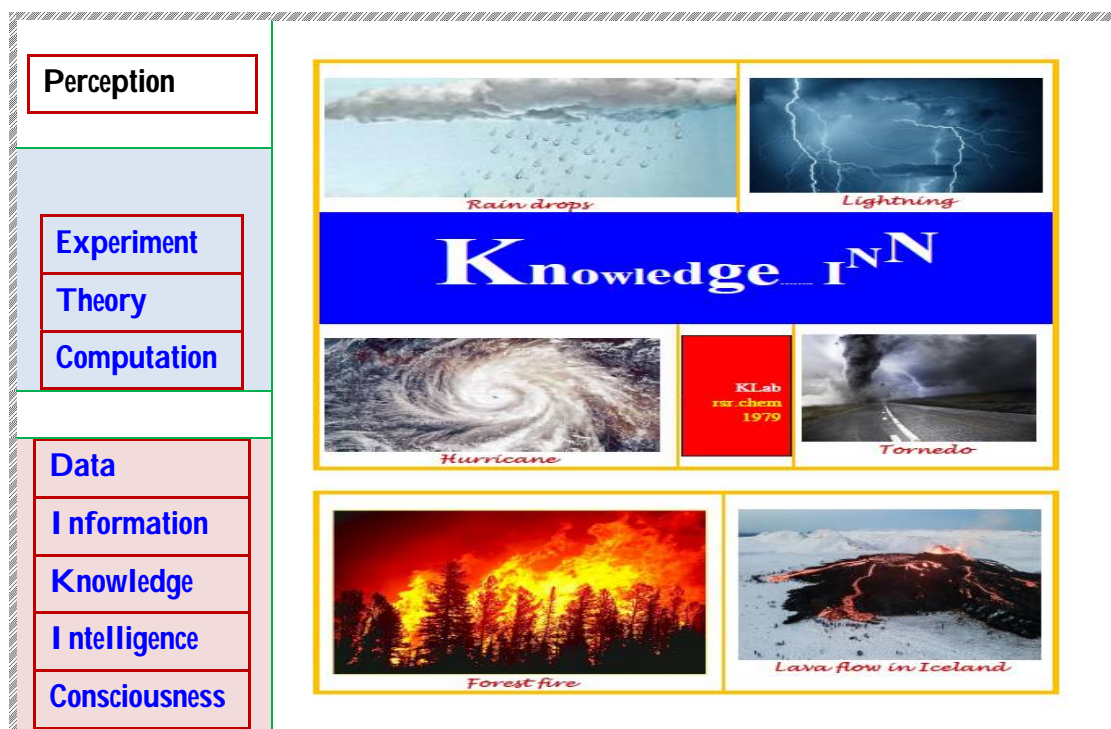




## KInn. Part-24. Professional Profile of Alan Mathison Turing

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**Conspectus:** Alan Mathison Turing (1912-1954) was one of the leading figures in Twentieth-century science. What is surprising about his (published and unpublished) papers are that although they were written decades ago, still address major tasks which concern researchers today. The sparkling ideas of Turing in diverse disciplines of science-technology still hover in the minds of experts of this decade in their ground breaking pursuits. He is referred as a genius in discussions about computer architecture, software engineering, nature of Artificial Intelligence, pure mathematics, mathematical logic and morphogenesis in plants

**Birth:** Alan (Mathison) Turing was born in Paddington, London in the year 1912 to British parents. Along with his elder brother, Alan was brought up till 1926 in foster homes as his father was deployed to Madras Presidency, India.

**Childhood:** The strict disciplinary attitude of British homes in that era deprived free expression and encouragement/appreciation for originality/discovery. At high school itself, teachers noticed and complained the signs of above average intelligence in Turing and his excessive focus on science and mathematics compared to classics. The impact of the book "Natural Wonders Every Child Should Know" was astounding on his mindset. A distinct mode of thinking/integration was a hidden driving firmware in his motivations as well as solution processes in a direction generally not persuaded by many of that order of intellect. That may be one reason why Turing (1912-1953) is a genius of his unique type and contributed in multiple disciplines within two decades of his academic and professional career.

**Educational profile:** Turing was elected for King's college fellowship (1931-34) and Smith's prize (1935). He was conferred with a distinguished degree. The paper on computable numbers ("Turing machines") was a mind-blowing contribution. This seminal paper was recommended for publication by Alonzo Church, American mathematical logician. Turing and Church independently proved the result and of course with different methods. It could also draw attention of Hungarian-American mathematician John von Neumann. During 1936-38, Turing went to Princeton Univ, USA to study mathematical logic and obtained in record time a Ph.D. degree under directorship of Dr Church. Alan did not accept a temporary lecturer post offered by Neumann at Princeton. He came back to Cambridge and lived on his King's College fellowship, as logician and number theorist.

**Employment:**

**Defence:** Dr Turing started working for the Government Code and Cypher School on a part-time basis. When the world war (WWII) broke, he joined wartime headquarters at Bletchley Park, Buckinghamshire as a cryptanalyst. Turing implemented the first systematic method to break messages encrypted by the sophisticated German cipher machine. In 1940, "Bombe", first electromechanical machine of Alan Turing that was installed.

**NPL-London:** Turing was recruited in 1945 to the National Physical Laboratory (NPL) in London. His job was to create an electronic computer.

**Academic position:** Dr Turing joined for an academic role Manchester univ. in 1953. The readership in the theory of computing was specially created for him.

**Awards and honours:** At the end of the war (WWII) in 1945, Turing was made an Officer of the Most Excellent OBE (Order of the British Empire) for his ingenious code-breaking approaches. It is not known to the civilian public for several years because of the British Official Secrets Act, which prevented discussion of the wartime work outside defence premises. ACM's (Association for Computing Machinery's) prestigious Mathematics annual Award (since 1966) was named after Alan Turing. He is named as one of the 100 Most Important People of the 20th Century by Time Magazine. On 23<sup>rd</sup> June 2021, a new £50 note was issued by with Alan Turing figure by Bank of England.

**Keywords:** Mathematics; Cryptography; Morphogenesis, Computer Science; Artificial Intelligence;

## Graphical Abstract



- 📖 New £50 note, featuring the scientist Alan Turing, issued on 23 June 2021
  - ✓ Contains advanced security features
  - ✓ Two windows and a two-colour foil, making it very difficult to counterfeit

<https://youtu.be/UbGcN007Aq8?t=33>

New Alan Turing £50 banknote enters circulation (UK)  
- BBC News - 23rd June 2021 (2.3 min)

**Parents and birth place:** Alan (Mathison) Turing was born on 23<sup>rd</sup> June, 1912, in a nursing home in Paddington, London, England. His father was Julius who had been in the Indian Civil Service, serving in the Madras Presidency. Alan's mother was Ethel Sara Stoney, the daughter of the chief engineer of the Madras railways, who came from an Anglo-Irish family.

**Childhood:** Alan Turing and his elder brother John were fostered in various English homes until their father's retirement from India in 1926. The menace of the brought up was that there was no encouragement of expression, originality, or discovery during formative years.

**Family life:** Turing was engaged to Joan Clarke; but the deal was broken. Thus, Alan remained unmarried all through his life.

**Death:** Alan was found dead in his bed on June 7, 1954, Wilmslow, Cheshire. It might be an accident of inhaling cyanide fumes from an experiment in the tiny laboratory adjoining his bedroom. This occurred during a period he was amidst carrying out the groundbreaking work.

**Inspiration:** The popular book entitled "*Natural Wonders Every Child Should Know*" had seminal influence on his mindset. The extra-curricular passion for him was Science and its expressions sparked in primitive chemistry experiments. The uniqueness of his mind, was also a hidden factor in driving his pursuits and solution processes in a direction none could have foreseen.

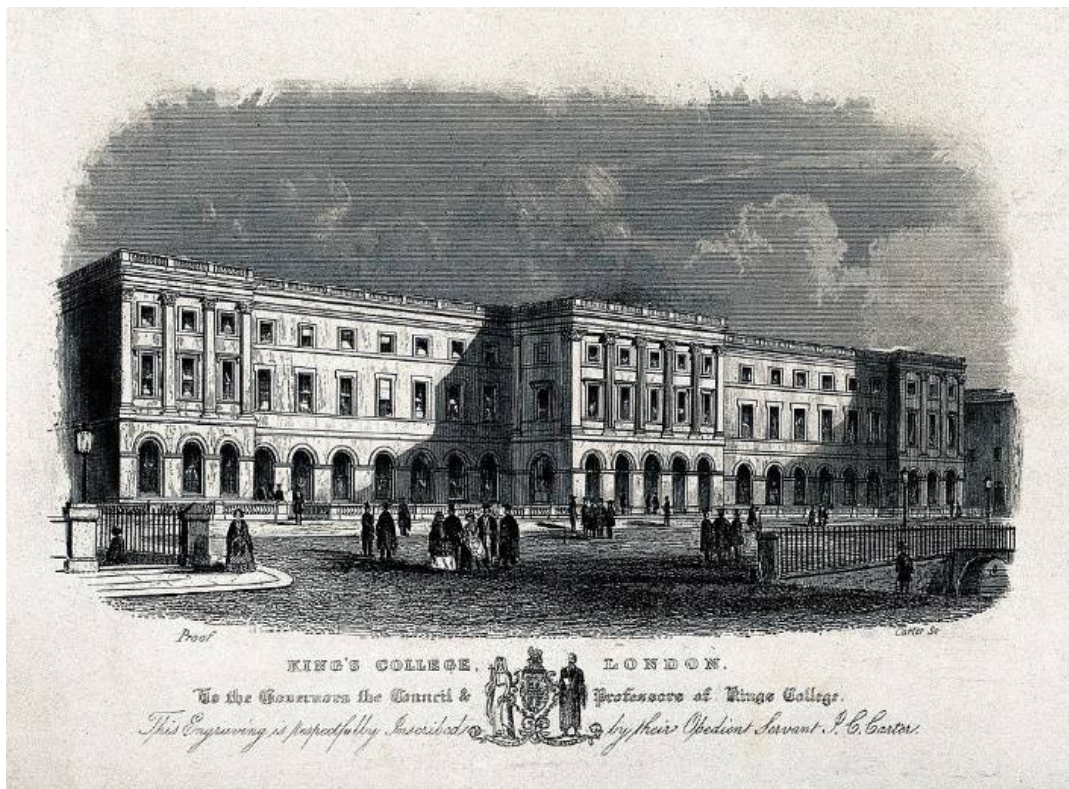


## Academic profile of Alan Turing

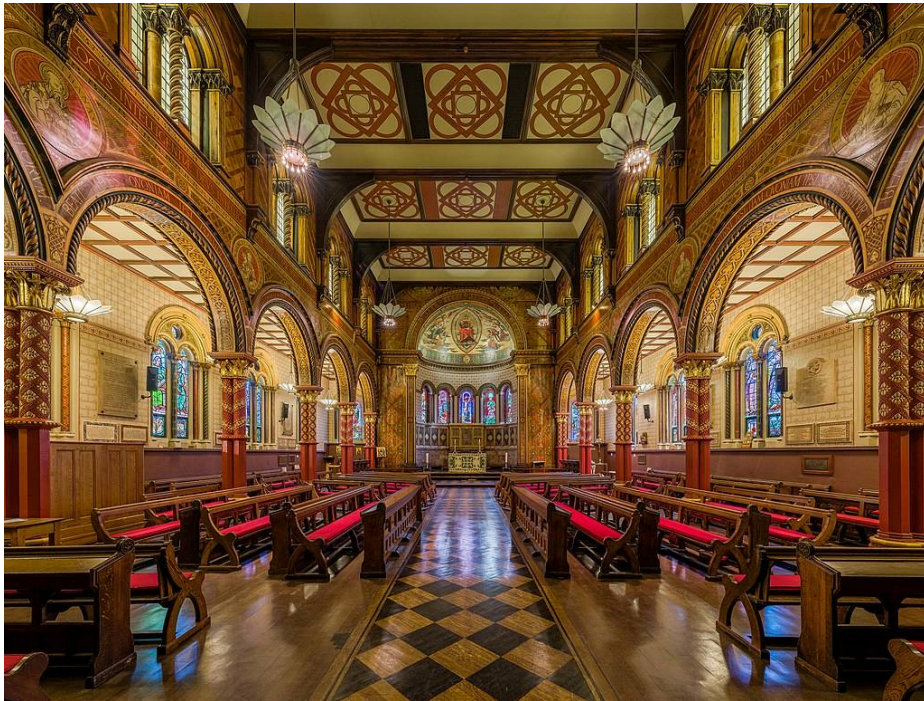
1918	St. Michael's school	! Turing began to show signs of above average intelligence
1926	Sherborne School Dorset, England	! Teachers criticized that Turing was focusing too much on learning mathematics and science ! Not spending enough time on the study of important classics
1928	Read Albert Einstein's work	! Figured out that Einstein was questioning Isaac Newton's laws of motion. ☞ But Einstein did not explicitly say so in his text

## Academic profile of Alan Turing

1931- 1934	A distinguished degree	King's College, University of Cambridge mathematics study
	Elected to a fellowship at King's College	In recognition of his research in probability theory (Dissertation on the central limit theorem)
1935	Smith's Prize in Fellowship of King's College	King's College



**King's College London in 1831, as engraved by J. C. Carter**



**King's College London Chapel on the Strand Campus**



**The Maughan Library courtyard**



**The Round Reading Room at the Maughan Library**



## Doctoral Research of Alan Turing

1936-1938	Doctoral study
Thesis	Systems of Logic Based on Ordinals (1938)
Doctoral advisor	Alonzo Church Institute for Advanced Study Princeton University, New Jersey
1938	Ph. D

## Published Research of Alan Turing

Church-Turing thesis	<ul style="list-style-type: none"> <li>✓ That everything humanly computable can also be computed by the universal Turing machine</li> <li>✓ Extension of his ideas (Ordinal Logics) lead to Ph.D. thesis</li> </ul>
On Computable Numbers, with an Application to the Entscheidungs [Decision Problem]	<ul style="list-style-type: none"> <li>☞ In 1936, proved that machines (ie. "Turing machines") were capable of any mathematical computation if the computations could be presented as algorithms</li> <li>☞ This seminal paper was recommended for publication by Alonzo Church, American mathematician             <ul style="list-style-type: none"> <li>! Church himself just then published a paper that reached the same conclusion as Turing's, although by a different method</li> </ul> </li> <li>+ The idea had come to the attention of the leading Hungarian-American mathematician John von Neumann</li> </ul>

Summer of 1938	<ul style="list-style-type: none"> <li>☞ Post-doctoral research             <ul style="list-style-type: none"> <li>○ Having returned from the United States to his fellowship at King's College</li> </ul> </li> </ul>
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## Employment of Alan Turing

1938-1939	<ul style="list-style-type: none"> <li>☞ In 1938 Turing was offered a temporary post at Princeton by von Neumann</li> <li>☞ But instead, he returned to Cambridge and             <ul style="list-style-type: none"> <li>○ Lived on his King's College fellowship, as logician and number theorist</li> <li>○ He had no University lectureship</li> </ul> </li> </ul>
Sep 1938-	He began working for the Government Code and Cypher School on a part-time basis starting from Sep 1938

1939	<ul style="list-style-type: none"> <li>☞ Joined the Government Code and Cypher School</li> <li>☞ At the outbreak of war with Germany in September 1939, he moved and reported to organization's wartime headquarters at Bletchley Park, Buckinghamshire on 4 Sep 1939</li> </ul>
1939-autumn and spring of 1940	<ul style="list-style-type: none"> <li>▪ Turing and others designed a related, but very different, code-breaking machine known as the Bombe. <ul style="list-style-type: none"> <li>○ For the rest of the war, Bombes supplied the Allies with large quantities of military intelligence.</li> </ul> </li> </ul>
18 Mar 1940	<ul style="list-style-type: none"> <li>+ "Bombe", Alan Turing's first electromechanical machine was installed</li> </ul>
6 Sep 1941	<ul style="list-style-type: none"> <li>+ Alan Turing met British Prime Minister Winston Churchill during Churchill's visit at the Government Code and Cypher School at Bletchley Park in Milton Keynes, Buckinghamshire, England, United Kingdom.</li> </ul>

1942	<ul style="list-style-type: none"> <li>+ Cryptanalysts at Bletchley Park were decoding about 39,000 intercepted messages each month, a figure that rose subsequently to more than 84,000 per month—two messages every minute, day and night</li> </ul>
1942	<ul style="list-style-type: none"> <li>☞ Turing also devised the first systematic method for breaking messages encrypted by the sophisticated German cipher machine that the British called "Tunny."</li> </ul>
Honor	<ul style="list-style-type: none"> <li>! At the end of the war, Turing was made an Officer of the Most Excellent Order of the British Empire (OBE) for his code-breaking work</li> </ul>
1945	<ul style="list-style-type: none"> <li>✓ In 1945, the war was over</li> <li>✓ Turing was recruited to the National Physical Laboratory (NPL) in London to create an electronic computer</li> </ul>
19 Feb 1946	<ul style="list-style-type: none"> <li>✓ Alan Turing presented a paper that revealed his design of a stored-program computer</li> <li>✓ But he was securitized by the British government as it contained too much secret technology developed during WW2.</li> </ul>
1953 May	<ul style="list-style-type: none"> <li>! Was appointed to a specially created readership (Manchester) in the theory of computing</li> </ul>

## Science and Alan Turing

Honor 1951 FRS	Turing was elected as a fellow of the Royal Society (FRS) of London
1951-	Started working on what is now known as artificial life.
1952 -- 1954	<p>Between 1952 and his death in 1954, Turing</p> <ul style="list-style-type: none"> <li>✓ Studied mathematical biology (Chemical Basis of Morphogenesis)</li> <li>✓ Pattern in living organisms-- <ul style="list-style-type: none"> <li>○ Understanding of mathematical patterns such as Fibonacci numbers in plant structures (Fibonacci phyllotaxis)</li> </ul> </li> </ul> <p>📖 Manchester's Ferranti Mark I computer was used to model his hypothesized chemical mechanism for the generation of anatomical structure in animals and plants</p>

## Books of Alan Turing

Alan Turing	The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life Plus the Secrets of Eni	<table border="1" style="margin: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Collected works of Turing</th> </tr> <tr> <th style="color: red;">Volume</th> <th style="color: red;">Title</th> </tr> </thead> <tbody> <tr> <td>I.</td> <td>Mechanical Intelligence</td> </tr> <tr> <td>II.</td> <td>Pure Mathematics</td> </tr> <tr> <td>III.</td> <td>Morphogenesis</td> </tr> <tr> <td>IV.</td> <td>Mathematical Logic</td> </tr> </tbody> </table>	Collected works of Turing		Volume	Title	I.	Mechanical Intelligence	II.	Pure Mathematics	III.	Morphogenesis	IV.	Mathematical Logic
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Alan Turing	Alan Turing's Systems of Logic: The Princeton Thesis													
Alan Turing & Michael Woodger	A. M. Turing's ACE Report of 1946 and Other Papers													

### Awards and recognitions to Alan Turing

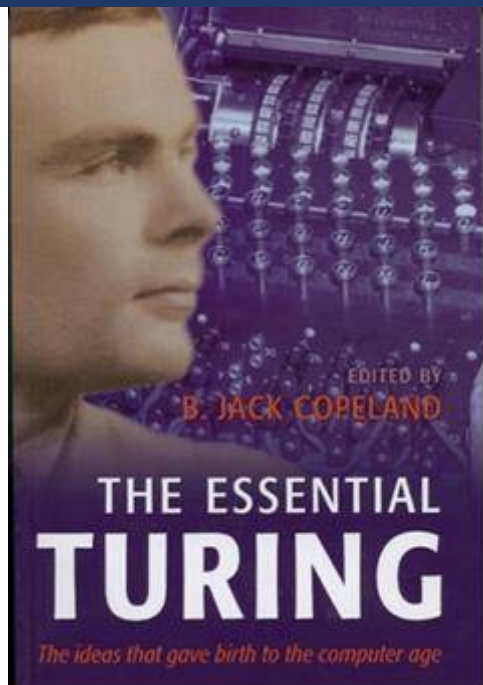
1945	Award for his wartime services
1966	The Association for Computing Machinery's prestigious Award for mathematics was named after Alan Turing, who was said to be the "Father of computer science".
1999	In 1999, he was named one of the 100 Most Important People of the 20th Century by Time Magazine for his involvement in the creation of the modern computer.
23 June 2021	New £50 note, with Alan Turing figure was issued

### Innovations of Alan Turing

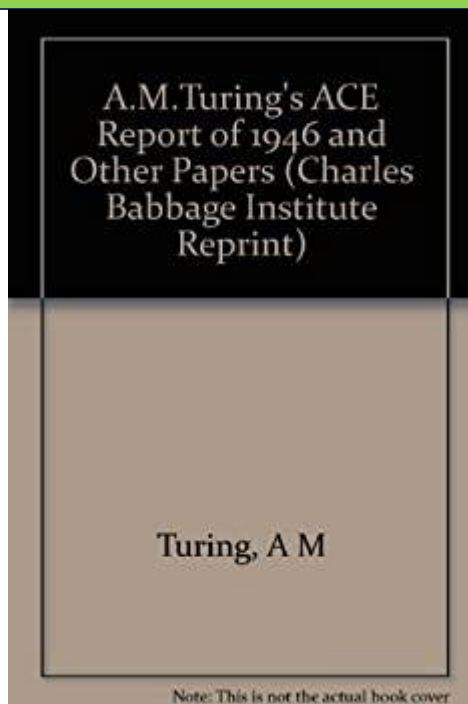
<ul style="list-style-type: none"> <li>✓ Turing test</li> <li>✓ Turing machine (1935)</li> <li>📖 Universal Turing machine</li> <li>✓ Turing's proof</li> <li>✓ Turing pattern</li> <li>✓ Turing reduction</li> </ul>	<p style="color: red;">Cryptanalysis</p> <ul style="list-style-type: none"> <li>○ One of the core team members who built The Bombe -- Decoding the Enigma in 1942</li> <li>○ Key team member which decoded the 'Fish' cipher</li> </ul>
<b>Expertise of Alan Turing</b>	<b>New disciplines</b>
<ul style="list-style-type: none"> <li>✓ Mathematics                             <ul style="list-style-type: none"> <li>➔ Ordinal logics</li> </ul> </li> <li>✓ Philosophy</li> <li>✓ Biology                             <ul style="list-style-type: none"> <li>! Mathematical</li> <li>! Theoretical</li> </ul> </li> </ul>	<p>Later named</p> <ul style="list-style-type: none"> <li>📖 Computer science</li> <li>📖 Cognitive science</li> <li>📖 Artificial intelligence</li> <li>📖 Artificial life</li> <li>📖 Computer architecture                             <ul style="list-style-type: none"> <li>➔ Designed paper model of world's first digital computer</li> </ul> </li> </ul>



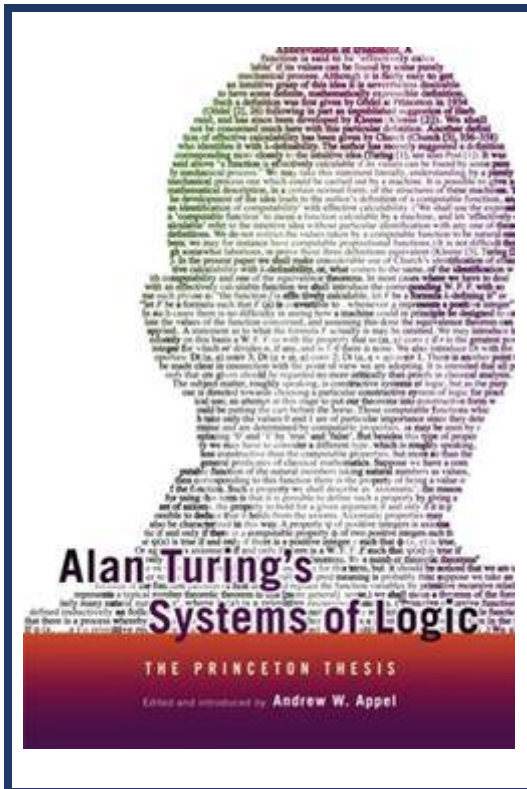
## Appendix



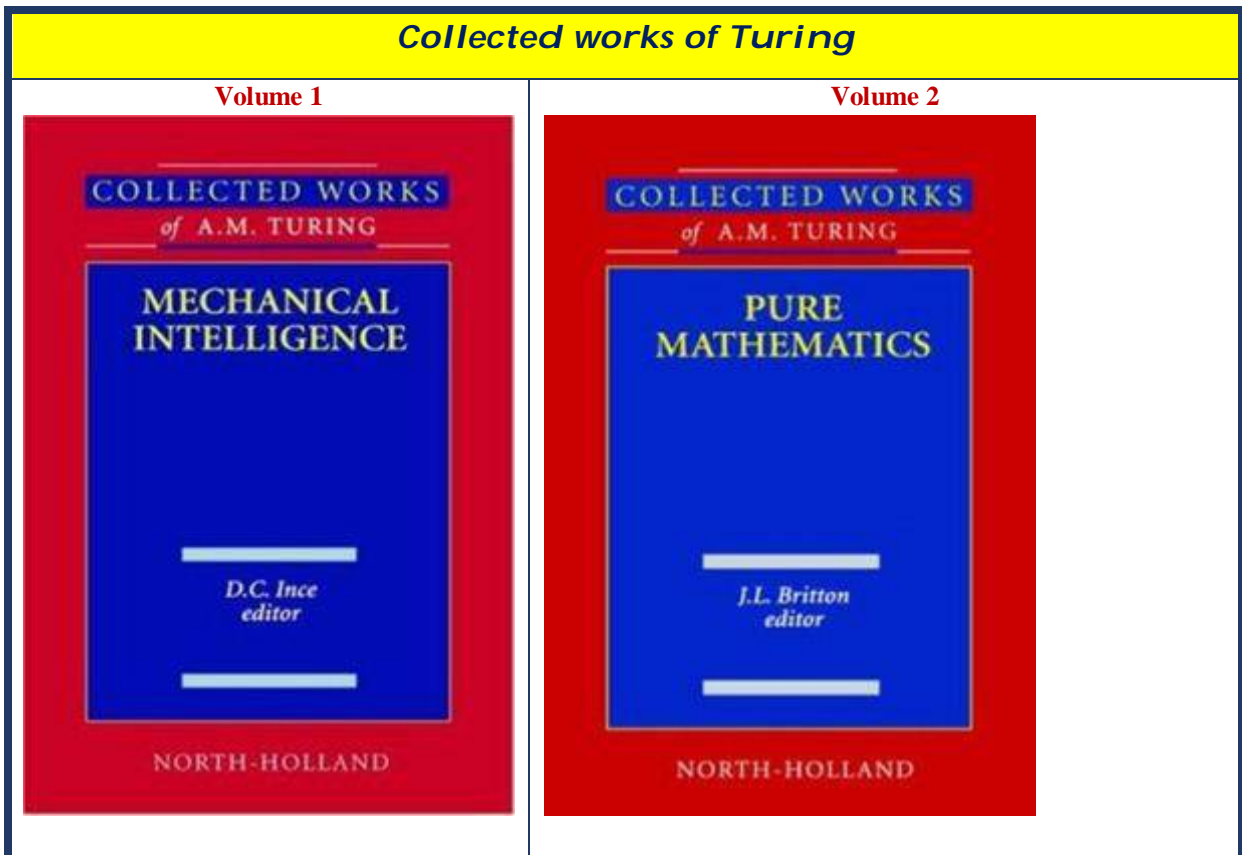
- ✓ Key writings of Turing are made available to a broad, non-specialist readership
- ✓ Introduction by leading Turing expert Jack Copeland provides the background of work. Also guides the reader through the selection of contents
- ✓ Contemporary computational theory, cognitive science, artificial intelligence, and artificial life all spring from this ground-breaking work



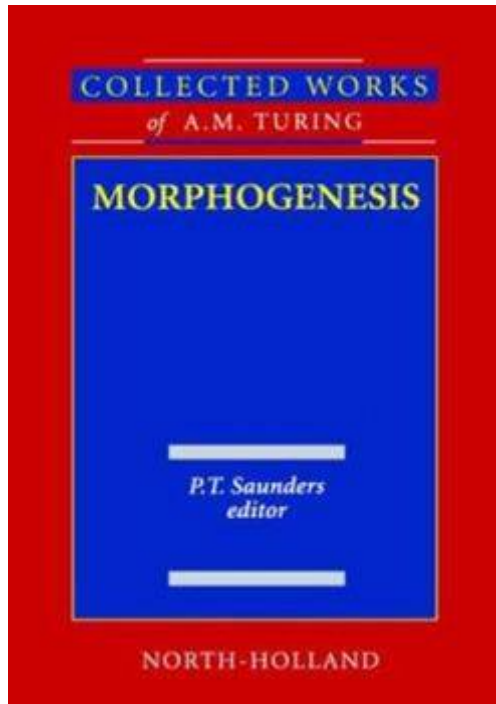
- Volume 10 in the Babbage Reprint Series contains →
- Seminal paper detailing the design for an electronic universal machine called the Automatic Computing Engine (ACE),
  - Turing's Lecture to the London Mathematical Society (1947) amplifying the ideas outlined in the ACE report
  - Turing's report was the first time that the notion of artificial intelligence was discussed as a real possibility. Turing went on to devote the next decade to AI



- 📖 A facsimile of the original typescript of Turing's fascinating and influential 1938 Princeton PhD thesis
- 📖 It is one of the key documents in the history of mathematics and computer science
- 📖 Essays by Andrew Appel and Solomon Feferman that explain the still-unfolding significance of the ideas Turing developed at Princeton
- + Turing's thesis envisions a practical goal--a logical system to formalize mathematical proofs so they can be checked mechanically. If every step of a theorem could be verified mechanically, the burden on intuition would be limited to the axioms.
- + Turing's vision of "constructive systems of logic for practical use" has become reality: in the twenty-first century,
- + Automated "formal methods" are now routine

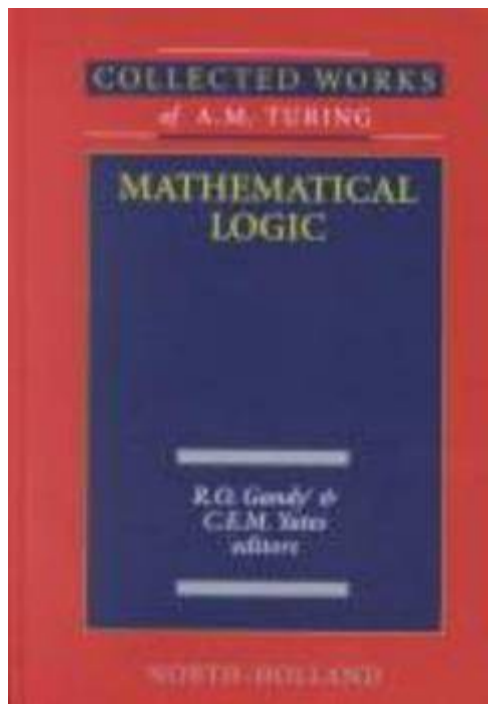


**Volume 3**



- ! Covers work on morphogenesis in plants
- ! Is acknowledged as being of the greatest originality and of permanent importance

**Volume 4**



- ☞ Turing's works is intended to include all his mature scientific writing, including a substantial quantity of unpublished material
  - ☞ Contents of this book are divided into three parts
- First part** :Focuses on computability and ordinal logics (work between 1937 and 1938)
- Second part**: Covers type theory (published and unpublished works between 1941 and 1948)
- Third part**:Focuses on enigmas, mysteries, and loose ends. It also delves into Turing's papers on programming and on minimum cost sequential analysis