How George Boole's zeroes and ones changed the world

The real value of the Cork mathematician's work emerged with the invention of the digital computer

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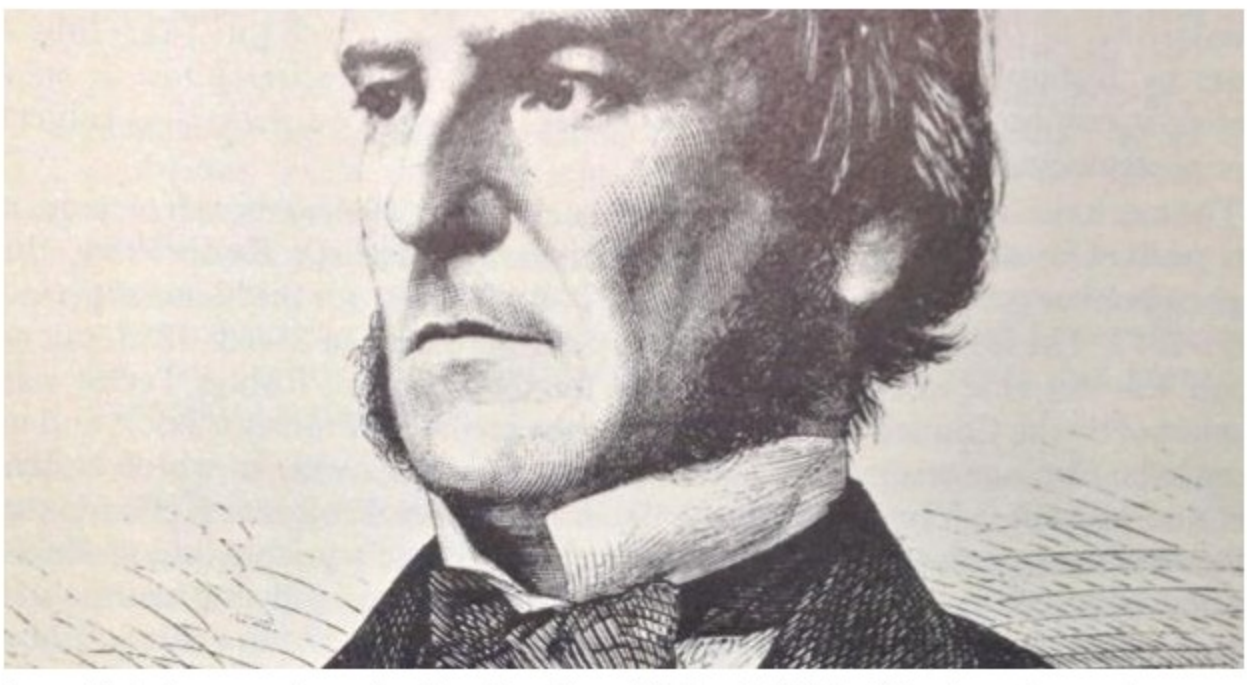

George Boole: became professor of mathematics at Queen's College in 1849 despite having no degree and never having attended any university

Mathematician and logician George Boole died just 150 years ago, on December 8th, 1864, following a drenching as he was walking between his home and Queen's College, Cork. He was just 49. UCC has planned a wide range of events for the year running up to the bicentenary of his birth next November.

Boole was the first professor of mathematics in Cork. His work has had a growing influence in recent decades, in computer science and digital technologies of all kinds. A biography, *The Life and Work of George Boole*, by Desmond MacHale of UCC has just been published by Cork University Press, which gives a well-drawn portrait of Boole not just as a man of science but as a social reformer, religious thinker and family man.

Boole's father, John, was a shoemaker with limited formal education, but with a keen interest in science and mathematics, even to the extent of neglecting his business in favour of books. He was happier making a telescope than mending a shoe. George was born in 1815, the eldest of four children. When he was 16, his father's business collapsed, and, to support the family, George took a job as a teacher. Later, he opened his own school in Lincoln when he was just 19.

Linear algebra

In parallel with his teaching, Boole undertook a programme of research in mathematics. He published papers on differential equations, integration, logic, probability, geometry and linear algebra. Some 24 of his papers were in the *Cambridge Mathematical Journal*. His paper *On a General Method of Analysis* was published in 1844 in the *Philosophical Transactions of the Royal Society* and won him the society's gold medal.

In October 1849, Boole became professor of mathematics at Queen's College, despite having no degree and never having attended any university. During his early years there he was lonely, but that changed when, aged 40, he married Mary Everest, then 23 years old. Mary was a niece of George Everest, surveyor general of India, after whom the world's highest mountain is named. The marriage was a happy if brief one, and they had five daughters, all extraordinary in different ways.

In 1833, when he was 18, Boole had a flash of inspiration that logical relations could be expressed in symbolic form. This idea would later grow into his major contribution to science: to explain the process of human thought in precise mathematical terms. His great work, *The Laws of Thought*, was written during his tenure at Queen's College.

The real value of Boole's work emerged with the invention of the digital computer. His symbolic logic was precisely what electronic engineers needed to design and analyse digital computer circuitry. If logical propositions are expressed in algebraic form, then logical deductions can be drawn by algebraic calculations. We may map the logical dichotomy "true or false" to mathematical bits or binary digits "0 or 1" and then to electric switches "open or closed". Boole's symbolic logic proved eminently suitable for the design of modern computers.

MacHale writes that Boole's name will live on as long as digital computers continue to operate and as long as students study mathematical logic. Boole would have been delighted, MacHale notes, could he have known how all modern communication – whether of data, text or images – comprises strings of the Boolean symbols 0 and 1.

More on the forthcoming year of George Boole at georgeboole.com

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