BOOKS

Was Newton a plagiarist?

A polemic argues that Robert Hooke deserves half the credit for 'Principia Mathematica', says *Andrew Robinson*

OUT OF THE SHADOW OF A GIANT
by John and Mary Gribbin

384PP, WILLIAM COLLINS, £25, EBOOK £12.99

★★★★☆

The anonymous "giant" in *Out of the Shadow of a Giant* is, of course, Isaac Newton (1642-1727), who needs no introduction. Newton's scientific contemporaries Robert Hooke (1635-1703) and Edmond Halley (1656-1742) – the book's twin foci – are rather less familiar figures to the general reader, except for Hooke's law that governs the compression and extension of a spring, and Halley's comet that returns every 74 to 79 years, more or less as Halley predicted. But according to veteran science-writers John and Mary Gribbin, Hooke and Halley deserve as much renown as Newton.

Indeed, anyone who reveres Newton's scientific achievements (as Albert Einstein did) may need to take a deep breath before reading this always stimulating, if sometimes over-zealous polemic. "Hooke was a great scientist who came up with the first scientific world-view; Newton was a great mathematician who put Hooke's world-view on a secure mathematical foundation, and then claimed credit for the whole thing himself," the authors contend. "Halley was nearly the equal of Hooke in the breadth of his scientific efforts, and did far more than Newton, who apart from his one piece of brilliance spent far too much time on pointless investigations of theology and alchemy," they continue. If Newton, Hooke and Halley are to be compared, "we would certainly place Hooke 'first among equals'," they conclude.

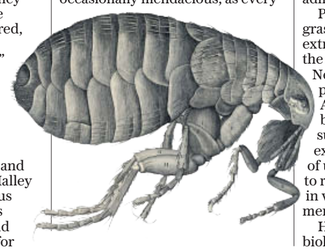
Consider Newton's most famous book, his three-volume *Principia Mathematica* (1687), which probably was provoked by Hooke's queries to Newton and certainly was financed by Halley on behalf of the impecunious Royal Society. The Gribbins estimate that Newton should share about half the credit for the book with Hooke.

They base their claim on analysis of Hooke's Royal Society lectures after he became its curator of experiments in 1662; and of Newton's correspondence with Hooke in 1679-80 and with others – in particular his rancorous rejection of the idea of giving credit to Hooke during the publication of *Principia Mathematica* in letters to Halley, and his astonishingly unscientific conjecture about Earth's gravitational attraction to Royal Society secretary Henry Oldenburg in 1675: that it "may be caused by the continual condensation of some... ethereal Spirit".

Hooke, it is clear, was the first to propose the following ideas: that there is a universal law of gravitation, applying to both the heavens and the Earth; that gravity is a centripetal attraction, keeping the Earth in orbit around the Sun; that every body continues at rest or moving in a straight line unless acted upon by a force (Newton's first law of motion); and that gravity operates through space without the need for any intervening fluid such as an ether. Finally, Hooke prompted Newton's embrace of the idea that gravity is inversely proportional to the square of the distance between two bodies.

Newton wrote a rancorous refusal to share his credit with Hooke

The Gribbins also capture the contrasting personalities of Newton, Hooke and Halley. Newton was notoriously solitary, secretive, self-centred, neurotic, intolerant of criticism and occasionally mendacious, as every Newton scholar has been obliged to accept. He made up the classic story of the falling apple as his eureka moment about gravity, dating it to 1665-66, safely before his contact with the Royal Society. Hooke and Halley, however, were generous and sociable, conducting their lives within a circle of colleagues and friends, frequently meeting in coffee houses; they accepted, and even welcomed, scientific criticism. Moreover, Halley was a diplomatic administrator and a leader of men.



Part of the problem in grasping their achievement is its extraordinary range, unlike that of the more narrowly concentrated Newton. "History is unkind to polymaths", notes historian Alexander Murray. "No biographer will readily tackle a subject whose range of skills far exceeds his own, while the rest of us, with or without biographies to read, have no mental 'slot' in which to keep a polymath's memory fresh."

Hooke contributed to biology, chemistry, geology, palaeontology, architecture, civil engineering and invention, as well as astronomy, mechanics and physics. "The multitude of his inventions is far too great to be enumerated in a brief history of the progress of science," wrote an even greater polymath, Thomas Young, in 1807. For example, Hooke invented a microscope capable of magnifying from 50 to 100 times and, in 1664, published *Micrographia*, an amazing folio of drawings of magnified needles, flies and fleas, feathers and more, including a plant cell – a term coined by Hooke because its shape reminded him of the cell of a monk. It was "the most ingenious book I ever read in my life", noted Samuel Pepys's diary. Hooke also designed the elaborate tower known as the Monument, north of London Bridge, as a memorial to the city's recovery from the Great Fire, which also doubled as an astronomical observatory-cum-gravitational laboratory. And his contribution to the restoration of the City by his friend Christopher Wren, based on Hooke's insight into the properties of an inverted fine mesh-like chain mail, leads the Gribbins to comment that "the best monument to Robert Hooke the architect is the Dome of St Paul's Cathedral".

Another scientific peer, Edmond Halley (1656-1742); a flea from Robert Hooke's 1664 *Micrographia*, left

Halley, though less of a polymath, besides becoming Astronomer Royal, was also a daring captain in the Royal Navy who commanded a ship on three voyages around the Atlantic Ocean, while surveying Earth's magnetic field and establishing the laws governing compass variation. Pepys called Halley "the first Englishman" to be competent in both "the science and practice of navigation".

Scholars are still catching up with Hooke. A biography published for the tercentenary of his death in 2003, *London's Leonardo: The Life and Work of Robert Hooke*, was obliged to have four contributors from disciplines as disparate as science and social history. In 2007, a noted historian of science tried to undermine Hooke's seminal suggestion that earthquakes over a vast timescale – rather than Noah's flood – might have been responsible for the puzzling occurrence of fossil seashells on the tops of mountains by claiming that Hooke still had "a firm conviction that the Earth was only a few thousand years old" (as implied by the Bible), like most of his scientific contemporaries.

Not so, as the Gribbins demonstrate. Hooke was sceptical of such religious orthodoxy and (unlike the cautious Newton) was willing to publish his scepticism. "Hooke didn't just question the biblical timescale, in particular for the Deluge, but dismissed it" – because, wrote Hooke, any story predating the invention of writing "cannot be much relied on or heeded, and at best will only afford us Occasions of Conjecture".

Hooke here surely sets too much store by written records. But he was perceptive about Earth's past convulsions. "Many Parts which have been Sea are now Land, and others that have been Land are now Sea; many of the Mountains have been Vales, and the Vales Mountains." In other words, earthquakes were integral to the process of continental formation and mountain building over millions of years that today we know as plate tectonics.

KEVIN DUTTON

ART

Even the plainest chessboard is an allegory – an abstracted battle – and the game can easily be piled with extra symbolism, as *Master Works: Rare and Beautiful Chess Sets of the World* shows. Sometimes potentates have wanted to stage their own battles on the board: Catherine the Great had her own face carved as queen, with her lover Potemkin as king, and the other royal pair her disloyal son and his wife. Sometimes the allegory is more universal, as in a "good vs evil" set made in 18th-century Florence for the Catholic Church, which ranges angels against Dantean devils; or in various "Reynard the Fox" sets, which illustrate the popular fable through fox-only chess pieces, like this 19th-century fox-bishop (far left).

Sometimes the symbolism is about sheer wealth: this intricate ivory set (centre) with king, queen and elephant-rook, was given by Cixi, Dowager Empress of China to Queen Victoria. And sometimes it's not: in a 1944 wooden set, of which you can see king (top right) and queen (bottom right), the sculptor Max Ernst pieced humble household objects together into otherworldly forms. *Fuel*, £34.95

Getting over the Deep Blues

Twenty years ago, chess world champion Gary Kasparov was beaten by IBM's computer – but he had the last laugh, learns *Tim Smith-Laing*

DEEP THINKING
by Garry Kasparov

304PP, JOHN MURRAY, £20, EBOOK £13.99

★★★★☆

If you go online, you can pull up a 1967 IBM infomercial called "The Paperwork Explosion". Its theme is a world where unstoppable progress has created so much paperwork that it presents a near-existential threat to humanity – a tide that can only be stemmed by IBM's advanced business machines. They take care of the paperwork so you do not have to, allowing you to work better, faster, and more productively, leaving ever more time for what really matters. The film culminates in the cast, spliced to the ratcheting rhythm of their office aids, saying over and over again: "Machines should work. People should think."

In 1967, that must have seemed like a clear-cut axiom to IBM. The idea that a machine even could think was the stuff of sci-fi. But 30 years later, the company looked as if they were about to make sci-fi a reality. In May 1997, the chess world champion Garry Kasparov faced off against IBM's Deep Blue (originally named Deep Thought) in a match designed to prove that machines could not just think but they could out-think the toughest human competitor imaginable. What happened next is history: in what *Newsweek*'s cover billed as "The Brain's Last Stand", Deep Blue won. For a moment, it looked as if the age of the thinking machine had truly arrived.

Of course, the apocalyptic claims were wildly overblown, as Kasparov's new book, *Deep Thinking*, makes doubly clear. Part meditation on the idea of the thinking machine and part score-settling, the book provides both a potted history of AI's struggles to become reality and the inside track on a match that was far from the fair fight IBM made out at the time.

At a moment when every other thinkpiece in the press seems to be about the terror of machines coming for our jobs, it is a salutary, uniquely well-informed call to hold back from hysteria. It is also, despite the foregone conclusion, a gripping account of an intellectual battle like no other.

For chess aficionados, the latter will be *Deep Thinking*'s major selling point. For fans, it will be like reading Nelson's post-match analysis of Trafalgar. For everyone else, it is worth it for the put-downs of other analyses alone. Readers are warned off Nate Silver's well-known discussion in

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Grandmaster flash: Garry Kasparov in his 1997 battle with Deep Blue

2012's *The Signal and the Noise* in no uncertain terms: just another one of those misguided amateurs who think that "winning a plastic trophy in a second-grade chess tournament qualifies them to comment insightfully on the moves and mindset of a world champion".

Much of the drama here takes place off the board. Kasparov was fighting IBM as much as Deep Blue, and it is clear the company sought every extra advantage they could. After all, the match was one of the biggest publicity opportunities of all time, so why make it harder for themselves to win? Kasparov could

IBM employed a Russian-speaking guard to eavesdrop on him in the match

not do the standard prep work of studying Deep Blue's past games, while the IBM team had all of his. They had even, he discovered later, positioned a Russian-speaking guard to eavesdrop on his inter-game discussions, incorporating them into the machine's tactics as they went. When he lost, the admittedly "sore loser" Kasparov complained about the conditions and demanded a rematch. But no rematch would ever happen. IBM had won both the publicity coup it wanted and an $11.4bn stock bump; why go back for seconds?

Kasparov might perhaps have won a rematch, but it does not really matter. He admits that computer domination in chess was always a question of when rather than if. Within a few years of the Deep Blue match, even the average PC program had become so strong that the idea of any human beating one seemed "outlandish". But the idea that it mattered had also come to seem outlandish, too. As the old saying goes, we did not give up on Olympic sprinters just because we have cars. Indeed, by winning, Kasparov notes, the IBM team "had engineered their own obsolescence".

While he went back to his day job, Deep Blue never played in public again. It was powered down in 2001, before being dismantled and sent to the Smithsonian and the Computer History Museum. Kasparov, who did not retire until 2005, remained the highest rated player of all time until 2013, and still has yet to wind up in a display case.

Fundamentally, Kasparov points out, despite our "fetishising of chess" as the most paradigmatically thinky of games, Deep Blue was not a thinking machine. Chess is susceptible to precisely the brute force calculation that computers are so good at, and while Deep Blue had algorithms designed by a team of grandmasters to refine its calculations, calculate is what it did. And the same holds for modern machines, right up to the most advanced AIs available. The laptop I am writing on is more powerful than Kasparov's nemesis, and more flexible, too, but it is not capable of thought. If it were, I would be considerably less sanguine about disparaging it via its own keyboard.

This will not stop people worrying, of course. We have been scared of being rendered obsolete by machines for almost as long as we have had machines. But *Deep Thinking* is both a lesson in not panicking prematurely and a warning about knowing who your real opponent is. Just as with Kasparov vs Deep Blue, when computers come for our jobs, it will not be because they are looking for fulfilling work to fill the empty hours of electro-existential angst; it will be because other humans stand to make money.