|, 24—, 32—, 25|, 30|, 25—, 15—, 16—, 22—, 23—, 9—, 10|

The detailed letter provided an explanation of how to avoid having pieces scattered around the board, including a series of moves to help crack the puzzle



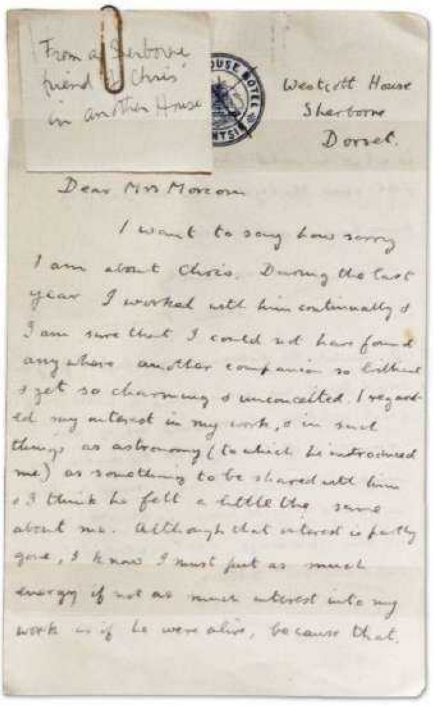
I find it helps, if I am trying to do the puzzle to use four kinds of pieces like this or better still to use a board with the squares in four colours. Each piece always stays on the same colour until it is taken. You start with only four X's and you must still have on at the end so you must be very careful of them. But there are 12 O's to be got rid of. One needs to remember this all the time.

I hope you all have a very nice holiday in Italian Switzerland. I shall not be very far away at

Club Mediterranée
Ipsos-Corfu
Greece

Yours
Alan Turing

He used diagrams to help explain to his niece how she might succeed with the puzzle



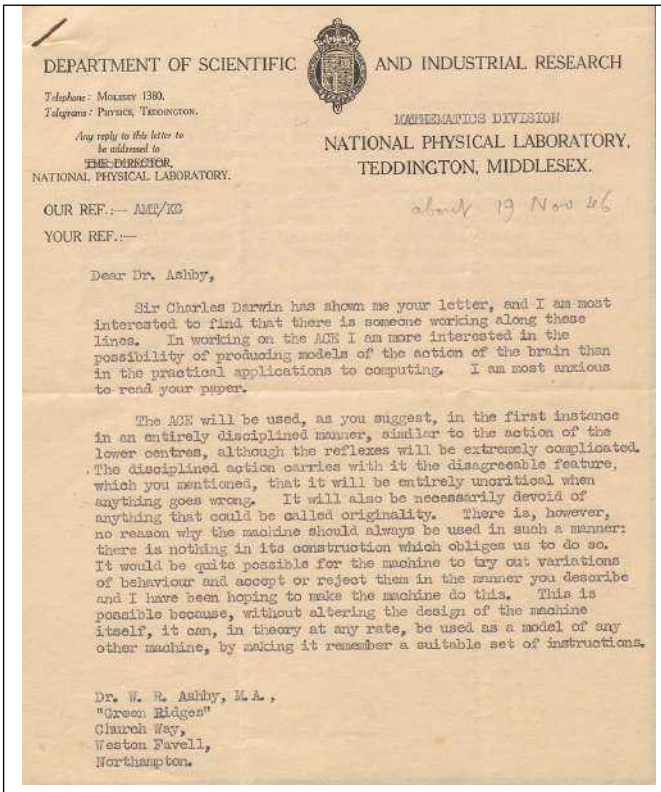
From a Sherborne friend Chris's in another House

Westcott House
Sherborne
Dorset.

Dear Mrs Morcom

I want to say how sorry I am about Chris. During the last year I worked with him continually & I am sure that I could not have found anywhere another companion so brilliant & yet so charming & unconceited. I regarded my interest in my work, & in such things as astronomy (to which he introduced me) as something to be shared with him & I think he felt a little the same about me. Although that interest is fairly gone, I know I must put as much energy if not as much interest into my work as if he were alive, because that

Alan Turing's letter to Christopher Morcom's mother. Christopher was Alan's first love, and he died very young



DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Telephone: Molesey 1380.
Telegrams: Physics, Teddington.

Any reply to this letter to be addressed to THE DIRECTOR, NATIONAL PHYSICAL LABORATORY.

MATHEMATICS DIVISION
NATIONAL PHYSICAL LABORATORY,
TEDDINGTON, MIDDLESEX.

OUR REF.:— AMT/KG

YOUR REF.:—

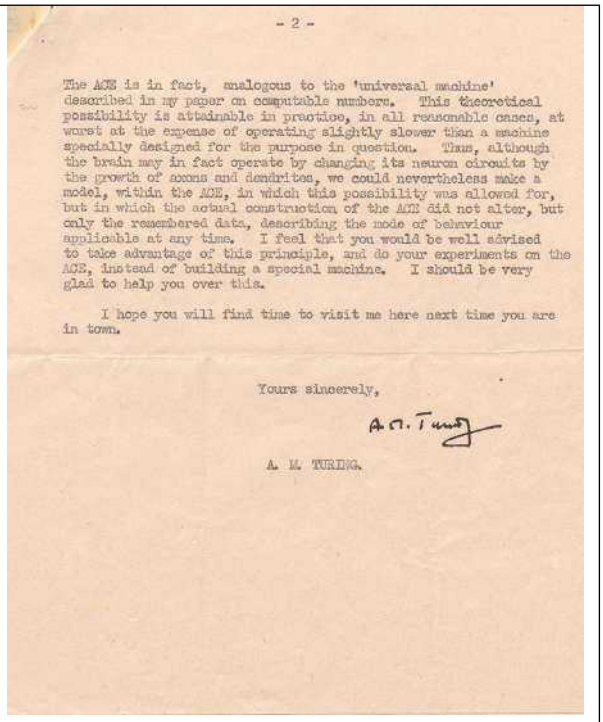
19 Nov 46

Dear Dr. Ashby,

Sir Charles Darwin has shown me your letter, and I am most interested to find that there is someone working along these lines. In working on the ACE I am more interested in the possibility of producing models of the action of the brain than in the practical applications to computing. I am most anxious to read your paper.

The ACE will be used, as you suggest, in the first instance in an entirely disciplined manner, similar to the action of the lower centres, although the reflexes will be extremely complicated. The disciplined action carries with it the disagreeable feature, which you mentioned, that it will be entirely uncritical when anything goes wrong. It will also be necessarily devoid of anything that could be called originality. There is, however, no reason why the machine should always be used in such a manner: there is nothing in its construction which obliges us to do so. It would be quite possible for the machine to try out variations of behaviour and accept or reject them in the manner you describe and I have been hoping to make the machine do this. This is possible because, without altering the design of the machine itself, it can, in theory at any rate, be used as a model of any other machine, by making it remember a suitable set of instructions.

Dr. W. R. Ashby, M.A.,
"Green Ridges"
Church Way,
Weston Favell,
Northampton.



- 2 -

The ACE is in fact, analogous to the 'universal machine' described in my paper on computable numbers. This theoretical possibility is attainable in practice, in all reasonable cases, at worst at the expense of operating slightly slower than a machine specially designed for the purpose in question. Thus, although the brain may in fact operate by changing its neuron circuits by the growth of axons and dendrites, we could nevertheless make a model, within the ACE, in which this possibility was allowed for, but in which the actual construction of the ACE did not alter, but only the remembered data, describing the mode of behaviour applicable at any time. I feel that you would be well advised to take advantage of this principle, and do your experiments on the ACE, instead of building a special machine. I should be very glad to help you over this.

I hope you will find time to visit me here next time you are in town.

Yours sincerely,

A.M. Turing

A. M. TURING.

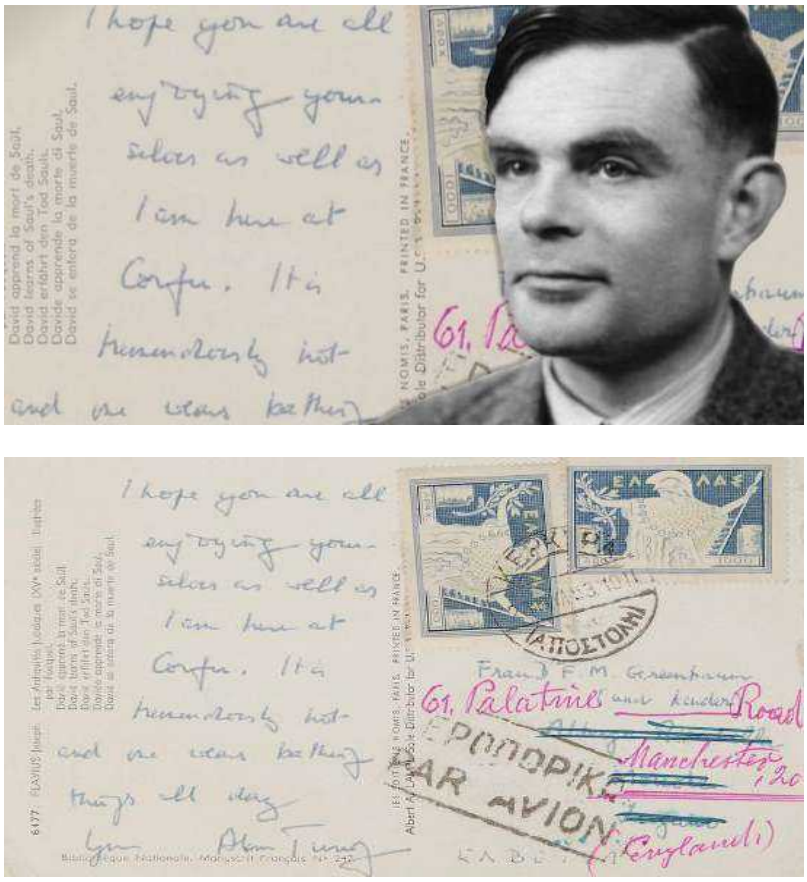
Letter from Alan Turing to W Ross Ashby

Alan Turing at the Science Museum

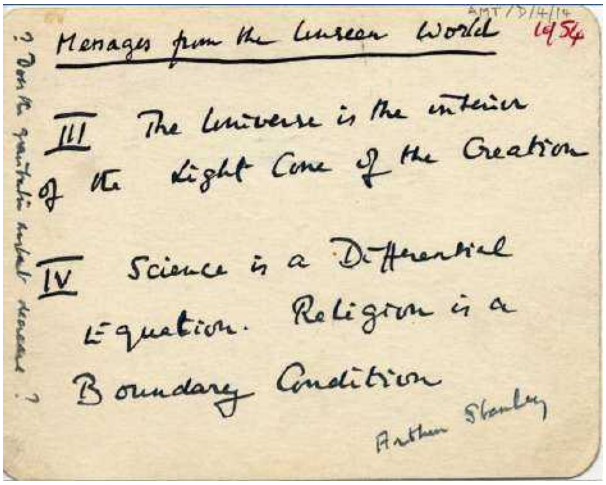
The blue plaque at Alan Turing's house on Adlington Road

Bronze bust of Alan Turing presented to ACM by Tom and Grant Mackenzie

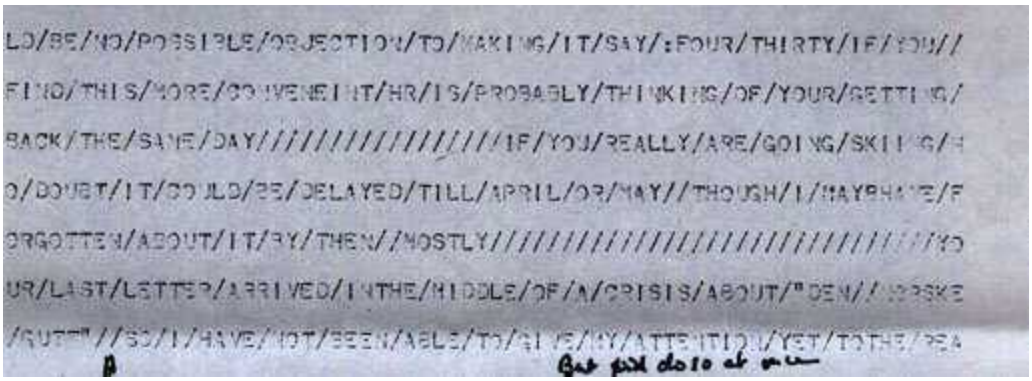
ACM A.M. Turing Award



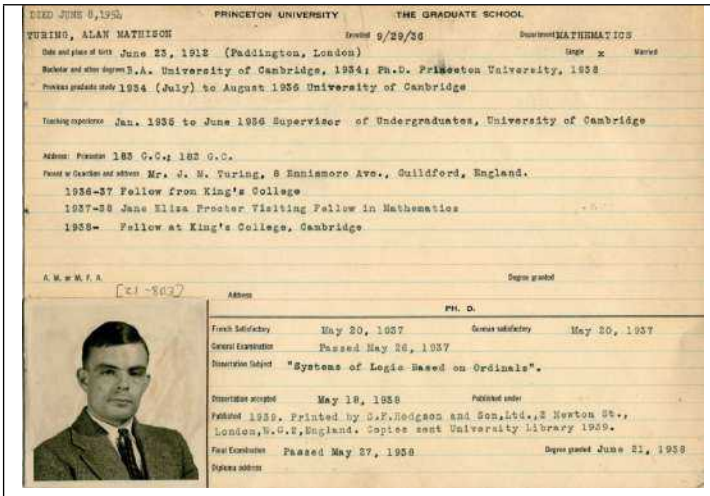
A postcard Alan Turing sent to his psychologist "Dr Franz Greenbaum" while on holiday in Corfu

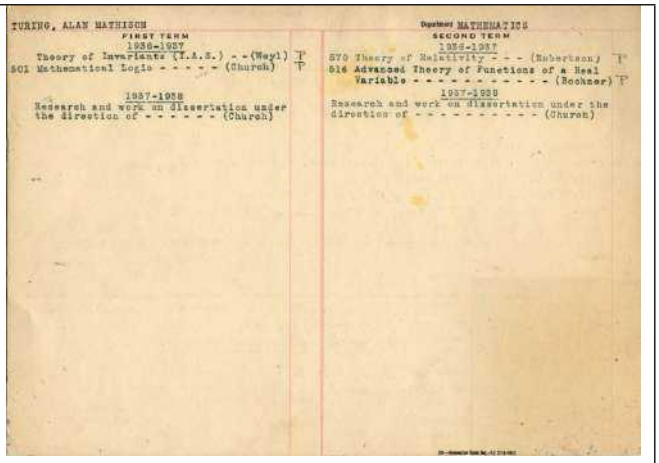


Note from Alan Turing to Robin Gandy, March 1954

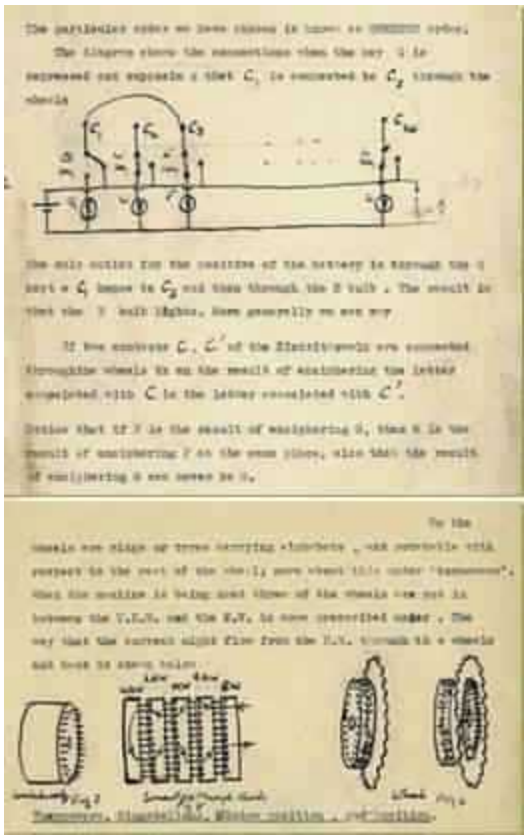


Message from Turing to Gandy, printed off the Manchester Mark I, ca. 1953

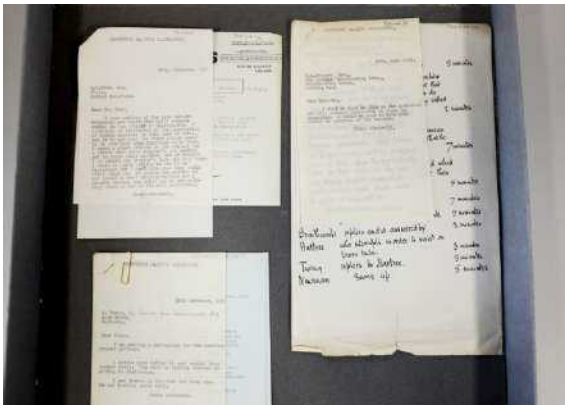




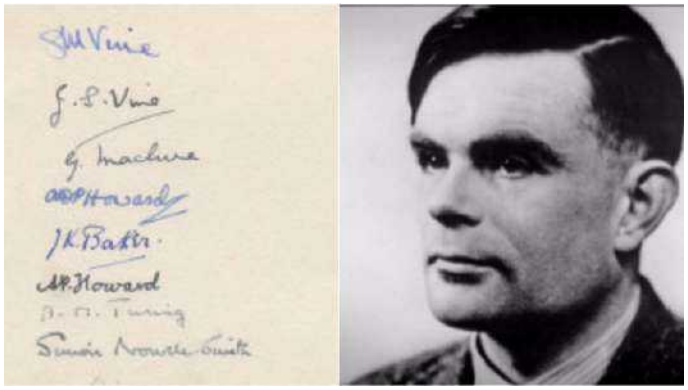
Alan Turing's Princeton University File



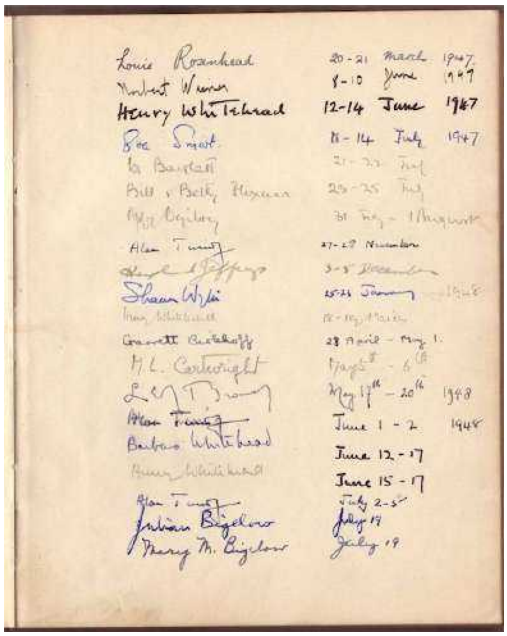
Extracts from Turing's notes on the Enigma Machine, c.1939–42



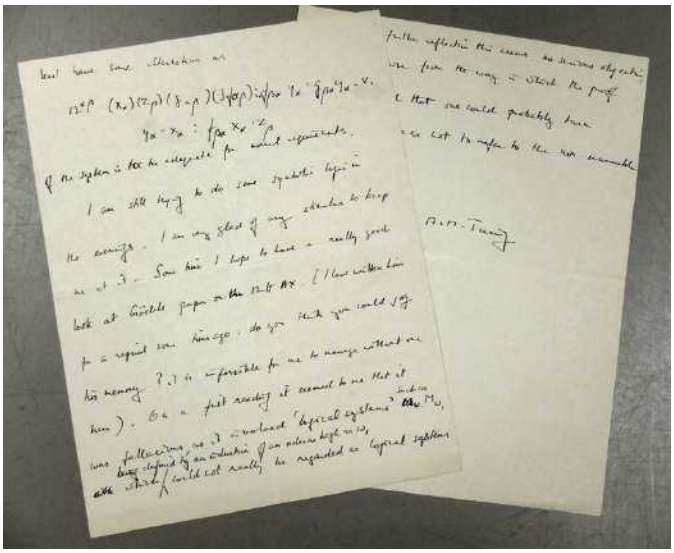
A unique collection of letters and correspondence from Alan Turing found in an old filing cabinet in a storeroom at the University of Manchester



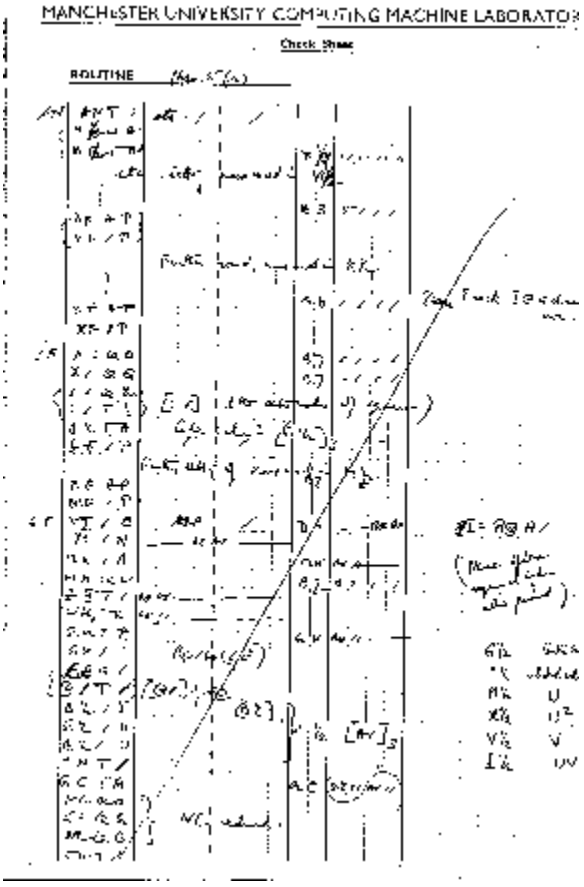
Alan Turing autograph.



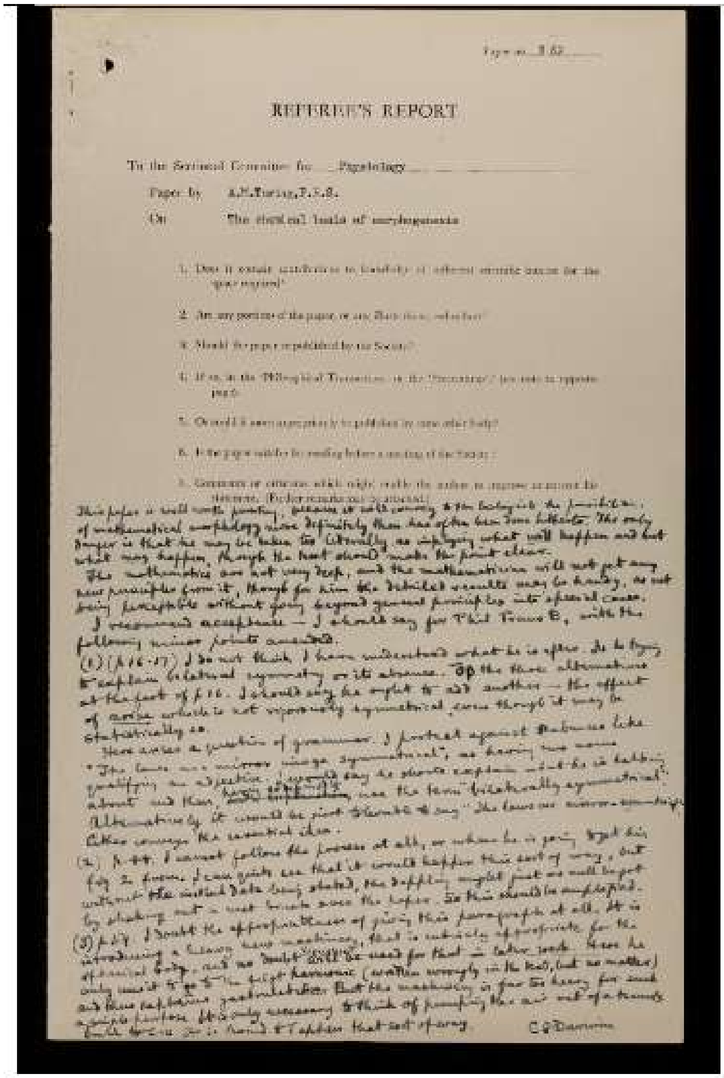
Visitor's Book signature: Alan Turing's signature 8th from the top.



Alan Turing Letter to Alonzo Church



Alan Turing Scrapbook



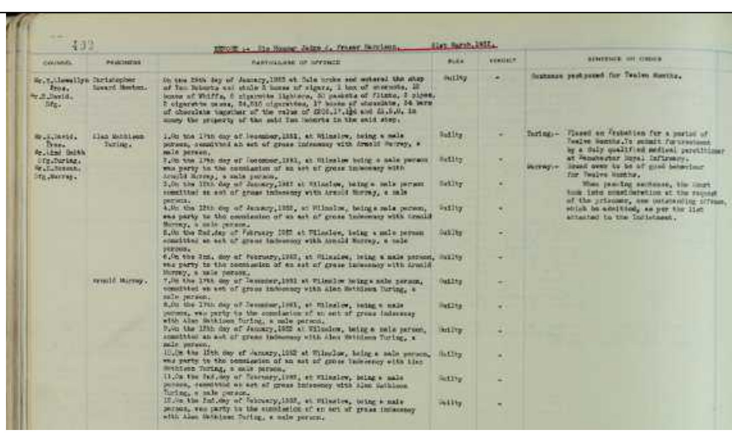
REFEREE'S REPORT

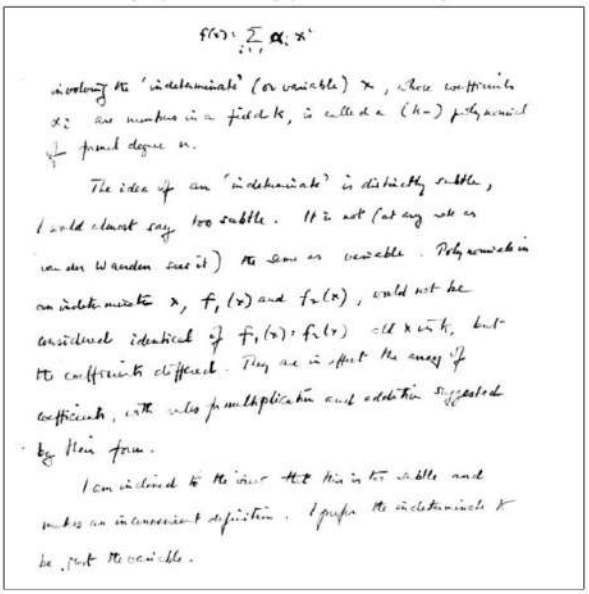
To the Sectional Committee for Physiology

Paper by A.M.Turing,F.R.S.

On The chemical basis of morphogenesis

Referee report by C. G. Darwin on 'On the Chemical basis of Morphogenesis' by A. M. Turing

	This is a photograph of the official record of the charges, pleas, and sentences passed on Alan Turing and Arnold Murray in respect of their crimes, 31 March 1952



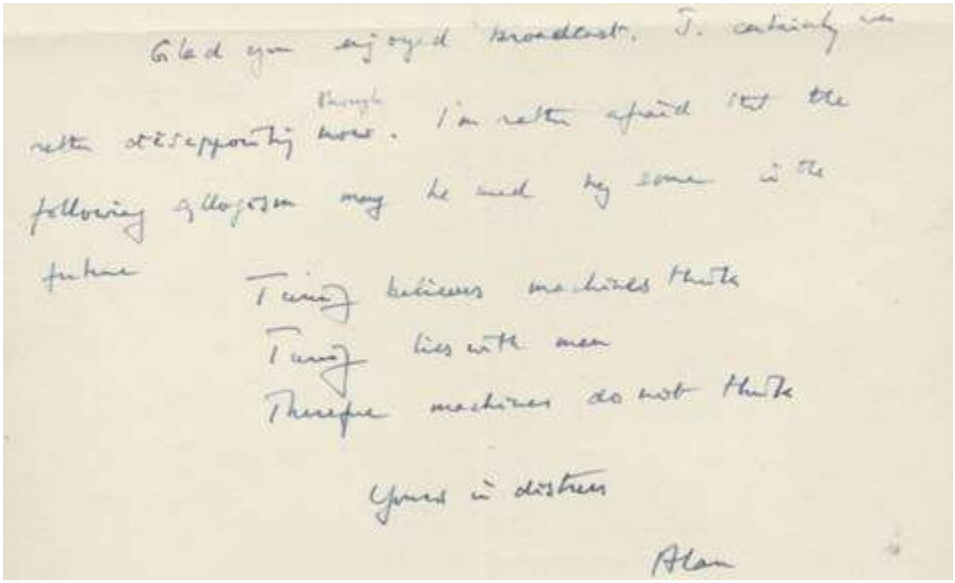
$$f(x) = \sum_{i=1} a_i x^i$$

involving the 'indeterminate' (or variable) x, where coefficients a_i are numbers in a field k, is called a $(k-)$ polynomial of finite degree n.

The idea of an 'indeterminate' is distinctly subtle, I would almost say too subtle. It is not (at any rate as we use the word) the same as variable. Polynomials in an indeterminate x, $f_1(x)$ and $f_2(x)$, would not be considered identical if $f_1(x) = f_2(x)$ all $x \in k$, but the coefficients different. They are in effect the ennuy of coefficients, with rules for multiplication and addition suggested by their form.

I am inclined to think that this is too subtle and makes an inconvenient definition. I prefer the indeterminate x to be just the variable.

A sample of the handwriting of Alan Turing



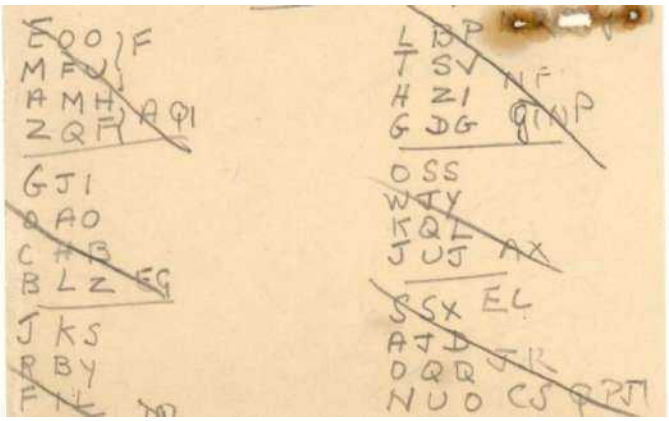
Glad you enjoyed broadcast. I certainly was though
quite disappointed with more. I'm rather afraid that the
following syllogism may be used by some in the
future

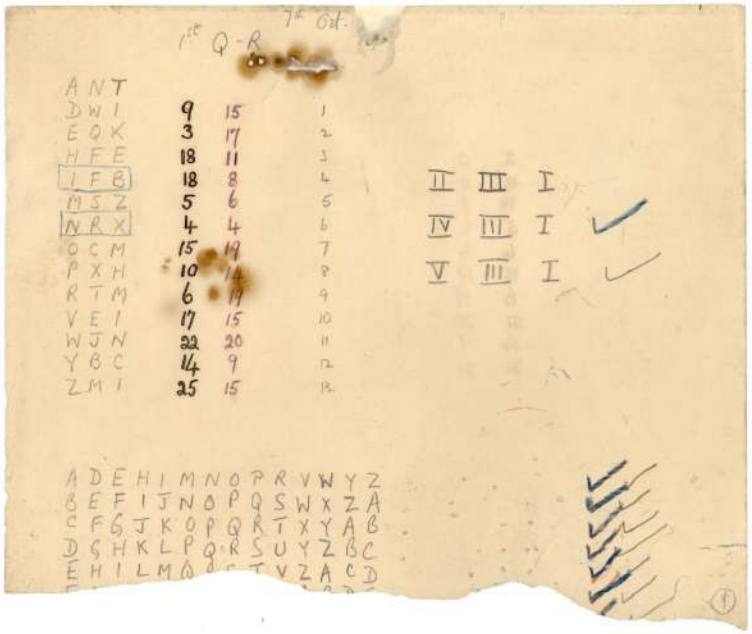
Turing believes machines think
Turing lies with men
Therefore machines do not think

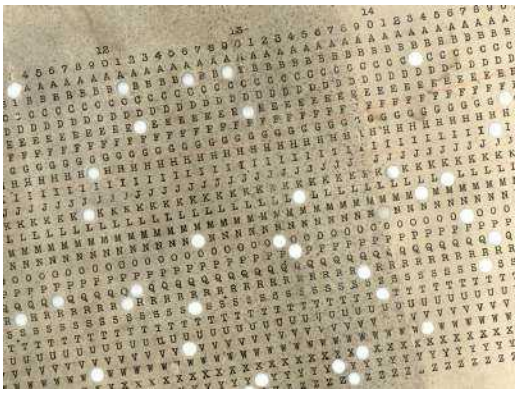
Yours in distress

Alan

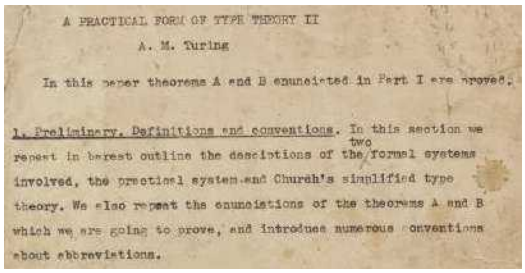
Alan Turing Letter to Dr. N. A. Routledge shortly before his conviction







Alan Turing's Code-Breaking Papers Discovered In Roof Holes At Bletchley Park



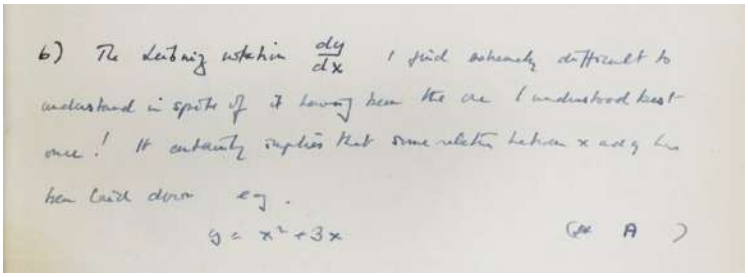
A PRACTICAL FORM OF TYPE THEORY II

A. M. Turing

In this paper theorems A and B enunciated in Part I are proved.

1. Preliminary. Definitions and conventions. In this section we repeat in brief outline the descriptions of the two formal systems involved, the practical system and Church's simplified type theory. We also repeat the enunciations of the theorems A and B which we are going to prove, and introduce numerous conventions about abbreviations.

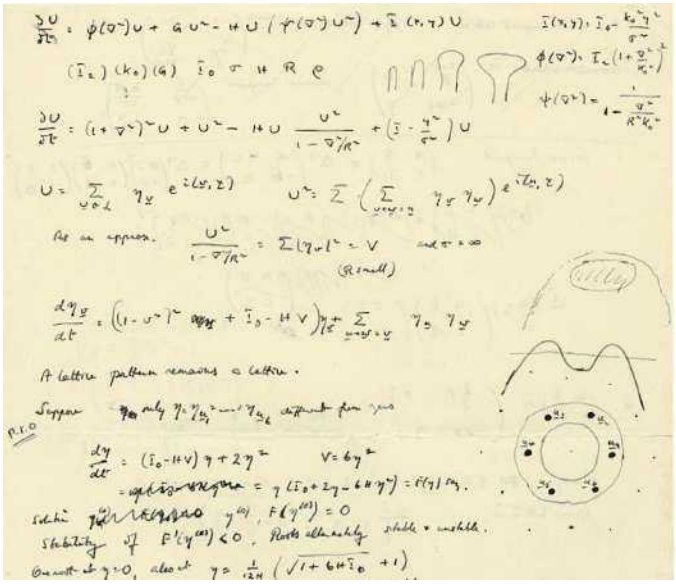
A sample of Turing's typing



6) The Leibniz notation $\frac{dy}{dx}$ I find extremely difficult to understand in spite of it having been the one I understood best once! It certainly implies that some relation between x and y has been laid down eg.

$y = x^2 + 3x$ (or A)

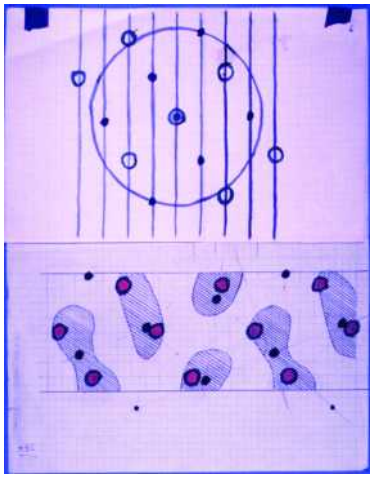
One of Alan Turing's journals, written while he was hacking away on the German Enigma Code



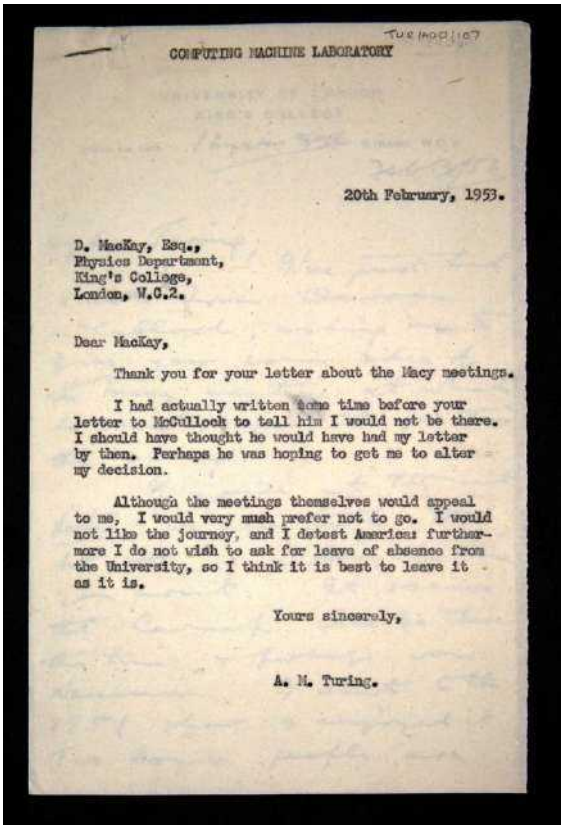
The unpublished work by the late Alan Turing (1912−1954). It includes many topics (how to play Go, eliptic functions...) and drawings and calculations related to his theory of morphogenesis

The Alan Turing Building at the University of Manchester

The London 2012 Olympic Torch flame was passed on in front of Turing's statue in Manchester on his 100th birthday



Colored diagrams showing patterns of dappling and calculations, made by Turing in connection with work on morphogenesis



COMPUTING MACHINE LABORATORY

20th February, 1953.

D. MacKay, Esq.,
Physics Department,
King's College,
London, W.C.2.

Dear MacKay,

Thank you for your letter about the Macy meetings.

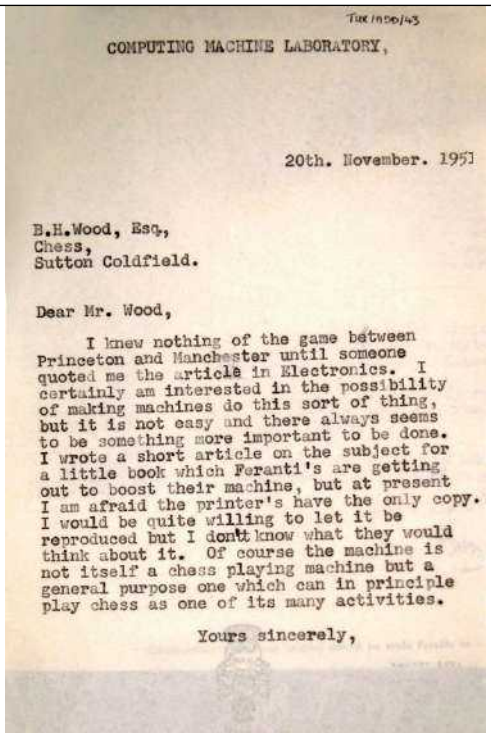
I had actually written some time before your letter to McCulloch to tell him I would not be there. I should have thought he would have had my letter by then. Perhaps he was hoping to get me to alter my decision.

Although the meetings themselves would appeal to me, I would very much prefer not to go. I would not like the journey, and I detest America: furthermore I do not wish to ask for leave of absence from the University, so I think it is best to leave it as it is.

Yours sincerely,

A. M. Turing.

Alan Turing Letter to London physicist Donald Mackay



COMPUTING MACHINE LABORATORY,

20th. November. 1951

B.H.Wood, Esq,
Chess,
Sutton Coldfield.

Dear Mr. Wood,

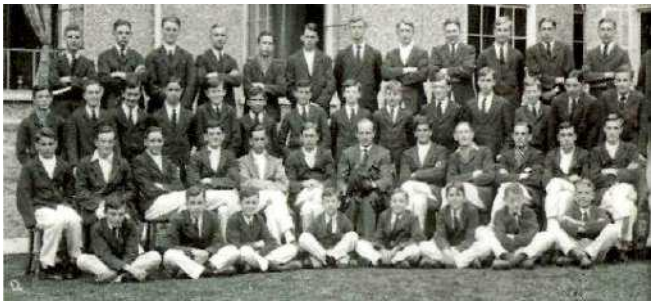
I knew nothing of the game between Princeton and Manchester until someone quoted me the article in Electronics. I certainly am interested in the possibility of making machines do this sort of thing, but it is not easy and there always seems to be something more important to be done. I wrote a short article on the subject for a little book which Feranti's are getting out to boost their machine, but at present I am afraid the printer's have the only copy. I would be quite willing to let it be reproduced but I dont know what they would think about it. Of course the machine is not itself a chess playing machine but a general purpose one which can in principle play chess as one of its many activities.

Yours sincerely,

Alan Turing Letter to B H Wood, editor of Chess magazine

Alan Turing on a 2000 "millennium" stamp commemorating his 1937 theory of digital computing

Slate statue of Alan Turing at Bletchley Park with the best-known image of Turing on the wall to the right



Turing (front row far left), aged 13, at Westcott House Sherborne, 1926

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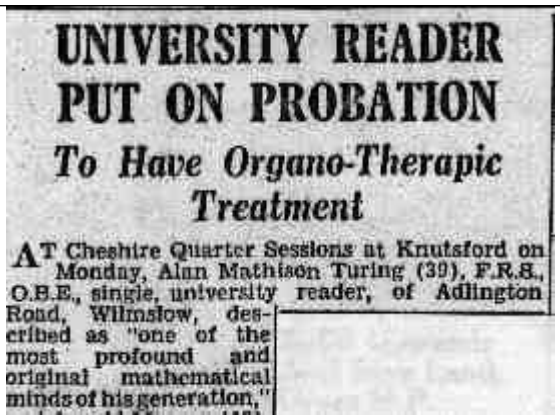
<td> 
UNIVERSITY READER
PUT ON PROBATION
To Have Organo-Therapic Treatment
AT Cheshire Quarter Sessions at Knutsford on Monday, Alan Mathison Turing (39), F.R.S., O.B.E., single, university reader, of Adlington Road, Wilmslow, described as "one of the most profound and original mathematical minds of his generation,"</td>
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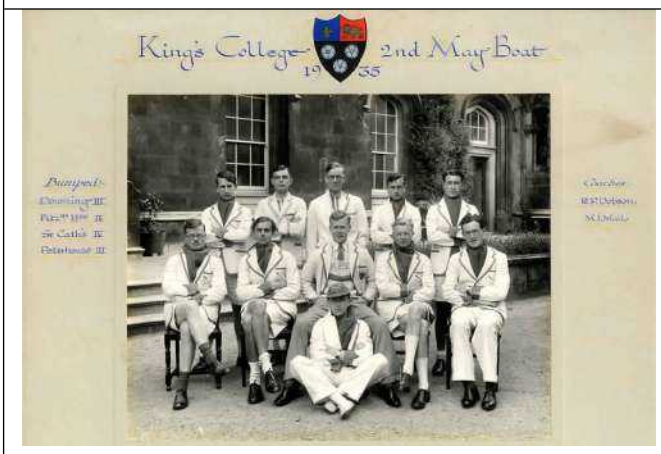
<td> 
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<td>Crew of King's College's 2nd boat, May 1935. Alan Turing is second from the Right</td>
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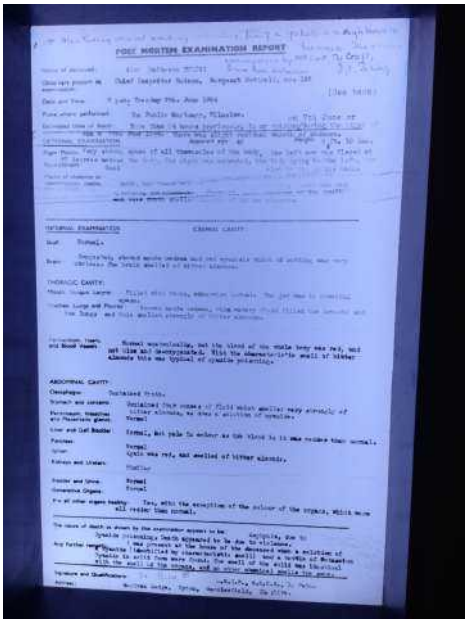
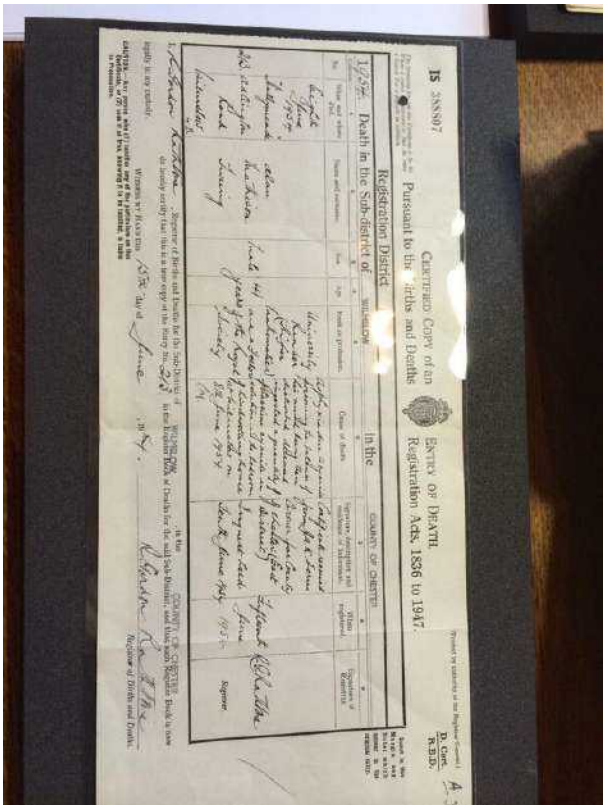


POST MORTEM EXAMINATION REPORT

Post Mortem Examination report of Alan Turing



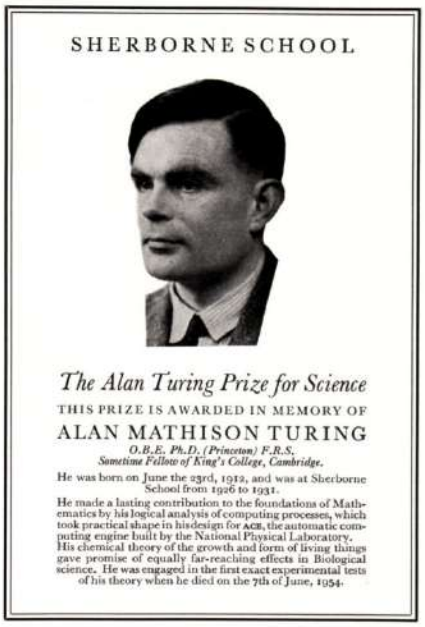
CERTIFIED Copy of an ENTRY OF DEATH
Pursuant to the Births and Deaths Registration Acts, 1836 to 1947.

IS 388907

Registration District ... WILMSLOW ... in the COUNTY OF CHESTER

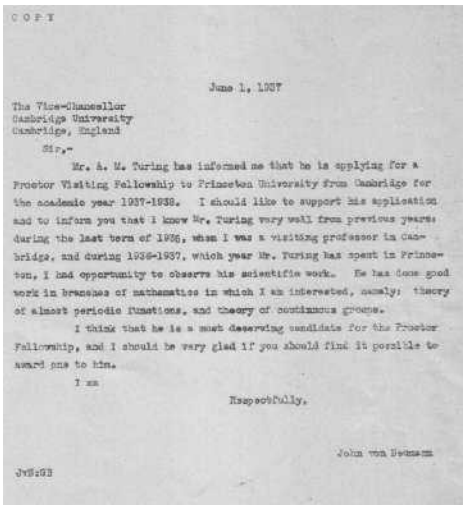
1954. Death in the Sub-district of WILMSLOW

Death certificate of Alan Turing



Alan Turing Prize for Science bookplate

Alan Turing Teddy Bear, Bletchley Park Museum



COPY

June 1, 1937

The Vice-Chancellor
Cambridge University
Cambridge, England

Sir,-

Mr. A. M. Turing has informed me that he is applying for a Procter Visiting Fellowship to Princeton University from Cambridge for the academic year 1937-1938. I should like to support his application and to inform you that I know Mr. Turing very well from previous years: during the last term of 1926, when I was a visiting professor in Cambridge, and during 1936-1937, which year Mr. Turing has spent in Princeton, I had opportunity to observe his scientific work. He has done good work in branches of mathematics in which I am interested, namely: theory of almost periodic functions, and theory of continuous groups.

I think that he is a most deserving candidate for the Procter Fellowship, and I should be very glad if you should find it possible to award one to him.

I am

Respectfully,

John von Neumann

JvN:GB

von Neumann's formal letter of reference dated June 1, 1937, supporting Turing's application for a Procter Fellowship at Princeton for the year 1937–38

Brian Randell Letter to Alan Turing's mother

Remarks of Prime Minister Gordon Brown
10 September 2009

This has been a year of deep reflection – a chance for Britain, as a nation, to commemorate the profound debts we owe to those who came before. A unique combination of anniversaries and events have stirred in us that sense of pride and gratitude that characterise the British experience. Earlier this year, I stood with Presidents Sarkozy and Obama to honour the service and the sacrifice of the heroes who stormed the beaches of Normandy 65 years ago. And just last week, we marked the 70 years which have passed since the British government declared its willingness to take up arms against fascism and declared the outbreak of the Second World War.

So I am both pleased and proud that, thanks to a coalition of computer scientists, historians and LGBT (lesbian, gay, bisexual and transgender) activists, we have this year a chance to mark and celebrate another contribution to Britain's fight against the darkness of dictatorship: that of code-breaker Alan Turing.

Turing was a quite brilliant mathematician, most famous for his work on breaking the German Enigma codes. It is no exaggeration to say that, without his outstanding contribution, the history of the Second World War could have been very different. He truly was one of those individuals we can point to whose unique contribution helped to turn the tide of war. The debt of gratitude he is owed makes it all the more horrifying, therefore, that he was treated so inhumanely.

In 1952, he was convicted of "gross indecency" – in effect, tried for being gay. His sentence – and he was faced with the miserable choice of this or prison – was chemical castration by a series of injections of female hormones. He took his own life just two years later.

Thousands of people have come together to demand justice for Alan Turing and recognition of the appalling way he was treated. While Turing was dealt with under the law of the time, and we can't put the clock back, his treatment was of course utterly unfair, and I am pleased to have the chance to say how deeply sorry I and we all are for what happened to him. Alan and the many thousands of other gay men who were convicted, as he was convicted, under homophobic laws, were treated terribly. Over the years, millions more lived in fear in conviction. I am proud that those days are gone and that in the past 12 years this Government has done so much to make life fairer and more equal for our LGBT community. This recognition of Alan's status as one of Britain's most famous victims of homophobia is another step towards equality, and long overdue.

But even more than that, Alan deserves recognition for his contribution to humankind. For those of us born after 1945, into a Europe which is united, democratic and at peace, it is hard to imagine that our continent was once the theatre of mankind's darkest hour. It is difficult to believe that in living memory, people could become so consumed by hate – by anti-Semitism, by homophobia, by xenophobia and other murderous prejudices – that the gas chambers and crematoria became a piece of the European landscape as surely as the galleries and universities and concert halls which had marked out the European civilisation for hundreds of years.

It is thanks to men and women who were totally committed to fighting fascism, people like Alan Turing, that the horrors of the Holocaust and of total war are part of Europe's history and not Europe's present. So on behalf of the British government, and all those who live freely thanks to Alan's work, I am very proud to say: we're sorry. You deserved so much better.

Gordon Brown

The complete text of Gordon Brown's apology to Alan Turing

Letter to Winston Churchill

Secret and Confidential
Prime Minister only

Hut 6 and Hut 8
21st October 1941

Dear Prime Minister,

Some weeks ago you paid us the honour of a visit, and we believe that you regard our work as important. You will have seen that, thanks largely to the energy and foresight of Commander Travis, we have been well supplied with the 'bombes' for the breaking of the German Enigma codes. We think, however, that you ought to know that this work is being held up, and in some cases is not being done at all, principally because we cannot get sufficient staff to deal with it. Our reason for writing to you direct is that for months we have done everything that we possibly can through the normal channels, and that we despair of any early improvement without your intervention. No doubt in the long run these particular requirements will be met, but meanwhile still more precious months will have been wasted, and as our needs are continually expanding we see little hope of ever being adequately staffed.

We realise that there is a tremendous demand for labour of all kinds and that its allocation is a matter of priorities. The trouble to our mind is that as we are a very small section with numerically trivial requirements it is very difficult to bring home to the authorities finally responsible either the importance of what is done here or the urgent necessity of dealing promptly with our requests. At the same time we find it hard to believe that it is really impossible to produce quickly the additional staff that we need, even if this meant interfering with the normal machinery of allocations.

We do not wish to burden you with a detailed list of our difficulties, but the following are the bottlenecks which are causing us the most acute anxiety.

1. Breaking of Naval Enigma (Hut 8)

Owing to shortage of staff and the overworking of his present team the Hollerith section here under Mr Freeborn has had to stop working night shifts. The effect of this is that the finding of the naval keys is being delayed at least twelve hours every day. In order to enable him to start night shifts again Freeborn needs immediately about twenty more untrained Grade III women clerks. To put himself in a really adequate position to deal with any likely demands he will want a good many more.

A further serious danger now threatening us is that some of the skilled male staff, both with the British Tabulating Company at Letchworth and in Freeborn's section here, who have so far been exempt from military service, are now liable to be called up.

2. Military and Air Force Enigma (Hut 6)

We are intercepting quite a substantial proportion of wireless traffic in the Middle East which cannot be picked up by our intercepting stations here. This contains among other things a good deal of new 'Light Blue' intelligence. Owing to shortage of trained typists, however, and the fatigue of our present decoding staff, we cannot get all this traffic decoded. This has been the state of affairs since May. Yet all that we need to put matters right is about twenty trained typists.

3. Bombe testing, Hut 6 and Hut 8

In July we were promised that the testing of the 'stories' produced by the bombes would be taken over by the WRNS in the bombe hut and that sufficient WRNS would be provided for this purpose. It is now late in October and nothing has been done. We do not wish to stress this so strongly as the two preceding points, because it has not actually delayed us in delivering the goods. It has, however, meant that staff in Huts 6 and 8 who are needed for other jobs have had to do the testing themselves. We cannot help feeling that with a Service matter of this kind it should have been possible to detail a body of WRNS for this purpose, if sufficiently urgent instructions had been sent to the right quarters.

4. Apart altogether from staff matters, there are a number of other directions in which it seems to us that we have met with unnecessary impediments. It would take too long to set these out in full, and we realise that some of the matters involved are controversial. The cumulative effect, however, has been to drive us to the conviction that the importance of the work is not being impressed with sufficient force upon those outside authorities with whom we have to deal.

We have written this letter entirely on our own initiative. We do not know who or what is responsible for our difficulties, and most emphatically we do not want to be taken as criticising Commander Travis who has all along done his utmost to help us in every possible way. But if we are to do our job as well as it could and should be done it is absolutely vital that our wants, small as they are, should be promptly attended to. We have felt that we should be failing in

our duty if we did not draw your attention to the facts and to the effects which they are having and must continue to have on our work, unless immediate action is taken.

We are, Sir, Your obedient servants,
A M Turing
W G Welchman
C H O'D Alexander
P S Milner-Barry

Alan Turing's letter to Churchill

The Turing Bombe Rebuild Project, Bletchley Park Museum

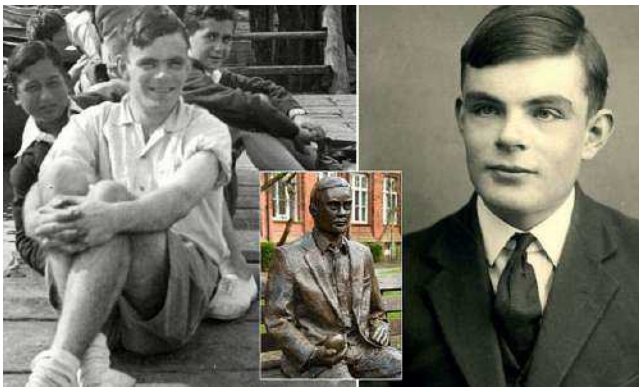
Alan Turing's belongings from school and university days

Turing was injected with Stilboestrol − a synthesised form of oestrogen

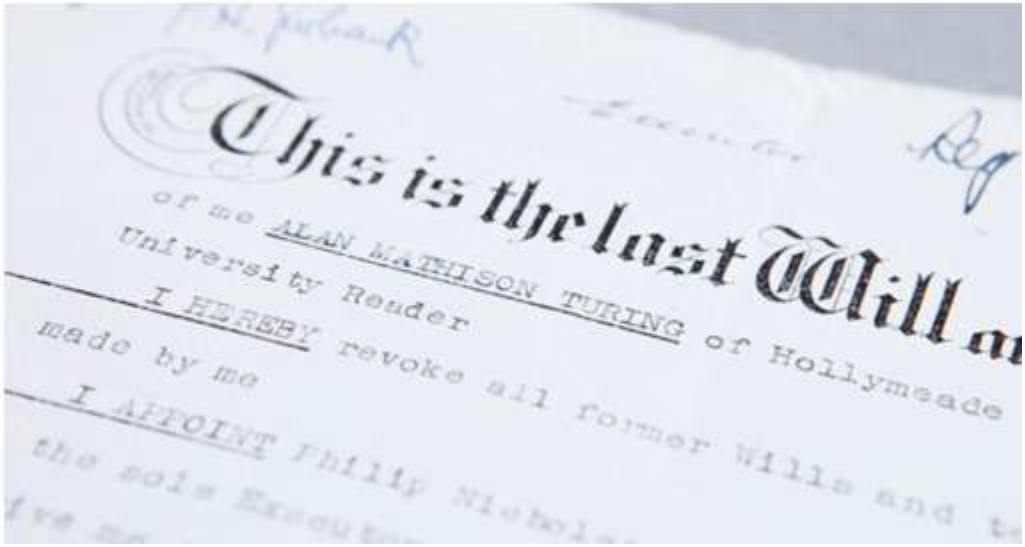
The Turing residence at 22 Ennismore Avenue, Guildford

Bletchley Park : Mansion : Turing's Blade

Alan Turing monument in Sackville Gardens



Alan Turing has been crowned the greatest person of the 20th Century by BBC viewers

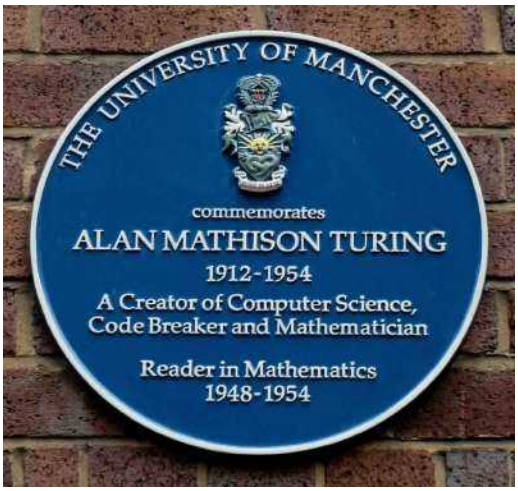


The will of Alan Turing

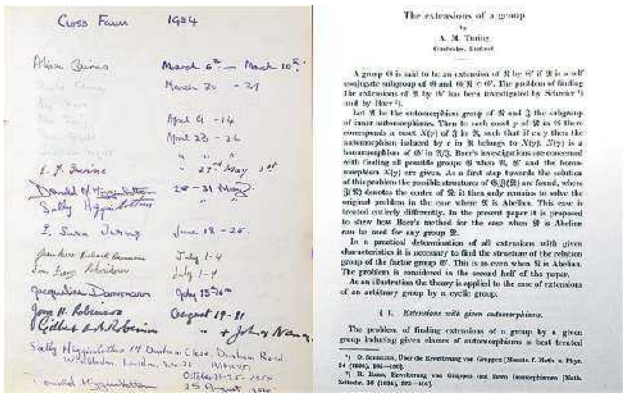
Letter written by Turing on solitaire

Ethel Sara Turing

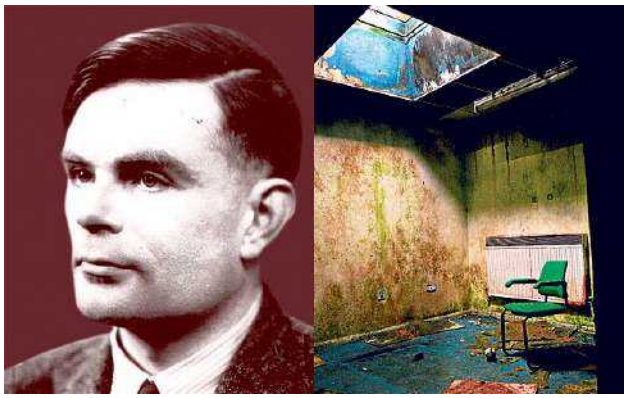
Ethel Sara Turing (nee Stoney) in her old age. She died in 1976 aged 95



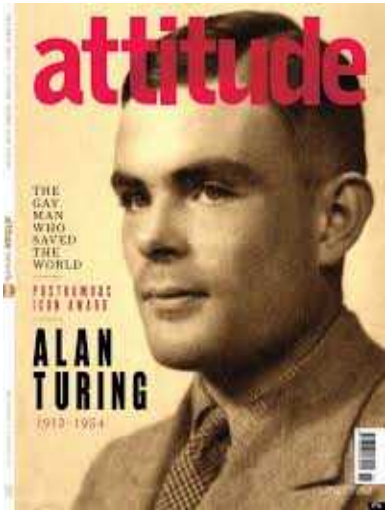
CRG researchers confirm that a mathematical theory first proposed by Alan Turing in 1952 can explain the formation of fingers

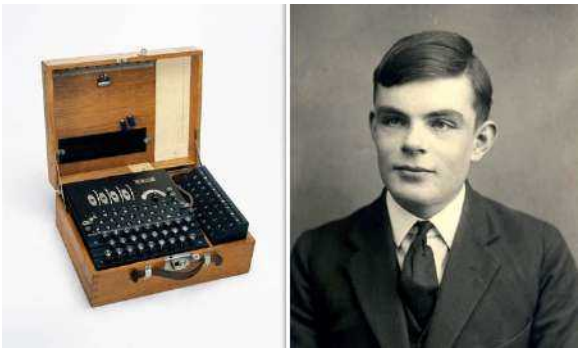


Alan Turing's secret papers

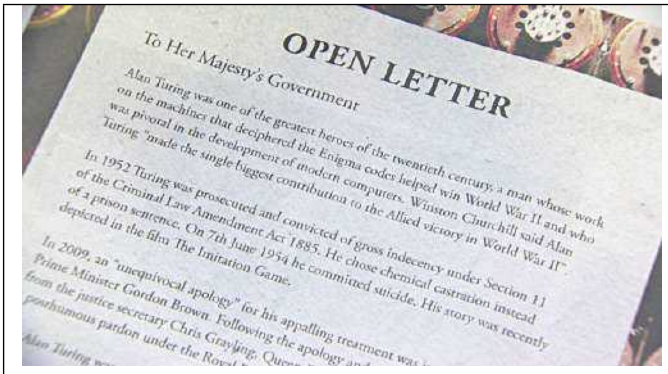


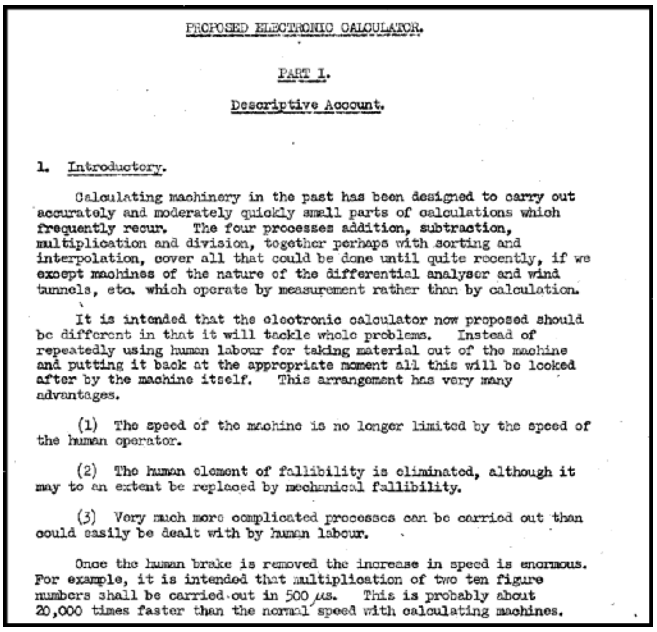
Alan Turing, who worked at Bletchley Park breaking codes. Plans are now afoot to restore Block C





Turing was prosecuted in 1952 for homosexual acts, when such behavior was still criminalized in the UK. He accepted treatment with oestrogen injections (chemical castration) as an alternative to prison. Turing died in 1954, 16 days before his 42nd birthday, from cyanide poisoning.

	Open letter asking the government to pardon 49,000 men who were prosecuted for being gay



PROPOSED ELECTRONIC CALCULATOR.

PART I.

Descriptive Account.

1. Introductory.

Calculating machinery in the past has been designed to carry out accurately and moderately quickly small parts of calculations which frequently recur. The four processes addition, subtraction, multiplication and division, together perhaps with sorting and interpolation, cover all that could be done until quite recently, if we except machines of the nature of the differential analyser and wind tunnels, etc. which operate by measurement rather than by calculation.

It is intended that the electronic calculator now proposed should be different in that it will tackle whole problems. Instead of repeatedly using human labour for taking material out of the machine and putting it back at the appropriate moment all this will be looked after by the machine itself. This arrangement has very many advantages.

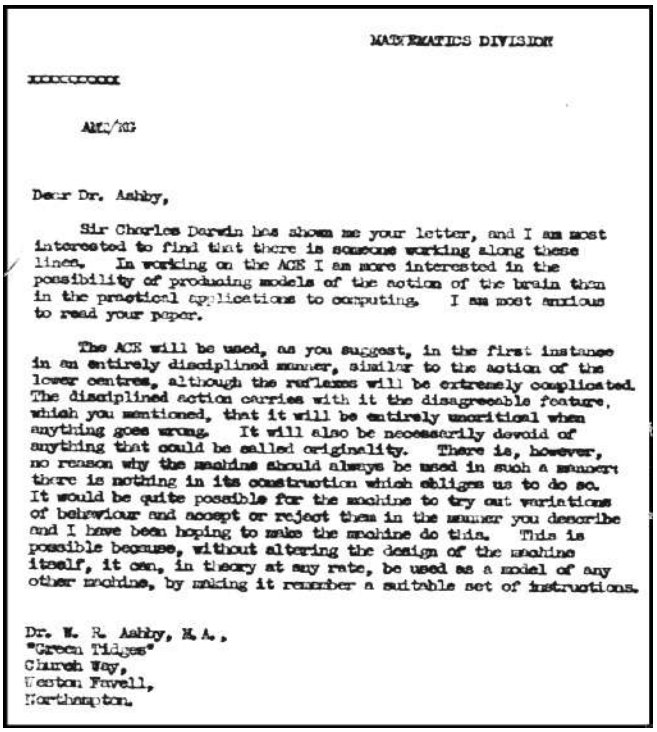
(1) The speed of the machine is no longer limited by the speed of the human operator.

(2) The human element of fallibility is eliminated, although it may to an extent be replaced by mechanical fallibility.

(3) Very much more complicated processes can be carried out than could easily be dealt with by human labour.

Once the human brake is removed the increase in speed is enormous. For example, it is intended that multiplication of two ten figure numbers shall be carried out in 500 μs. This is probably about 20,000 times faster than the normal speed with calculating machines.

Original manuscript of "Proposed Electronic Calculator," which was to become the Automatic Computing Engine (ACE)



MATHEMATICS DIVISION

XXXXXXXXX

AMT/MG

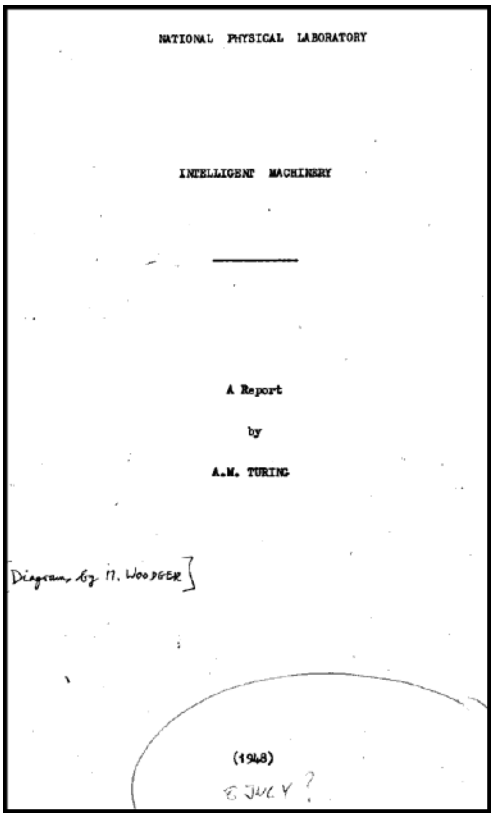
Dear Dr. Ashby,

Sir Charles Darwin has shown me your letter, and I am most interested to find that there is someone working along these lines. In working on the ACE I am more interested in the possibility of producing models of the action of the brain than in the practical applications to computing. I am most anxious to read your paper.

The ACE will be used, as you suggest, in the first instance in an entirely disciplined manner, similar to the action of the lower centres, although the reflexes will be extremely complicated. The disciplined action carries with it the disagreeable feature, which you mentioned, that it will be entirely uncritical when anything goes wrong. It will also be necessarily devoid of anything that could be called originality. There is, however, no reason why the machine should always be used in such a manner: there is nothing in its construction which obliges us to do so. It would be quite possible for the machine to try out variations of behaviour and accept or reject them in the manner you describe and I have been hoping to make the machine do this. This is possible because, without altering the design of the machine itself, it can, in theory at any rate, be used as a model of any other machine, by making it remember a suitable set of instructions.

Dr. W. R. Ashby, M.A.,
"Green Tidges"
Church Way,
Weston Favell,
Northampton.

Letter from Turing to Sir W. Ross Ashby, describing how ACE could be used to mimic how the human brain works



NATIONAL PHYSICAL LABORATORY

INTELLIGENT MACHINERY

A Report

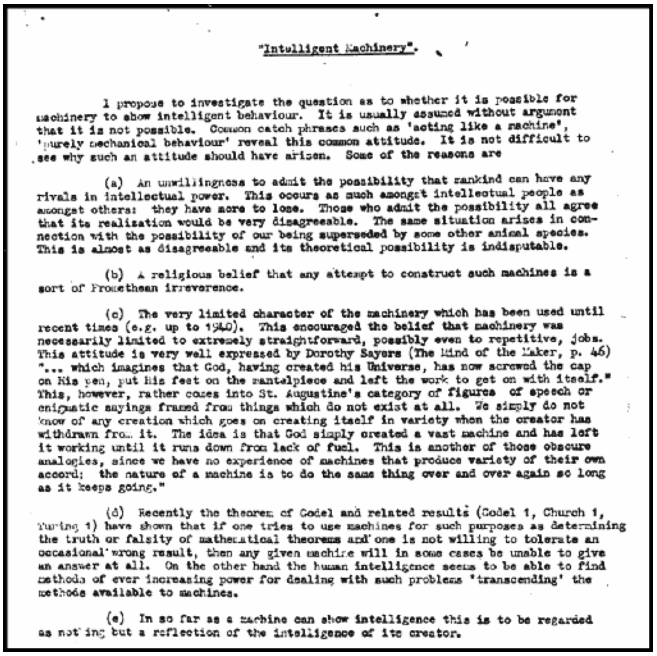
by

A.M. TURING

Diagram by M. Woodger

(1948)

E. JUDY ?



"Intelligent Machinery".

I propose to investigate the question as to whether it is possible for machinery to show intelligent behaviour. It is usually assumed without argument that it is not possible. Common catch phrases such as 'acting like a machine', 'purely mechanical behaviour' reveal this common attitude. It is not difficult to see why such an attitude should have arisen. Some of the reasons are

(a) An unwillingness to admit the possibility that mankind can have any rivals in intellectual power. This occurs as much amongst intellectual people as amongst others: they have more to lose. Those who admit the possibility all agree that its realization would be very disagreeable. The same situation arises in connection with the possibility of our being superseded by some other animal species. This is almost as disagreeable and its theoretical possibility is indisputable.

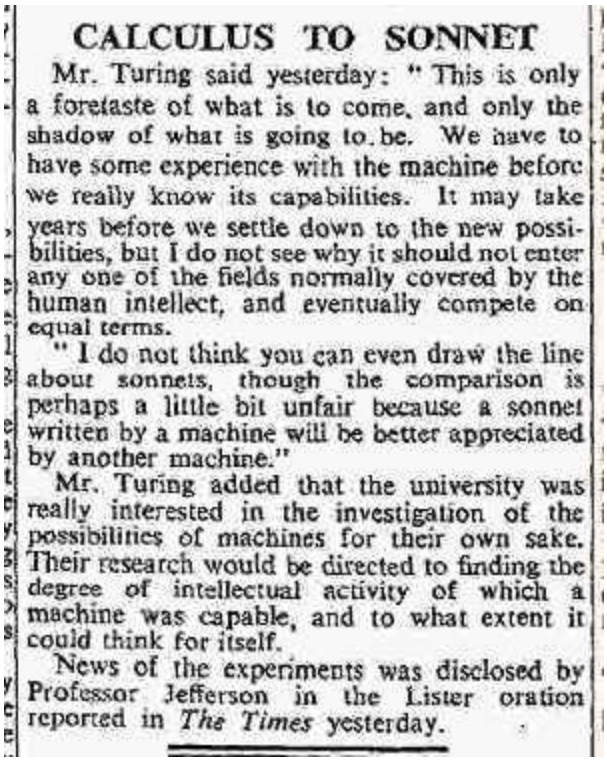
(b) A religious belief that any attempt to construct such machines is a sort of Promethean irreverence.

(c) The very limited character of the machinery which has been used until recent times (e.g. up to 1940). This encouraged the belief that machinery was necessarily limited to extremely straightforward, possibly even to repetitive, jobs. This attitude is very well expressed by Dorothy Sayers (The Mind of the Maker, p. 46) "... which imagines that God, having created his Universe, has now screwed the cap on His pen, put His feet on the mantelpiece and left the work to get on with itself." This, however, rather comes into St. Augustine's category of figures of speech or enigmatic sayings framed from things which do not exist at all. We simply do not know of any creation which goes on creating itself in variety when the creator has withdrawn from it. The idea is that God simply created a vast machine and has left it working until it runs down from lack of fuel. This is another of those obscure analogies, since we have no experience of machines that produce variety of their own accord; the nature of a machine is to do the same thing over and over again so long as it keeps going."

(d) Recently the theorem of Godel and related results (Godel 1, Church 1, Turing 1) have shown that if one tries to use machines for such purposes as determining the truth or falsity of mathematical theorems and one is not willing to tolerate an occasional wrong result, then any given machine will in some cases be unable to give an answer at all. On the other hand the human intelligence seems to be able to find methods of ever increasing power for dealing with such problems 'transcending' the methods available to machines.

(e) In so far as a machine can show intelligence this is to be regarded as nothing but a reflection of the intelligence of its creator.

A report written by Turing in 1948 titled "Intelligent Machinery" is the most detailed treating of artificial intelligence written before 1950. It was not published during Turing's lifetime



CALCULUS TO SONNET

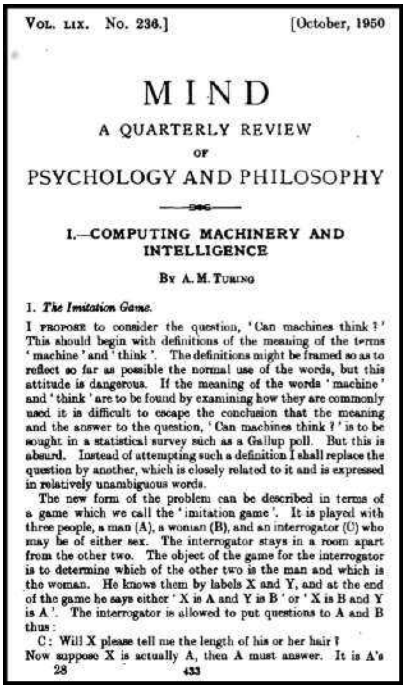
Mr. Turing said yesterday: " This is only a foretaste of what is to come, and only the shadow of what is going to be. We have to have some experience with the machine before we really know its capabilities. It may take years before we settle down to the new possibilities, but I do not see why it should not enter any one of the fields normally covered by the human intellect, and eventually compete on equal terms.

" I do not think you can even draw the line about sonnets, though the comparison is perhaps a little bit unfair because a sonnet written by a machine will be better appreciated by another machine."

Mr. Turing added that the university was really interested in the investigation of the possibilities of machines for their own sake. Their research would be directed to finding the degree of intellectual activity of which a machine was capable, and to what extent it could think for itself.

News of the experiments was disclosed by Professor Jefferson in the Lister oration reported in *The Times* yesterday.

Alan Turing quoted in 11 June 1949 edition of "The Times" (UK)



VOL. LIX. No. 236.] [October, 1950

MIND

A QUARTERLY REVIEW

OF

PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND INTELLIGENCE

BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

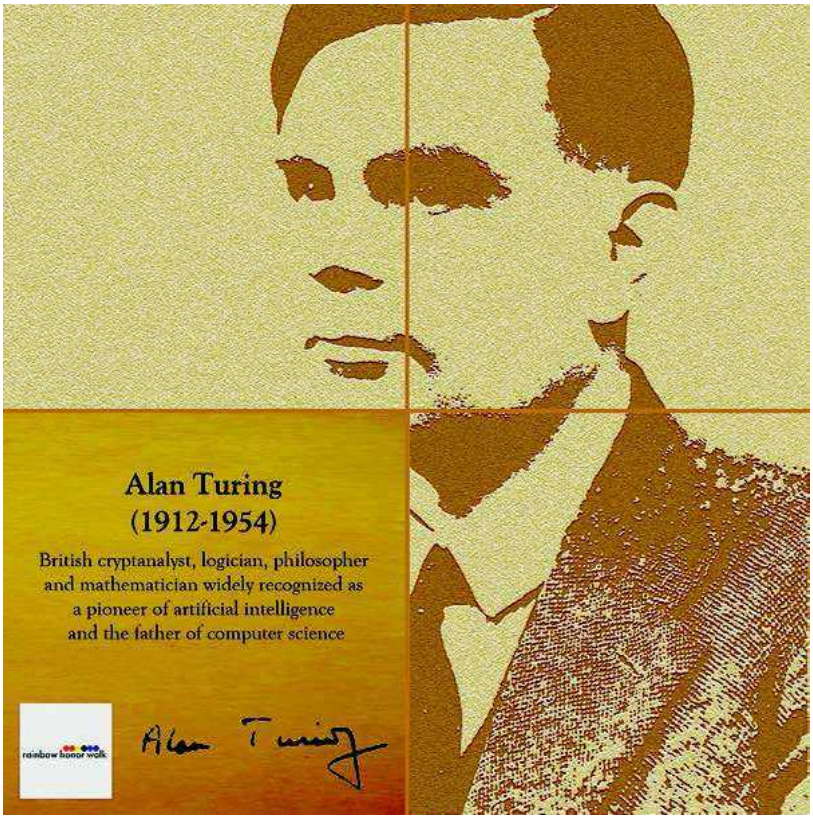
The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either 'X is A and Y is B' or 'X is B and Y is A'. The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?

Now suppose X is actually A, then A must answer. It is A's

First page of Turing's 1950 article "Computing Machinery and Intelligence," where the now famous "Turing Test" was introduced


ALAN TURING


Alan Turing
(1912-1954)
British cryptanalyst, logician, philosopher
and mathematician widely recognized as
a pioneer of artificial intelligence
and the father of computer science
rainbow honor walk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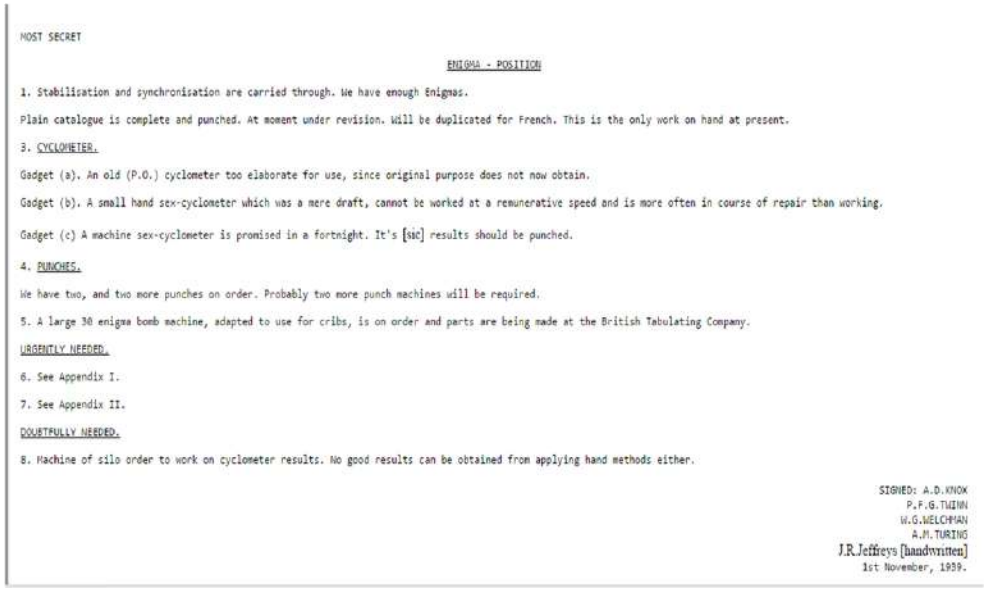
2009: APOLOGY

In August 2009, petition started urging the British Government to posthumously apologize to Alan Turing for prosecuting him as a homosexual. The petition received thousands of signatures. Prime Minister Gordon Brown acknowledged the petition, releasing a statement on 10 September 2009 apologizing and describing Turing's treatment as "appalling":

"Thousands of people have come together to demand justice for Alan Turing and recognition of the appalling way he was treated. While Turing was dealt with under the law of the time and we can't put the clock back, his treatment was of course utterly unfair and I am pleased to have the chance to say how deeply sorry I and we all are for what happened to him ...*

So on behalf of the British government, and all those who live freely thanks to Alan's work I am very proud to say: we're sorry, you deserved so much better."

In August 2009, petition started urging the British Government to posthumously apologize to Alan Turing for prosecuting him as a homosexual



MOST SECRET

ENIGMA - POSITION

1. Stabilisation and synchronisation are carried through. We have enough Enigmas.

Plain catalogue is complete and punched. At moment under revision. Will be duplicated for French. This is the only work on hand at present.

3. CYCLOMETER.

Gadget (a). An old (P.O.) cyclometer too elaborate for use, since original purpose does not now obtain.

Gadget (b). A small hand sex-cyclometer which was a mere draft, cannot be worked at a remunerative speed and is more often in course of repair than working.

Gadget (c) A machine sex-cyclometer is promised in a fortnight. It's [sic] results should be punched.

4. PUNCHES.

We have two, and two more punches on order. Probably two more punch machines will be required.

5. A large 30 enigma bomb machine, adapted to use for cribs, is on order and parts are being made at the British Tabulating Company.

URGENTLY NEEDED.

6. See Appendix I.

7. See Appendix II.

DOUBTFULLY NEEDED.

8. Machine of silo order to work on cyclometer results. No good results can be obtained from applying hand methods either.

SIGNED: A.D.KNOX
P.F.G.TWINN
W.G.WELCHMAN
A.M.TURING
J.R.Jeffreys [handwritten]
1st November, 1939.

1st November, 1939.

APPENDIX II

NAVAL ENIGMA SITUATION

The solution of Naval Enigma will divide itself into two parts, that of solving one message of a day, and that of solving further messages.

The first problem is to be tackled by:

(a). Analytical methods, using Jeffrey's statistics (virtually hopeless).

(b). By the machine now being made at Letchworth, resembling, but far larger than the Bombe of the Poles (superbombe machine).

If one message is solved by one of these means we shall have the machine settings for the day, viz. Walzenlage, Steckerverbindungen, Ringstellung, but not Grundstellung nor list of bigrams used in the indicating system. We might also obtain the Stecker by capture.

For the second problem; i.e. solving further messages, we may either:

(i) Guess three or four letters of the message.

(ii) Make use of another machine, the "rack", which operates by so setting the messages that the decode contains sufficiently many letters E.

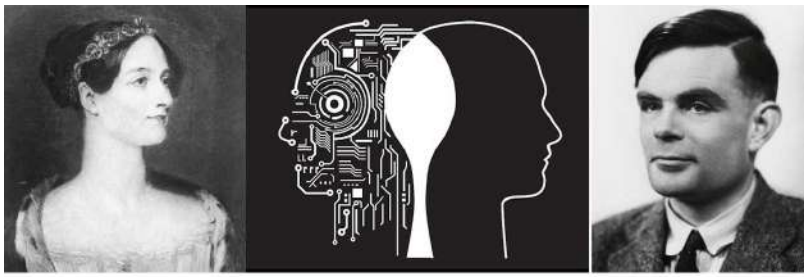
We have at present no information which will be of use for Method (i), although when a number of messages have been solved it may be applicable. Without a "rack" we shall, therefore, not be able to get any further if, for instance, position Stecker were captured from a submarine.

With the "rack" we shall, in such cases, almost certainly be able to solve 40% of the messages, and probably 70%. If by that time we are able to apply Method (i) as well, we may be able to solve as many as 200 messages on that day. If this ever happens it will be possible to solve the indicating system; i.e. to obtain the bigram list. This will enable us to solve all further messages for that day at once, and, on later days while the bigram list lasts, to solve all the messages as soon as a single message has been solved for that day.

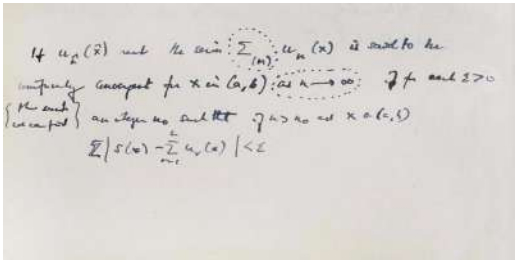
We feel that no unnecessary time should be lost in experimenting with and constructing such a machine.

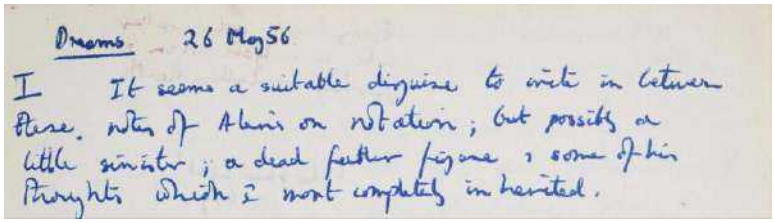
SIGNED: A.D.KNOX
P.F.G.TWINN
W.G.WELCHMAN
A.M.TURING
J R Jeffreys [handwritten]
1st November, 1939.

Enigma Report, 1939, Alan Turing Internet Scrapbook



"Let us return for a moment to Lady Lovelace's objection,
which stated that the machine can only do what we tell it to do."
- Alan Turing

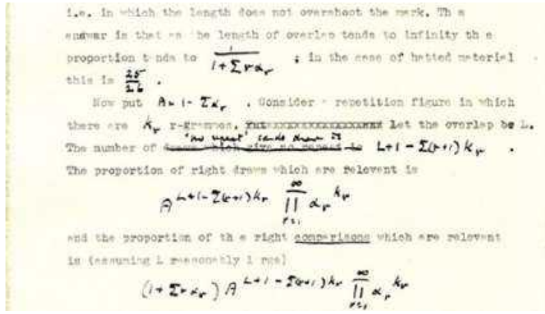




Alan Turing's Hand Scribbled Notebook

A University of Wolverhampton building has been renamed in honour of mathematician and wartime codebreaker Alan Turing

In 2009, the British Government issued this posthumous apology to Alan Turing but he was not pardoned



i.e. in which the length does not overshoot the mark. The answer is that as the length of overlap tends to infinity the proportion tends to $\frac{1}{1+\sum r\alpha_r}$; in the case of batted material this is $\frac{25}{26}$.

Now put $A = 1-\sum\alpha_r$. Consider a repetition figure in which there are k_r r-grammes. ~~xxxxxxxxxxxxxxxxx~~ Let the overlap be L. The number of ~~draws which give no repeat~~ 'no upset' cards drawn is $L+1-\sum(r+1)k_r$.

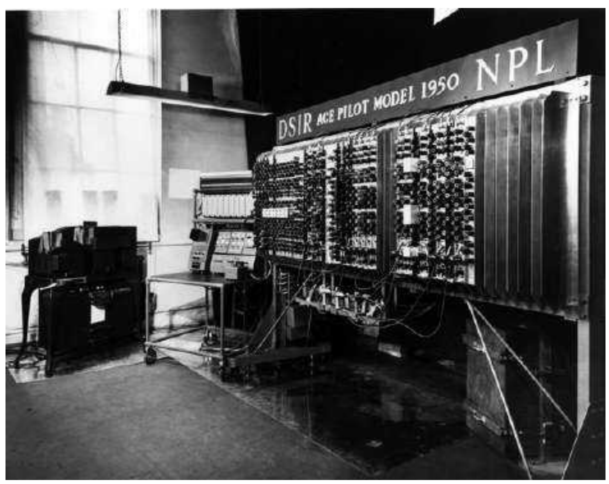
The proportion of right draws which are relevant is

$$A^{L+1-\sum(r+1)k_r}\prod_{r=1}^{\infty}\alpha_r^{k_r}$$

and the proportion of the right comparisons which are relevant is (assuming L reasonably large)

$$(1+\sum r\alpha_r)A^{L+1-\sum(r+1)k_r}\prod_{r=1}^{\infty}\alpha_r^{k_r}$$

Alan Turing's Secret Code-Breaking Essay

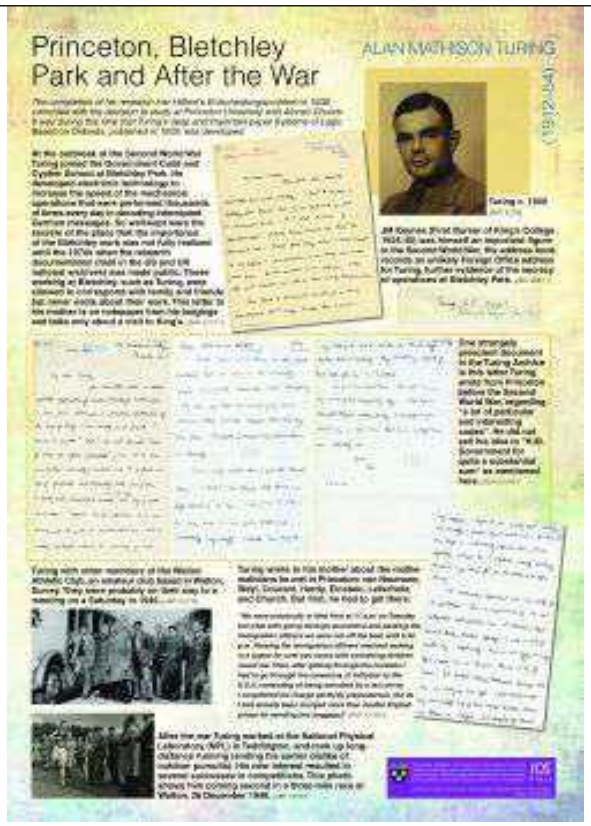


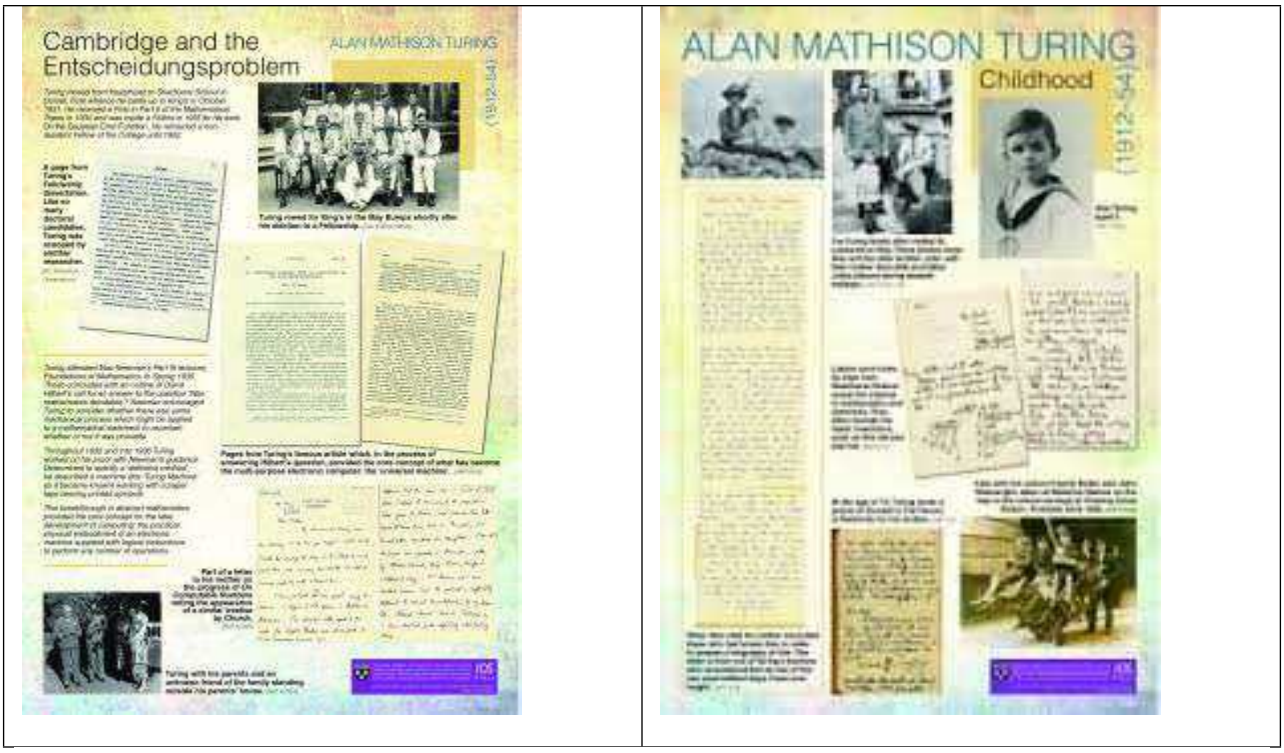
ACE Pilot Model designed by Alan Turing.

"I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted."

– **Alan Turing, Computing machinery and intelligence**


Morphogenesis
ALAN MATHISON TURING
(1912-54)


Princeton, Bletchley Park and After the War
ALAN MATHISON TURING
(1912-54)



The papers of Alan Turing assembled in the Archive Centre at King's College, Cambridge

Benedict Cumberbatch played Alan Turner in the 2014 American film, 'The Imitation Game'

Alan Turing

Mathematician
Logician
Cryptanalyst
Computer scientist
Invented the algorithm
A true human codebreaker
Considered to be the father of computer-science and artificial intelligence
He imagined the whole computer-science as it is today.

Condemned to take female hormones due to his homoseuxality
Died ingesting a letal dose of cianyde, injected to an apple.

Steve Jobs

Sold his products twice as expensive proving that mankind knows no limits to stupidity and pride.

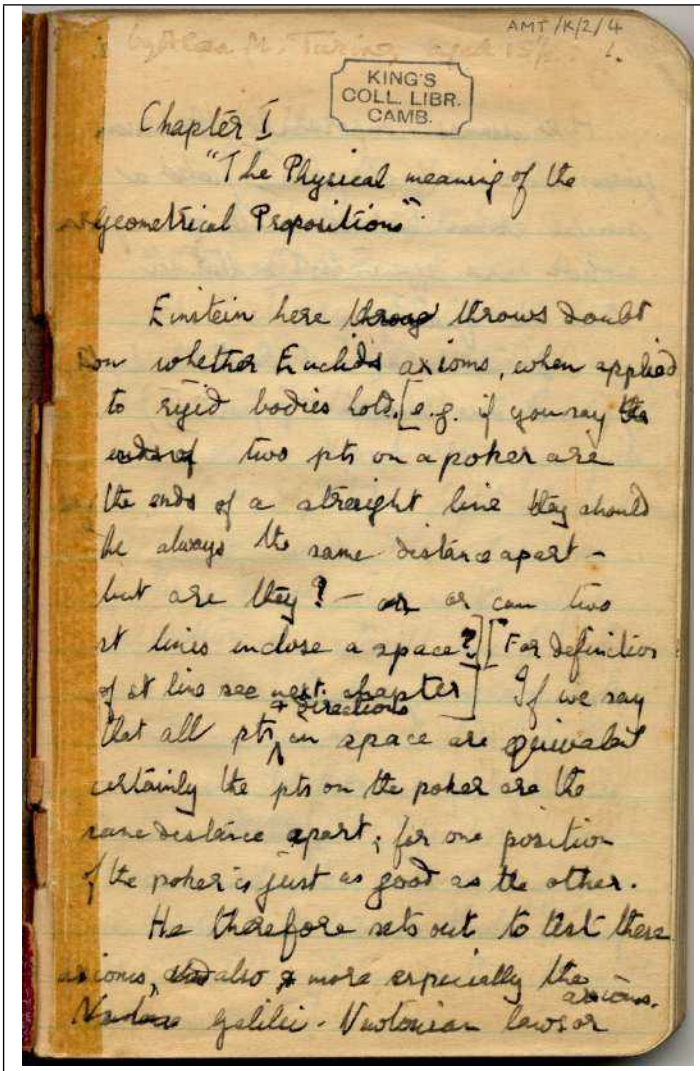
Invented... nothing.

Famous throughout the world.

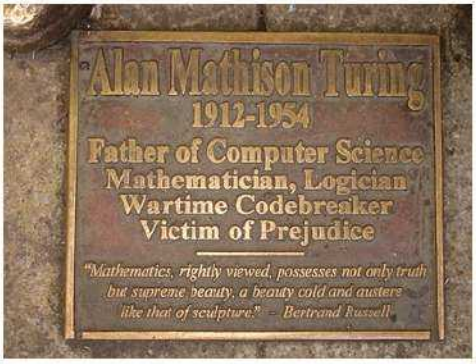
Sir Alan Turing saved around 21 Million lives with his Mathematics.

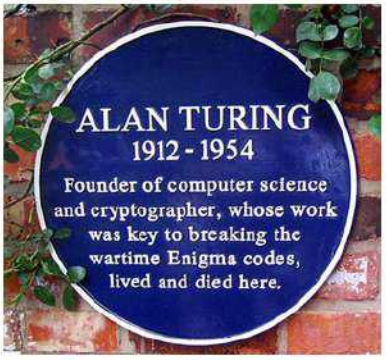

SHERBORNE SCHOOL

Road commemorating Alan Turing on the Research Park, Guildford



First page of Alan Turing's precis of The Theory of Relativity by Albert Einstein


Alan Mathison Turing
1912-1954
Father of Computer Science
Mathematician, Logician
Wartime Codebreaker
Victim of Prejudice
"Mathematics, rightly viewed, possesses not only truth but supreme beauty, a beauty cold and austere like that of sculpture." – Bertrand Russell


ALAN TURING
1912 - 1954
Founder of computer science and cryptographer, whose work was key to breaking the wartime Enigma codes, lived and died here.