Back to Article page

London Review of Books

Sailing Scientist

Steven Shapin

Edmond Halley: Charting the Heavens and the Seas by Alan Cook
Oxford, 540 pp, £29.50, December 1997, ISBN 0 19 850031 9

Joined for all time on the title-page of the Book that Made the Modern World are Isaac Newton (who wrote the *Principia Mathematica*) and Samuel Pepys (who, as President of the Royal Society, licensed it to be printed). It is one of the oddest couples in the history of thought: the man who, as a late 17th-century Cambridge student was heard to say, had 'writt a book that neither he nor any body else understands' and one of the multitude who understood scarcely a word of it; the wholly other and the all-too-human; the virgin ascetic who accused John Locke of trying to 'embroil' him with women, and the supreme London boulevardier whose consuming passions included Château Haut-Brion, the theatre and serial embroilments with women.

Turn the page and the odd couple is joined by a third, for here appears the name of the astronomer Edmond Halley (1656-1742) – the midwife to modernity. Halley it was who pressed Newton to write the book, who saw it through the press and corrected the sheets, who paid for its publication out of his own pocket, and who prepared a précis for personal presentation to the King – one of the earliest scientific soundbites. 'But for him, in all human probability', wrote Augustus de Morgan in the mid-19th century, the *Principia* 'would not have been thought of, nor when thought of written, nor when written printed'. Halley 'almost made' Newton write the book.

Halley was alter ego to the wholly other. He understood both the significance of Newton's celestial dynamics and the emotional dynamics of Newton's tortured soul. Over more than a year, he coaxed and cajoled Newton into completing the project, ever mindful that, at any moment, alternative claims to priority or even mild public expressions of scepticism might draw Achilles sulking back from open philosophical engagement to his Cambridge mathematical tent. Five or six hundred copies were printed; bound in calf it cost about nine shillings; and Halley's total profit on the business of modernity-making was about £10.

Newton's Preface acknowledged Halley – 'it was to his solicitations that its becoming publick

is owing' – and Halley prefixed an encomiastic Latin ode of his own composition, in the style of Lucretius' *De Rerum Natura*, that set the standard for later panegyrics:

> Come celebrate with me in song the name
> Of Newton, to the Muses dear; for he
> Unlocked the hidden treasuries of Truth:
> So richly through his mind had Phoebus cast
> The radiance of his own divinity.
> Nearer the gods no mortal may approach.

Halley meant it – he was in love with Newton's 'divine Treatise' – and history has repaid him accordingly. To the late Victorians Halley was a Good Second: 'the second most illustrious of Anglo-Saxon philosophers'.

If you want to understand the culture that joined Newton and Pepys on the *Principia*'s title-page, your best bet is understanding Edmond Halley. For it was Halley's life that linked the intellectually transcendent with the mundanely practical, the life of solitary scholarship with pressing Crown concerns. There was as much of Pepys as there was of Newton in Halley's make-up and in his life's projects.

Pepys's father was a London tailor; Halley's was a soap-boiler, although a very rich one with a sideline in real estate. Both went to St Paul's School, did well at university, and early on attracted patronage in high places that set the course of their future careers. Both were excellent company, assiduous networkers, habitués of taverns and coffee-houses, energetic, wide-ranging in their interests, and abundantly endowed with self-esteem. Pepys was the progressive administrator, Halley the precise astronomer, but sea-water ran through their veins with equal strength. The Navy and naval concerns substantially structured their careers. In the late 1680s, Pepys was probably one of the sponsors of Halley's surveys of English coastal waters. And Pepys knew very well what Halley was worth: he was 'the first Englishman' to be a master in 'the science and practice (both) of navigation'.

Temperamentally and socially unlike, the links between Halley and Newton were professional and disciplinary. Both were at times professors of mathematics; both were driven by the passion for precision and exactness, the yearning to subject the physical world to the discipline of the measure and the rule. In that task Halley was Newton's operational right arm.

Both did Crown business as they did astronomy, and Crown business, as it affected astronomy and mathematics, very substantially centred on the problems of exercising long-distance control, of knowing where in the world you were, of knowing how to get from there to where you wanted to be, and of delivering power from one point to distant others. The trading

companies needed to know such things, and so did the military. Effective colonial expansion was predicated on precision astronomy.

Newton never travelled abroad, but Halley was a sailing scientist from a very young age. His father sent him up to Oxford with state-of-the-art astronomical instruments, and subsidised his early research with an allowance – in current values – of £100,000 a year. But before he took his degree Halley's influential friends had already arranged to send him to make observations in the South Atlantic. His purpose was to 'make a most accurate sphere of the fixed stars, and complete our globe throughout', that is, to add a chart of the stars as seen in the skies of the still little-known Southern hemisphere to those in the better mapped North. The weather on St Helena was poor, but reliable Southern observations were valuable commodities, and when Halley returned to England (still only 22) he was celebrated as 'our southern Tycho', a young master of precision.

In the early 1690s, Halley was engaged by the Royal Africa Company to salvage a sunken treasure-ship off the Sussex coast, designing a diving-bell for the purpose, and going down in it himself. From 1698 to 1701, he was master and commander of the tiny Royal Navy ship *Paramore*, again in the South Atlantic. This was, it has been said, 'the first sea journey undertaken for a purely scientific object'. Captain Halley survived one virtual mutiny from a crew that took a dim view of risking their lives in iceberg-infested waters in the cause of astronomy. The next several years saw him doing hydrographic surveys of the Channel and being sent on a secret diplomatic and military mission to the Adriatic, where he inspected the Dalmatian coast for suitable harbours to support a British fleet in the War of the Spanish Succession. Not your conventional picture of the astronomer's or mathematician's life.

Settling down and filling out, Halley obtained the Savilian Chair of Geometry at Oxford, having been denied an earlier appointment to the astronomy professorship owing to imputations of infidelity, and set to editing the work of ancient mathematicians. Once captain, Halley now turned pirate. Long frustrated with the agonisingly slow pace at which the first Royal Astronomer, the Rev. John Flamsteed, was compiling his star-charts, Newton (now Sir Isaac and President of the Royal Society) used Halley as his instrument in prying Flamsteed's observations away from him and publishing them against his will. In 1719, Flamsteed died, and Halley was made Royal Astronomer in succession. At Greenwich, he continued his work of rectifying the tables of celestial motions, trying to make them precise enough to allow navigators on pitching ships in the open sea to find the longitude.

It was a task of exquisite complexity. And that complexity arose from endemic and worrying mismatches between, on the one hand, elegant mathematical and physical principles and, on the other, the motions described by real-world celestial bodies. Variation, anomaly, unpredictability and uncertainty were the residua of Newton's achievement. The motions of the Earth and Moon were non-uniform; that of comets was radically uncertain at the

beginning of Halley's career, and remained imperfectly understood at the end.

Newton appreciated the general lack of exact solutions to 'the three-body problem': his system could handle attractions between, say, Saturn and the Sun, but, when he had to take into account the gravitational interactions between Jupiter, Saturn and the Sun, the best he could offer were approximations. The variation of the Earth's magnetism exercised physicists. Tidal phenomena varied significantly from one body of water to another, and no existing physical theory precisely modelled them all. There were important anomalies in the times of the eclipses of Jupiter's moons, a celestial clock of potential use in navigation. How to standardise the barometer and the thermometer? What, indeed, was it that these instruments actually measured? Newton described the system of the world with very great, but limited, precision. Open-sea navigation needed still greater precision.

Halley aimed effectively to provide that precision by reducing the world to a set of standard charts, maps and tables: tables of latitudes and longitudes; tables of stars; tables of comets, trade winds, geomagnetism, tides, the motions of Jupiter's moons, specific gravities, the weather; and maps and charts of coastal waters. He girdled the globe with graphic coils. His system of depicting physical variables as isolines – lines joining points of equal physical value across areas of the Earth – was original. It was not the 'returning' comet of 1607, 1682 and 1758, but the isolines of geomagnetic variation ('Halleyan lines') to which contemporaries attached his name.

Halley's tabulating and standardising impulses had social and political objects as well. Some historians have called him 'the father of modern life assurance' because of his 1693 tables of life expectancies. In the same year, he estimated the total land acreage of England by a brilliantly straightforward method involving weighing pieces cut out of a map. As one of Newton's deputies at the Mint in the 1690s, Halley helped standardise the value of England's currency, making it safe against clippers by milling the edges of coins.

On the scale of a table, the world becomes disciplined and portable. Put it on a reliable table and you can handle it; you might even be able to put it in your pocket and move around, knowing where you are and what to expect when you get to where you're going in space and time. But tabling the world in that way, and enjoying its benefits, involves standardised means of representation, and these standards had to be invented, fought for and secured.

The standardisation of the world, like its 'disenchantment', is a much misunderstood business. No intellectual passions are stronger than those involved in achieving precision, standards and conventions. The stable results of those struggles appear matter-of-fact, but realising them is an emotional, political and messy business. Scientific agreement on the value of the last decimal place, the last second of arc, the starting meridian of longitude, the relative accuracy of naked-eye or telescopic sights on the sextant, the value of a foot, ounce and pound, and the calibration of the thermometer mobilises passions and political energies on a

heroic scale. Those who mean to achieve precise scientific representations and to make them widely credible must, for these reasons, be as good at social engineering as at observing, recording and measuring.

Knowledge of the apparent and proper motions of a comet through the sky or of the duration of a solar eclipse, for example, were collective accomplishments, and so, too, were reliable star-charts and maps of geomagnetic variation. To produce such things, and to make them credible, you had to know something not only about the natural world but also about other observers, their skill and their integrity. You had to know who was a skilful and honest observer, you had to get them to communicate their observations, you had to bring these observations together in one place, and represent them in such a way that they could circulate robustly in a range of scientific and practical communities.

Halley had a uniquely powerful vision of scientific projects extending both backwards and forwards in time. The collectivities he aimed to construct included not only the living but the judiciously selected dead: reliable astronomical observations were recruited from the distant past and projects were designed for astronomers to execute after his death. As he constructed a contemporary community engaged in global projects, so he helped to create the social and cultural realities of ongoing scientific traditions.

Halley was a very good social engineer. Unlike some of his astronomical contemporaries – one thinks, for example, of the irritable Newton, the peevish Hooke and the testy and intellectually costive Flamsteed – Halley's style was open and communicative. He was a quick publisher, hospitable, gregarious, generous and patient. As Clerk, and later Secretary, of the Royal Society, Halley made himself into a one-man clearing-house on a wide variety of topics. Intellectual exchange was lubricated by civility. In these sorts of matters, personality mattered as much as skill and knowledgeability.

Historians have never known quite what to say about Halley's personality and morality or, rather, what they ought to say. The social attractiveness is in no doubt, but Victorians agonised over evidence that he was a banterer and scoffer in matters of religion – the presumed occasion of his initial rebuff in securing an Oxford chair – and sought to exculpate him from charges of infidelity. His infidelity was limited but substantial enough, points of scientific principle conflicting with cherished articles of Christian faith. Halley was accused of asserting the eternity of the world, and, even after that initial disappointment, was prepared to say in public that there was no 'valid argument ... from what has been observed in nature that this Globe of the Earth ever did begin or ever shall have an end'. He later sought to disclaim belief in the eternity of the world, evidently with enough persuasiveness to succeed at Oxford the second time around.

Halley's difficulties probably arose from the same temperament that made him such excellent company and such a skilled social engineer. As David Brewster wrote in the 19th century, he

'was a man of the world, much esteemed in society'. He seems to have been one of those who would rather lose a job than a joke. He told one scientific colleague who declined to drink with him on a Friday that he 'had a Pope in his belly'. When Bishop Stillingfleet sent round his chaplain to vet Halley's orthodoxy, the astronomer sent him away with a flea in his ear: 'I declare myself a Christian and hope to be treated as such.' Contemporary gossip put it about that he had slept with the wife of a distinguished fellow astronomer; that he had mortally offended Newton by his cavalier attitude towards religion; that he had taken part in a drunken carouse with the visiting Tsar Peter, wrecking their host's furniture; and that he joked in the coffee-houses about taking oaths and the hereditary right of kings. The pious Flamsteed could not abide Halley's 'ill manners': 'He now talks, swears, and drinks brandy like a sea captain' – which, of course, he was.

Halley was full of the juices of life, and one hopes for a biography that does justice both to the scientific achievements and to the passions and personality of the man who achieved them, indeed a biography that recognises the constitutive role of passions and personality in making scientific knowledge. That biography remains to be written. The problems involved in writing it are both practical and generic. Practically, there isn't quite as much archival material to go on as there is for other intellectual contemporaries: Boyle, Newton, Evelyn or Flamsteed. There are few surviving letters; little is known of his domestic life; and many of the stories about him derive from questionable sources.

Generically, most modern scientific biography tends to work within a framework that segregates the personal and the intellectual, or even sets them in opposition. What can truth about the natural world possibly have to do with temperament and personality? The pertinence of the personal to the intellectual is widely acknowledged as a matter of course when artistic, religious and political projects are at issue, and denied or even handled with prim embarrassment in scientific biography.

Alan Cook is no professional historian. Professor of Geophysics at Edinburgh, then Jacksonian Professor of Natural Philosophy at Cambridge, he has devoted his life to the same sorts of precision project that structured Halley's career, and this sprawling biography is evidently the culmination of a long-standing and wholly justified scientific admiration.

He prefaces his story with a perfunctory dismissal of what he takes to be trendy social constructionism, and defiantly advertises his book's 'old-fashioned' nature: 'The "construction" of science is not a subjective undertaking; it must agree with the empirical structure of the world around us ... Halley is not a lay figure on which to hang sociological notions: he was a large man in a grand time.' Cook is trivially right about empirical agreement – what else could Halleyan lines be but facts about the world? – but profoundly wrong about the irrelevance of subjectivity: how else can facts about the world be established, made credible and circulated but through the passions and personalities of those who champion

those facts? Like some others in the lamentable Science Wars that are threatening to poison our cultural conversations, Cook seems to conflate the defence of science with the defence of an impoverished version of philosophical empiricism. It is a conflation that serves the defence of science very poorly.

In fact, he wastes little time with either philosophy or historiography, and there are more mundane causes for the deep disappointment occasioned by this book. It is endlessly repetitious, ploddingly written, inexcusably dull and ultimately lifeless. Like the Victorians, Cook seems disturbed by Halley's reputation for infidelity and free-thinking, offering only the most anodyne and superficial accounts of the theological and moral issues involved.

The book vacillates in generic intention between biography and modern scientific text: Halley is praised when he gets it right, gently corrected when his measurements deviate from those in modern textbooks. There are pages and pages of undigested observational data, presented without any serious attempt to link them with the technical scientific culture of the 17th and 18th centuries. There were major and intriguing changes in such enterprises as cometary and magnetic theory in Halley's lifetime, many of which he helped to make. But it obscures rather than reveals Halley's social and technical achievements if these practices are judged solely in terms of late 20th-century knowledge. This is not a book designed to be accessible to readers other than professional astronomers or geophysicists. If you don't already know what, for example, is meant by collimation, libration, nutation or the Coriolis force, Cook is not going to forgive your ignorance.

Two other semi-popular biographies of Halley are available – by Angus Armitage (1966) and Colin Ronan (1969). Neither is as compendious or as technically demanding, but both are far more readable and more lively. It is one of the ironies of Cook's performance that his laudable intention to celebrate 'a large man in a grand time' winds up diminishing its subject. 'A man of the world' needed to be painted on a wider canvas and with brighter colours.

Vol. 20 No. 13 · 2 July 1998 » Steven Shapin » Sailing Scientist (print version)
Pages 12-13 | 3284 words

Letters

Vol. 20 No. 15 · 30 July 1998

From Nicholas Jardine

Semi-popular but 'inexcusably dull' and accessible only to scientific specialists, defiantly 'old-fashioned' in its perfunctory dismissal of social constructivism, the work of a scientist rather than a professional historian: such are the terms in which Steven Shapin (*LRB*, 2 July) castigates Alan Cook's *Edmond Halley: Charting the Heavens and the Seas*. Reviewers who pontificate from professional high ground should be a bit

more careful. Cook's book addresses the scientifically literate public. Unlike the semi-popular biographies with which Shapin unfavourably compares it, Cook's work presents important archival discoveries which add significantly to our knowledge of Halley's life and social circumstances and his wide-ranging contributions to the sciences. As evidence of inaccessibility to all but 'professional astronomers or geophysicists', Shapin cites Cook's mentions of 'collimation', 'nutation', 'libration' and 'the Coriolis force'. GCSE science students know what the Coriolis force is; and the others, far from being advanced technical terms, were well established in Halley's time and can readily be looked up in the *Concise Oxford Dictionary*. As for dullness, well, it's a matter of taste. Cook is chary of the fruity tales of low life and high living spread about by Halley's enemies; and his Halley is indeed on the dry side. Shapin is less fastidious, and the Halley he sketches is exceedingly moist.

As for Cook's alleged dismissal of social constructivism, Shapin is disingenuous. The issue is not, as he implies, whether 'passions and personality' have a role in the establishment of scientific facts. Shapin is generally acknowledged as an architect of the social constructivist approach to the history of the sciences, and he well knows that this involves more than platitudes about the need for energy, sociability and sound judgment of people in the collaborative enterprises of the sciences. Thus *Leviathan and the Air Pump*, which he co-authored, concludes that 'as we come to recognise the conventional and artefactual status of our forms of knowing, we put ourselves in the position to realise that it is ourselves and not reality that are responsible for what we know.' Such is the provocative claim from which Cook distances himself when he remarks in his preface that 'the "construction" of science is not a subjective undertaking; it must agree with the empirical structure of the world around us.' Shapin counters this moderate empiricism by associating Cook's good-natured and scholarly book with 'the Science Wars that are threatening to poison our cultural conversations'. Insensitivity to the contents of the sciences, macho images of scientists, misplaced professional élitism, insolent reviewing – these, I think, rank higher among the real enemies of conversation about the sciences.

Nicholas Jardine
Department of History and Philosophy of Science, Cambridge

 ^ Top