Science

The genius of space and time

PD Smith celebrates the centenary of Einstein's theory of relativity

The Born-Einstein Letters 1916-1955: Friendship, Politics and Physics in Uncertain Times
by Max Born
235pp, Macmillan, £19.99

Einstein 1905: The Standard of Greatness
by John S Rigden
173pp, Harvard, £14.95

Einstein's Miraculous Year: Five Papers that Changed the Face of Physics
edited by John Stachel
198pp, Princeton, £10.95

The Unexpected Einstein: The Real Man Behind the Icon
by Denis Brian
260pp, Wiley, £15.99

The New Quotable Einstein
edited by Alice Calaprice
407pp, Princeton, £9.95

The Collected Papers of Albert Einstein, Vol 9: The Berlin Years
edited by Diana K Buchwald et al
696pp, Princeton, £72

Albert Einstein: Chief Engineer of the Universe. One Hundred Authors For Einstein
edited by Jürgen Renn
471pp, Wiley-VCH, £22.50

The Invisible Century: Einstein, Freud and the Search for Hidden Universes
by Richard Panek
258pp, Fourth Estate, £15.99

A World Without Time: The Forgotten Legacy of Gödel and Einstein
by Palle Yourgrau
210pp, Allen Lane, £20

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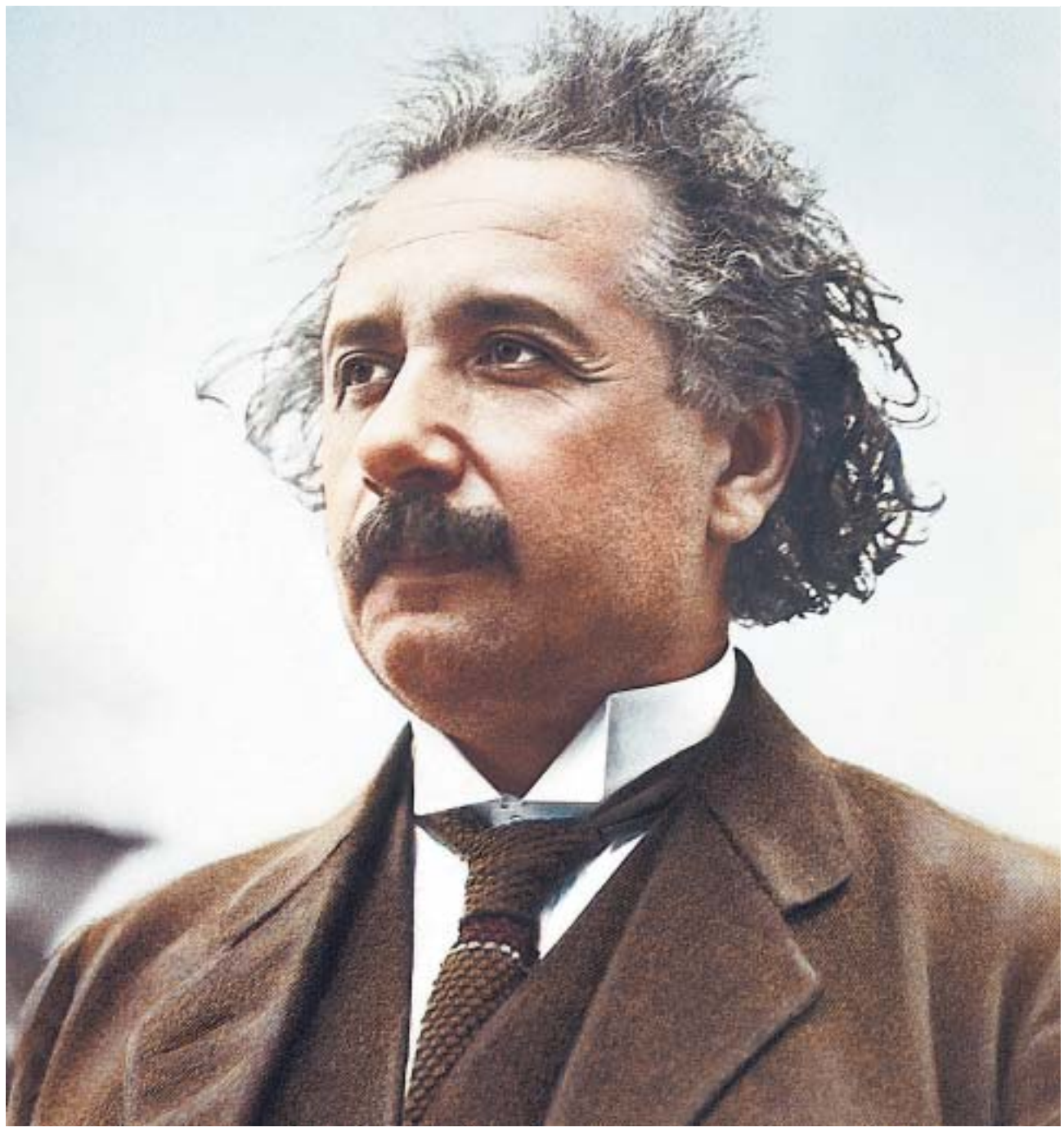

Einstein . . . 'as satisfied by a good sausage as by a good theorem'

The universe was never quite the same after 1905. Our understanding of space, time, matter and energy was transformed by a 26-year-old civil servant working a 48-hour week at a Swiss patent office. A "respectable Federal ink pisser" was how Albert Einstein described himself. He didn't even have a PhD. But the man who had failed to find an academic job had a secret drawer – it was, he told his friends, the department of theoretical physics. And in 1905, after six months of intensive thought, five scientific papers emerged from this drawer that would revolutionise the laws of physics.

From March to June he wrote one paper a month. The first was on the particle nature of light. Next came a method for determining the size of atoms which finally won him his PhD (at the third attempt). This was followed by a study of the random movement of particles, known as Brownian motion. In June, after a pause for moving house with his wife and one-year-old son, he completed the special theory of relativity which made the speed of light into a universal constant and overturned the Newtonian absolutes of space and time. "My joy is indescribable," he told a friend at the patent office afterwards. Then in September, having complained that there weren't any exciting subjects "ripe for rumination", he wrote a three-page paper outlining the equivalence of mass and energy: $E=mc^2$.

But Einstein hadn't finished with the laws of physics. Two years later he was day-dreaming at his patent office desk when he saw a builder on the rooftop opposite his window. Physicists find inspiration in the strangest things: Einstein imagined the man falling off the roof and called it "the happiest thought of my life". He realised the man wouldn't feel his own weight, at least not until he hit the ground. Eureka! It was the spur he needed to extend relativity to gravity.

According to physicist Max Born, it was "the greatest feat of human thinking about nature, the most amazing combination of philosophical penetration, physical intuition, and mathematical skill". The two physicists corresponded from 1916 until Einstein's death 50 years ago. A new edition of *The Born-Einstein Letters* appears this year, charting the fascinating story of their friendship. A preface by physicist Kip Thorne and historian Diana Buchwald provides an excellent survey of the "conceptual and philosophical issues that came to divide the two men". Einstein could never accept the indeterministic quantum mechanics that grew, ironically, out of his first paper of 1905, on the photoelectric effect. This argued that light was not a wave but made of particles (aka photons). Einstein rightly described the paper as "very revolutionary", but as a new generation of physicists carried the red banner of quantum revolution into ever stranger territory, Einstein clung doggedly to what he called "objective reality". As he told Born in 1926, God does not play dice. If an electron could choose its direction "of its own free will", he said, "I would rather be a cobbler, or even an employee in a gaming house, than a physicist." Always an outsider, Einstein's desire to prove the quantum theorists wrong inspired his quest for the unified field theory, a final triumphal synthesis of his ideas about the physical universe. Unfortunately, it proved too Herculean a task even for Einstein, although historians are still painstakingly working through his last notes in the hope that his equations contain the holy grail of physics – the theory of everything.

Mention 1905 to a physicist or a science writer, and a cascade of superlatives is sure to follow. Naturally there's a certain amount of hyperbole. For instance, in *Einstein 1905*, John S Rigden suggests that Einstein essentially "predicted nuclear energy 34 years before the discovery that made it possible". It's an eye-catching comment but, as ever, reality is more complex. After positing the equivalence of energy and mass, Einstein spent the next 34 years pouring cold water on the possibility of nuclear energy. It was left to others to imagine the future. In 1933, no one took Leo Szilard seriously when he correctly predicted that a chain reaction was the key to nuclear power. But when the atom was split in 1938, it was Szilard who banged on Einstein's door with the news. The great physicist was astonished: "*Daran habe ich gar nicht gedacht!*" – I never thought of that!

Rigden provides a fine account of the scientific importance of Einstein's five papers. If you want to read the papers themselves, *Einstein's Miraculous Year* by John Stachel has just been reprinted with a new introduction. Stachel devotes several pages to rebutting recent claims that Einstein's first wife, Mileva Maric, co-authored the 1905 papers. Einstein referred once to "our work on relative motion", and Maric did indeed help him with some of the calculations on relativity (he was a "lazy dog" at maths, said his university tutor). Einstein's treatment of his first wife was certainly shabby, but (as Stachel shows) relativity and the quantum revolution sprang from the subtle grey matter of Einstein's brain alone.

Denis Brian's *Unexpected Einstein* also sets out to debunk myths which cast Einstein variously as a plagiarist, a dyslexic, or a misogynist. Wisely, Einstein himself soon gave up trying to correct the "brazen lies and utter fictions" that were being printed about him. He had more important things to do – like messing around in boats, one of his greatest pleasures in life.

"Is $E=mc^2$ a sexed equation?" Luce Irigary's priceless question is included in Alice Calaprice's *New Quotable Einstein*. This excellent updated edition is packed with wonderful quotes and anecdotes, such as this from the 1920s: while playing violin in a quartet, Einstein repeatedly made wrong entrances during the rehearsal. The exasperated pianist, Artur Schnabel, eventually turned to him and said: "For heaven's sake, Albert, can't you count?"

This centenary year brings another instalment of Einstein's *Collected Papers*, in a revealing and meticulously annotated volume that contains correspondence from January 1919 to April 1920. It covers such diverse subjects as his divorce and remarriage, the death of his mother, his love of *The Brothers Karamazov* ("the most wonderful book I have ever laid my hands on"), and a violin. The man who made the instrument for him was a "drunken sod", Einstein admitted, but his violins sounded sublime. However, many found the physicist's fiddling far from sublime. He "played like a lumberjack", says Denis Brian, somewhat harshly.

In November 1919 the results were announced of the British solar eclipse expeditions to test the general theory of relativity. Einstein predicted that starlight would be bent by the warping of space around the sun. The news that he had been proved right spread around the globe at the speed of light and a scientific hero was born. The Cambridge Review was moved to verse: "We thought that space was straight and Euclid true / God said 'Let Einstein be' and all was skew".

But all the great physicist could do was kvetch about "being hounded by the press and other riffraff". He describes a dream in which he was "burning in hell and the postman is the devil and is continually screaming at me, hurling a fresh bundle of letters at my head because I still haven't answered the old ones". Yet despite the publicity, Methuen, who were publishing Einstein's popularisation of his theory, found relativity a hard sell, as a 1920 letter in the *Collected Papers* reveals: "Our travellers tell us that there is complete ignorance in the public mind as to what Relativity means. A good many people seem to think that the book deals with the relations between the sexes."

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Albert Einstein: Chief Engineer of the Universe includes chancellor Gerhard Schröder's address to mark the start of "Einstein year", in which he calls for a "new culture of science" in Germany, the country whose citizenship Einstein twice renounced. This fascinating and beautifully illustrated volume explores the great man's life, science and cultural impact. One essay even details his unlikely venture (with Leo Szilard) into refrigerator design in the late 20s. A team of crack German scientists celebrated the centenary of his annus mirabilis and the 50th anniversary of his death by recreating this rather half-baked piece of consumer technology.

The best books on Einstein don't just try to explain his ideas for the nth time, but place them in an original intellectual context. In *The Invisible Century*, Richard Panek has the rather wonderful idea of juxtaposing the universes of Freud and Einstein. Unfortunately, his justification for bringing these two very different scientists together between the covers of a single book is not wholly convincing. Panek's interest is epistemological: how 20th-century science focused on the "question of seeing itself – of perception, of how we see". Both men made "perceptual leaps", often on the basis of very little hard evidence, to discover their hidden universes. Now, thanks to them, we all have "X-ray eyes" capable of seeing deep into inner and outer space. Intriguing though his idea is, Panek glosses over the real differences between the two men, claiming, for instance, that Einstein, the great realist of 20th-century physics, was "writing about the personal and idiosyncratic side of science – its subjectivity". Einstein told a friend a year or so before he died that although Freud was a brilliant man, his theory was "nonsense". He refused to be analysed, preferring, as he put it, "to remain in the darkness".

Towards the end of his life, Einstein said he went to his office "just to have the privilege of walking home with Kurt Gödel". In *A World Without Time*, Palle Yourgrau tells how Einstein's ideas inspired Gödel to imagine such a world. Using relativity, Gödel calculated how a spaceship could travel into the past or the future: he "worked out the precise speed and fuel requirements, omitting only the lunch menu". But if we can travel into the past, then it never really "passed", and "a time that fails to pass is no time at all". Gödel had dropped a "mathematical bomb" on physics and Einstein was deeply shocked. Time was not just relative, it was an ideal: it did not exist. According to Yourgrau, "in one of the greatest scandals of modern intellectual history, a conspiracy of silence has descended upon this idea". Gödel's theory was too subversive even for the revolutionaries of physics.

Gödel was an uneasy amalgam of Einstein and Kafka, "gaunt, harrowed and haunted, peering through thick glasses like an owl from another dimension". A deeply disturbed personality, after Einstein died he descended into paranoia and eventually starved himself to death. Despite his jaunts to the outer limits of physics, Einstein always kept his feet firmly on the ground. Yourgrau puts it beautifully: he was "as satisfied by a good sausage as by a good theorem". This brilliant study of physics and a friendship is one of the most memorable books on Einstein's legacy to emerge this centenary year.

PD Smith's illustrated biography of Einstein is published by Haus.