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Speech

£50 note character selection announcement

Speech given by

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It's a pleasure to be at the Science and Industry Museum in Manchester. These galleries testify to the UK's rich history of discovery in science, technology and industry.

A little more than eight months ago, the Bank sought to recognise the UK's extraordinary scientific heritage by asking people across the country to "Think Science" in order to help us choose the character to feature on the new £50 note.

We were overwhelmed by the response. In six weeks, almost a quarter of a million nominations were submitted, from which we distilled a very long list of nearly 1,000 unique characters.[1]

The hard work of narrowing down these names to a shortlist of twelve options required the incomparable knowledge and tireless work of the Banknote Character Advisory Committee.[2] On behalf of the Bank, I would like to thank the external members of the Advisory Committee – Dr Maggie Aderin-Pocock, Dr Emily Grossman, Professor Simon Schaffer, Dr Simon Singh, Professor Sir David Cannadine, Sandy Nairne and Baroness Lola Young – for their invaluable expert advice and unbridled enthusiasm.

The characters that made it through to the final shortlist were:

- Mary Anning
- Charles Babbage and Ada Lovelace
- Paul Dirac
- Rosalind Franklin
- Stephen Hawking
- Caroline Herschel and William Herschel
- Dorothy Hodgkin
- James Clerk Maxwell
- Srinivasa Ramanujan
- Ernest Rutherford
- Frederick Sanger
- Alan Turing

The shortlist epitomises the breadth and depth of scientific achievement in the UK. Their work covers both the theoretical and the practical, and spans from the smallest building blocks of the universe to the nature of life itself.

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[1] Characters must be non-fictional and deceased. We also need to ensure that a suitable, easy to recognise, portrait of the person is available.
[2] https://www.bankofengland.co.uk/about/people/banknote-character-advisory-committee.

Rosalind Franklin's and Frederik Sanger's revelations about DNA, for example, furthered our understanding of the biology of life, and Dorothy Hodgkin's discoveries about the structure of insulin and vitamins better enabled us to preserve it. Mary Anning's palaeontological discoveries helped us understand the history of life on earth, while Caroline and William Herschel and Stephen Hawking opened up the heavens.

Srinivasa Ramanujan's pioneering research transformed modern theoretical mathematics. More practicably, the ground-breaking work of James Clerk Maxwell, Ernest Rutherford and Paul Dirac on electromagnetism, radiation and quantum mechanics laid the foundations for telecommunications and nuclear physics. Likewise, Charles Babbage and Ada Lovelace have contributed to the origins of computing that underpins virtually every aspect of modern life.

Each of the shortlisted scientists is worthy of celebration, so the Bank is delighted that this Museum is honouring them with a special exhibition that showcases their many and diverse achievements.

Sadly, there is not adequate space to feature them all on the new £50 note. A choice had to be made.

And it is my pleasure to announce today that the scientist that will feature on the new £50 note is Alan Turing.

Why Turing?

Alan Turing was an outstanding mathematician whose work has had an enormous impact on how we live today. As the father of computer science and artificial intelligence, Alan Turing's contributions were far ranging and path breaking.

Turing was insatiably curious about the world around him. With his mind ranging widely and freely, he approached a variety of seemingly intractable problems and found answers that passed others by. His genius lay in his unique ability to link the philosophical and abstract with the practical and concrete.

All around us, his legacy continues to build. Turing is a giant on whose shoulders so many now stand.

Born in Paddington, London on 23 June 1912, Turing displayed prodigious talent and vibrant interest in the sciences and mathematics as a schoolboy. This was reinforced by the untimely death of his close friend Christopher Morcom. Writing to Morcom's mother, he declared, "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."

To many, Turing is renowned for his "indispensable"[3] codebreaking contributions at Bletchley Park during the Second World War.[4] The advances Turing made in cryptanalysis then – including co-inventing the Bombe computer for solving ciphers and applying statistical techniques to speed up rates of decryption – were pivotal in cracking the hitherto unbreakable German Enigma code. Turing's work gave the Allies a crucial advantage in the battle for the Atlantic and is widely credited with hastening the end of the war by at least two years, potentially saving millions of lives in the process.

That alone would be more than enough for one lifetime, but Turing's contributions range far more broadly than those that have been rightly celebrated in print and on screen.

One of Turing's lesser-known interests was biology. In later life, Turing pioneered morphogenesis by applying his knowledge of mathematics and computer science to understand how plants and microorganisms develop their shapes and patterns. Turing used computers to simulate the results of hypothetical chemical reactions to develop truly original insights in this field. The theoretical foundations he developed have since been applied to solve puzzles such as why the leaflets on a pinecone follow the Fibonacci sequence and to explain the pattern of animals' coats from cats to zebras. This work of a lifetime helped lay a cornerstone in theoretical biology.

It was, however, the workings of the human mind that inspired Turing's greatest contributions to human knowledge and our lived experience. Turing answered a fundamental question: whether there is a definitive method that could be applied by machine to solve all mathematical problems. Once again, Turing's genius lay in his ability to think across boundaries, applying mathematical logic to a problem others had viewed as one of physics. The answer he supplied – captured in his 1936 paper *On Computable Numbers*[5] – provides the very foundations of computer science.

Turing envisaged a machine that could be turned to any well-defined task by supplying it with the appropriate program. The eponymous Universal Turing Machine, fed instructions through symbols on an infinite piece of tape, was an abstract concept in his time, but it's something that recognisably embodies the core principles of a modern computer and the logic of binary code. Moreover, his insight that only computable functions can be calculated is vital to software design. In recognition of the importance of this work, Turing was elected a Fellow of the Royal Society in 1951.

Enough for two lifetimes.

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[3] Cryptographic History of Work on the German Naval Enigma, by C H O'D Alexander, a colleague of Turing's at Bletchley. See: http://www.ellsbury.com/gne/gne-042.htm.
[4] In 1946, King George VI appointed Turing an Officer of the Order of the British Empire for his wartime services, although the details of his work remained secret for many years.
[5] Turing, A (1936), 'On Computable Numbers, with an Application to the Entscheidungsproblem', Proceedings of the London Mathematical Society, Volume 42, Issue 1, pp. 230-265.

Having imagined the concept of a computer, Turing helped turn it into reality. He played a vital role in the design and development of early electronic computers after the war, continuing to contribute key ideas such as implementing functions by flexible programing rather than pre-set built-in electronic components. Working first at the National Physical Laboratory in London and later at the Computing Machine Laboratory at Manchester University, his insights led to the creation of the Automatic Computing Engine (ACE) in 1950 and the program for Ferranti Mark 1, the world's first commercially available electronic computer.

A visionary as well as a revolutionary, Turing recognised that "*This is only a foretaste of what is to come and only the shadow of what is going to be*".

True to his nature, Turing himself began to suggest some possible directions.

His interests in neurology and physiology led him to ask whether computing machines could be capable of mimicking the faculties of the human mind, including the ability to learn. His work prefigured the neural networks that are used today in applications such as cancer diagnosis and self-driving cars and as yet undiscovered new technologies of tomorrow. And the Turing Test, a method for determining whether a computer can exhibit intelligent behaviour indistinguishable from a human being, remains the benchmark for judging true artificial intelligence.

Turing also leaves a very different, though no less important, legacy. In March 1952, he was convicted of Gross Indecency for his private relationship with a man, avoiding prison only by submitting to chemical castration. His security clearance was revoked for no reason other than his homosexuality, bringing to an end a promising post-war career as a consultant for GCHQ. He died shortly thereafter, on 7 June 1954, from cyanide poisoning.

In 2009, the then Prime Minister Gordon Brown made an official posthumous apology on behalf of the "government and all those who live freely thanks to Turing's work" for his "utterly unfair" treatment.[6] Turing received a royal pardon for his conviction in December 2013 and in 2017 the "Alan Turing Law" was passed, pardoning the nearly 50,000 men cautioned or convicted under now-rescinded historical legislation that outlawed homosexual acts.

In the UK today, we are fortunate to live in more inclusive times. Thanks to groups like the Sexual Law Reform Society and Stonewall, and initiatives like Pride, there has been huge progress towards ending the unfair treatment of people on the basis of sexual orientation and creating a society in which everyone can be their true selves without fear or favour.[7]

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[6] See https://webarchive.nationalarchives.gov.uk/20091005104048/
http://www.number10.gov.uk/Page20571
[7] The Bank of England aims to be an LGBT+ inclusive employer, taking part in the London Pride parade every year and flying the pride flag atop its Threadneedle Street building. The Bank has a thriving LGBT+ & Allies Network which was launched in 2006 and now has around 350 members and allies. In 2018, the Bank supported the rollout of rainbow lanyards in the spirit of creating a visibly inclusive and supportive environment – these are now worn by more than 1,000 colleagues. We complete the Stonewall benchmarking exercise each year and were pleased to have increased our ranking by over 100 places in 2018.

The Bank of England is committed to ensuring our banknotes are as inclusive as possible. That means celebrating the breadth of human achievement in this great country from science to the arts to statecraft to literature. And it means featuring a range of individuals who reflect the vibrant diversity of UK society.

The design of the note

Let me conclude by unveiling the image for the new Turing £50 note.

The design recognises the breadth and variety of Turing's contributions to science. The table taken from his seminal paper *On Computable Numbers* in the foreground is a succinct representation of a Turing Machine, and the ticker tape records Turing's birth date in binary code.

In the background are images of the ACE pilot machine and a section from the technical drawings of the Bombe.

The portrait is by Elliott and Fry, and the quote is from an interview published in *The Times*, dated 11 June 1949.

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The characters on our banknotes celebrate those who have advanced British thought, spurred innovation, shown exceptional leadership, shaped this diverse society and forged our common values. Alan Turing will join Winston Churchill on the £5 note and Jane Austen on the £10, and JMW Turner who will make his appearance on the new £20 next year.

Although we look to history when we chose a new character, Turing's work inspires us to look to the future and imagine what is still to come as a result of his genius.

If anyone can see the future, it's the next speaker. It is my pleasure to welcome Demis Hassabis – artificial intelligence researcher, neuroscientist, video game designer, chess champion, co-founder of DeepMind and one of the 225,000 who submitted a recommendation to this process – to celebrate Turing's past contributions to science and venture where they might take us tomorrow.