Charles Hutton: ‘One of the greatest mathematicians in Europe’?

Benjamin Wardhaugh

Charles Hutton, 1737–1823. If you are interested in eighteenth- or nineteenth century British mathematics, you’ve heard of him; you’ve quite probably used his 1795 *Dictionary* as a historical source. You quite possibly don’t know much else. I’m at present working on an AHRC-funded biography of Charles Hutton, together with an edition of his hundred-odd surviving letters. This article reflects on the nature and significance of Hutton’s achievements, and what his example tells us about mathematical biography more generally.

1. Hutton’s life

Charles Hutton was born in Newcastle in 1737. His father worked in the coal mines as either a ‘viewer’ or an ‘overman’: a position of some trust and status but nevertheless an unenviably hard and dirty profession. Following the death of his father and the remarriage of his mother Hutton – his own ambitions possibly now somewhat scaled back – worked down the pits himself, working a trapdoor as a small child and, aged about 18, as a coal hewer in the Long Benton colliery (Anonymous 1798, Bruce 1823, Gregory 1823: biographical information is taken from the latter two sources where no other reference is given).

Some now irrecoverable combination of family ambition and a sense of the boy’s talents resulted in Charles being kept at school well into his teens: quite how this was combined with his work in the pits is not clear, but such things were not impossible (Flinn and Stoker 1984, 438). At the age of 18, and after ambitions outside the pits had perhaps been largely abandoned, there resulted a sort of Cinderella moment, the fairy godmother taking the guise of local clergyman Jonathan Ivison. He had been presented with a benefice elsewhere and as a result had to leave the school he had taught at the village of Jesmond. Instead of letting it close he arranged for it to be taken over by Charles Hutton.

Hutton flourished to a remarkable degree as a teacher, moving over the next few years from the one-room ‘school’ at Jesmond through a series of increasingly grand

establishments which culminated in a purpose-built schoolhouse on Newcastle's fashionable Westgate Street (opposite the present Literary and Philosophical Society). He married and became the father of a son and three daughters. And he established himself as a mathematical practitioner: as well as teaching, he offered training in mathematics to other teachers, arranged public lectures on the sciences at his school and did paid surveying work for the corporation of Newcastle (Bruce 1823, 50; *Newcastle Courant*, 27 December 1766; Hans 1951, 110; Hutton 1812, vol. 3, 379; Hutton 1772).

Thus far his was a merely local success and local visibility, but Hutton quite clearly aspired to more. He contributed mathematical problems and solutions to at least three periodicals: *Martin's Magazine of the Sciences*, the *Gentleman's Diary*, and the *Ladies' Diary*. After just six years as a teacher, he also brought out – privately printed – a textbook of arithmetic for use in schools (Hutton 1764). The *Schoolmaster's Guide* succeeded well enough to justify two more editions over the next few years, backed by a Newcastle and a London publisher, and Hutton next wrote a much more ambitious geometry textbook which he successfully promoted by subscription (Hutton 1770).

In 1773 it was brought to Hutton's notice that the Royal Military Academy at Woolwich was seeking a new mathematics teacher, and armed with letters of recommendation from a gamut of local notables he participated in the public competition for the post. He impressed the judges, and took up his new job in Woolwich, near London, in June, leaving his Newcastle school to one of his assistants. The RMA had problems not just with discipline among the cadets but also with the attitude of some of the teaching staff, and simply by turning up when required and not engaging in open insubordination Hutton was able to gain both the trust of his superiors, and rapidly increasing power over the curriculum and the progress of students through the academy (Jones 1851).

As well as his teaching duties in Woolwich, Hutton undertook an almost unbelievable quantity of other work during his first decade in the London area. He was already engaged in a five-volume reprint of all the problems and solutions that had appeared in the popular mathematical periodical the *Ladies' Diary* since 1704 (Hutton 1775).

Within days of his arrival in London he was engaged as the *Diary*'s regular editor as well, the previous incumbent having died. After a few years he was also overseeing the astronomical calculations for most of the other almanac-style periodicals produced by the Stationers' Company of London (Stationers' Company 1985: Court book M, 483; Supplementary documents Series I, Box B, folder 6, items i–iv; Court book O, 77). Through the Astronomer Royal, Nevil Maskelyne, he was engaged to do occasional work as a 'comparer' for the lunar predictions in the *Nautical Almanac*, and he was given other work both as calculator and as translator by the Board of Longitude (Cambridge University Library RGO 4/325, 14/5). The Board also paid for the printing of his first volume of mathematical tables (Hutton 1781). When Maskelyne undertook ground-breaking astronomical observations in Scotland with the intention of determining the gravitational attraction exerted by a certain mountain – and consequently determining the density of the earth – it was Hutton who was trusted with the calculations. In 1775, Maskelyne was awarded the Royal Society's highest honour, the Copley Medal, for the project (Maskelyne 1775; Hutton 1778).

Hutton aspired to be not just a calculating assistant but a front-rank experimental philosopher in his own right, and to that end he launched a programme of experiments on the explosive force of gunpowder using personnel and equipment supplied by his employers at Woolwich. His results had potentially important implications for the design of cannon and the calculation of trajectories for projectiles moving close to or above the speed of sound, and he in his turn was awarded the Copley Medal in 1778 (Hutton 1778; also Hutton 1812 on his later ballistics experiments).

Hutton, elected a fellow in 1774, was briefly the Royal Society's golden boy, invited to its exclusive dining club and fêted by its president John Pringle. But then things went catastrophically wrong. Pringle was replaced as president by Joseph Banks for reasons that were rumoured to be political: Pringle was a friend of radicals, dissenters and Americans and this was 1778 (Hunter Dupree 1984, 15). Hutton was tainted by some of the same associations, and Banks was no friend to mathematics – nor to professional practitioners and commercial authors – at the best of times. Hutton was sacked from his position as Foreign Secretary to the Royal Society. His friends resented it, and the ensuing dispute held up the scientific business of the Royal Society for several weeks in early 1784, in the most violent row the Society has ever

seen. But the damage was done, and Hutton and a number of other mathematicians ended up in self-imposed exile from the Royal Society for the next thirty-five years. (The best of the many modern accounts of the row is that in Higgitt 2014, 229–35; see also Wardhaugh 2017a, ch. 6, and Wardhaugh 2016.)

Hutton's attempts to rebuild his career after this disaster focussed in part on building up his status and his personal connections through membership of a number of clubs and societies: the Royal Society of Edinburgh, the American Philosophical Society, the Society of Civil Engineers, the Chapter Coffee House Philosophical Society, the Military Society at Woolwich, as well as the so-called Friday Dining Club that included most of the mathematicians now exiled from the Royal Society. The latter never really became a stable learned society, and its plans to publish a periodical to rival the *Philosophical Transactions* came to nothing. Hutton instead published most of his own mathematical and scientific work in a total of four volumes of what he called 'Tracts' (Howse 1989, 161; Hutton 1786; Hutton 1812).

At Woolwich, he continued his work on ballistics. He produced a textbook on conic sections, for which he was presented at court in 1787; it is a measure of Hutton's abilities as a networker that he could be invited to kiss the hand of George III for writing a book about conic sections (Hutton 1787; Anonymous 1805, 67). Later he distilled the mathematical curriculum he was teaching at Woolwich into a two-volume printed *Course* (Hutton 1798). Hutton's first wife died and he remarried in 1785. The period was also marked by the deaths of two of Hutton's daughters: Charlotte Matilda, still at home, of lung disease and Camilla of yellow fever in Guadeloupe, with her soldier husband. Camilla's infant son became Hutton's responsibility (Vignoles 1982).

A final strand of Hutton's activity was mathematical popularization. He spent ten years working on his monumental dictionary, which distilled much that he had learned about recent and living mathematicians from the *Ladies' Diary* and a lifetime's worth of reading in mathematics and its history (Hutton 1795). He later undertook the translation of Ozanam's 1696 *Mathematical Recreations* (in Montucla's 1790–91 edition) into English, and was one of three editors on a massive eighteen-volume abridgement of the *Philosophical Transactions* from 1664 to 1800

(Hutton *et al*. 1809).

Hutton retired from his work at Woolwich in 1807 and spent the next decade and more on activities designed to secure his intellectual legacy. All of his major books received new, revised editions, sometimes considerably expanded. And Hutton used his status and his unparalleled knowledge of the British mathematical scene to provide a long stream of recommendations for mathematical teaching posts at schools and military academies. By the time of his death most of the prominent mathematics teachers in Britain were the recipients of Hutton's support and recommendation (Bruce 1823, Anonymous 1821).

There was still controversy to be faced. Sir Joseph Banks now controlled what has been called a 'learned empire' encompassing the Society of Antiquaries, the Society of Dilettanti, the Board of Longitude and the British Museum as well as the Royal Society. The mathematicians who had seceeded from the Royal Society in 1784 had come to think of themselves as an oppressed minority against this Goliath, and collected folklorish examples of wrongs done to them by Banks and his cronies (Miller 1981; Miller 1983; Heilbron 1993). Sometimes their concerns were well founded. The mathematical curriculum at Woolwich came in for savage attack in print during the 1810s, as did its governor and chief mathematics master (Saint 1811). Both were Hutton's protegés. In 1820 Banks opposed the formation of the Astronomical Society (unsuccessfully). In 1815 Hutton was obliged to sell his large library of mathematical books when Banks blocked its acquisition by the British Library (Bruce 1823).

But Hutton, in the event, laughed last. Banks died in 1820 and was replaced as President of the Royal Society by Sir Humphry Davy, a figure altogether more congenial to Hutton and his friends. In a kind gesture Hutton was elected onto the Council of the Royal Society once again, and he even published one final paper in the *Philosophical Transactions* (Hutton 1821). His friends busied themselves attacking Banks in anonymous newspaper articles. Charles Hutton died in January 1823 at his home in Bedford Row, near Holborn.

2. Hutton's reputation

For many during his lifetime Hutton was an admired celebrity, his achievements as a teacher, writer and natural philosopher self-evident. At the time of his death, the Duke of Wellington stated that his country would be forever in his debt for what Hutton had contributed to military training and battlefield tactics. The Lord Chancellor, who had been one of Hutton's pupils in Newcastle, said that his contact with him had been 'one of the many blessings' in his long life, and he would 'long be remembered by a country so essentially benefited by his life and works' (Gregory 1823). Hutton's many friends and protegés filled the columns of the local and national newspapers – and the *Ladies' Diary* – with eulogies, sometimes extravagant. A year or so before his death a committee of subscribers commissioned a marble bust of Hutton and a medal commemorating his work on ballistics and on the density of the earth (Anonymous 1821).

In part Hutton's celebrity was a result of his longevity; by the end he could reminisce without fear of contradiction to an audience of younger friends who did not remember the disputes of 1784, still less the 1760s in Newcastle, and it is therefore no surprise that there were many accounts of him that made no attempt to question the too-neat rags-to-riches story, complete with second-act setback and triumphant recovery.

But there were dissentient voices nevertheless. Manuscript reminiscences collected in Newcastle – which did *not* make it into the printed 'lives' of Charles Hutton – recalled a sharp-tongued, arrogant young man (Woodhorn: Northumberland Collections Service SANT/BEQ/26/1/7/77, SANT/BEQ/26/1/7/98/a and SANT/BEQ/26/1/8/584). One local historian printed the story of his first wife, left behind in Newcastle in 1773, and at least one abandoned mistress (Mackenzie 1827, 560). His family similarly preserved a knowledge of the breakdown of his first marriage, the illegitimacy of his youngest daughter and a catastrophic row with one of his grandsons: Charles Blacker Vignoles, the only one of his grandchildren to achieve prominence. All of this, together with the fact that Hutton had once worked down the coal pits, they carefully kept out of public view; Hutton's manuscripts and letters were meanwhile the subject of a number of accidents, some of which may have really been accidental.

More publicly in London, supporters of Joseph Banks continued to press the view that Hutton had presided over an ossification of the syllabus at Woolwich, that his celebrated estimate of the density of the earth was simply wrong, and that his work on ballistics had made no difference to military practice whatever. This was essentially the view of Banks himself, that Hutton was a solid teacher and a gifted calculator who should never have aspired to be more and of whom it was absurd to claim that he had achieved more (Anonymous 1811; Anonymous 1820).

Time passed, and Hutton remained visible through re-editions of his books. His textbook of arithmetic was still in print in the 1860s, his volume of tables in the 1890s. His *Course of Mathematics* was used at military colleges in Britain and America until at least the 1840s, and as a result of enthusiasm on the part of the Bengal artillery it was translated into Bengali, Arabic, Sanscrit and Marath'a by 1840, giving Hutton an international reach equalled among Georgian mathematical writers only by Robert Simson's edition of Euclid's *Elements*.

On the other hand, he was at the same time falling out of fashion. He had been strongly associated with the *Ladies' Diary*, the network of both amateur and professional mathematicians it supported, and the model of mathematical achievement it represented: small, incremental increases in the stock of mathematical knowledge, motivated by specific problems or puzzles (Hutton 1775, 1). By the second half of the nineteenth century, this world of 'philomaths' had all but died out, and mathematical achievement looked very different, with conceptual innovation at a premium.

Furthermore, Hutton was a member of the last generation of creative British mathematicians who did not actively participate in the style of analysis pioneered in Paris, Germany and St Petersburg by – chiefly – Euler, Lagrange and Cauchy. Hutton was a keen reader of continental mathematics, but he evidently felt unable to use in his textbooks or even his research writings notation and conceptual vocabulary increasingly unfamiliar in Britain. Already by the start of the nineteenth century some reformers were making continental methods the chief test of mathematical worth, and the reputation of Hutton and some of his contemporaries suffered at the hands of reformers notably at Cambridge and in the Analytical Society (Miller 1986;

Guicciardini 2004).

The many posthumous editions of Hutton's books, indeed, were in a several cases re-written so as to bring him up to date, subordinating textual fidelity to relevance to new generations of students; large sections were removed or re-written, analysis was substituted for fluxions, new research results were added. If the name of Hutton was being kept before generations of students, his authentic voice and his distinctive achievements were not.

Thus by the start of the twentieth century Hutton's star had waned. By the time of his bicentenary in 1937 he could still be, perhaps rather optimistically, called 'well-known' by a correspondent to *Nature*, his *Dictionary* a uniquely valuable contribution to scientific biography (Anonymous 1937). By the early twenty-first century he certainly could not be called well known.

3. Hutton as a historical subject

Some of the same facts that made Hutton's star wane during the nineteenth century have contributed to his lack of prominence as a historical subject. If active participation in continental analysis is the measure of a mathematician, Hutton deserves to be forgotten; if conceptual innovation is what creative mathematics is about, he scarcely qualifies as a mathematician at all. Some historical writing is dismissive of Charles Hutton for these kinds of reasons, and in its support it has even been claimed that his mathematical work lacked novelty, that his love for detailed calculation and numerical accuracy made him an anachronism even in his own time, and that his scientific work on gunpowder was insignificant for the design and use of cannon: all claims that are demonstrably false (for instance Smith 1923–25, 2.458). The absence of a well-organised *nachlass* also makes him a relatively poor candidate for historical study: only a small fraction of his letters and papers seem to have survived, despite his own efforts to organise and hand on to colleagues at least some of them.

On the other hand, as the history of mathematics matures as a discipline, we are rightly more attentive to actors' categories and their judgements about importance,

and at least as attentive to the experiences of practitioners and technicians as to high-concept narratives about intellectual innovation. On both counts Hutton seems likely to come out rather well. Indeed, he is not just a rewarding but a versatile, malleable historical subject, capable of being related to several longer-term historical processes.

One is the mathematicians' secession from the Royal Society, and the folklore of the seceding group, in which mathematicians were a persecuted minority unwelcome at the Royal Society and struggling to organise themselves against determined oppression from Banks's 'learned empire' and its representatives. Hutton and his immediate circle initiated this way for British mathematicians to think about themselves, and sustained it for a generation or more, though Hutton himself certainly did not participate in all its manifestations, nor indeed live to see the end of it. Long after his death British mathematicians were refusing election to the Royal Society and giving reasons for it that sound strikingly like the views of the Society and its agenda current in his day (Higgitt 2006; Heilbron 1993).

Or, again, Hutton can be part of a story about the changing status of mathematics in Britain during the eighteenth and nineteenth centuries. As practitioners repackaged their skills as abstract knowledge from the seventeenth century onwards, mathematics had a special place: more frequently appealed to and increasingly seen by elite knowledge-makers as holding universal significance (Dear 1995). The philomath journals – the *Ladies' Diary* and its imitators – began a process in which mathematical discourse acquired a place in a public sphere based on commercial print and the values of commercial print (Costa 2000, 2002). Hutton contributed more than anyone to this process, in particular through his *Dictionary* and his translation of Ozanam, and also through his relentless embedding of mathematics teaching in military training. He did more than anyone of his generation for the visibility of mathematics and for the acceptability of talking about it in public, paving the way for its reintegration into British science a generation or so later.

And finally, there is the story of the changes that took place in British mathematics after about 1800, when the developments taking place at Paris and Petersburg – never really very far from view – produced responses ranging from derision to panic (Guicciardini 2004). In the event neither extreme prevailed, and British mathematics

underwent a gradual evolution – more gradual than some reformers would have liked (Enros 1983) – in the direction of continental notation and the programme and methods of Laplace and others (Guicciardini 1989). It lost little of its distinctiveness, and although the views of the panicked minority have sometimes been taken for the truth and histories written of the 'decline' and 'revival' of British science, it was in fact the experience of the more moderate majority that was decisive. Of that group Hutton is a key representative: outward-looking in his reading and his correspondence, but for professional reasons tied to the British notation and research programme. Key admirers of Laplace such as John Playfair were his personal friends; two of the founders of the Analytical Society – Babbage and Herschel – held written testimonials from him (Wardhaugh 2017b).

Why is Hutton so versatile as a historical subject? Why, indeed, did he divide his contemporaries? Ultimately because of the extraordinary range of different worlds he inhabited and roles he played. Hutton was a philomath, a reader and solver of puzzles. He was a mathematical practitioner, a teacher, surveyor and author. He was a calculating assistant, a translator, an editor and an overseer of almanacs. And he was a Fellow of the Royal Society and an experimental philosopher. This is why the same man could be for Samuel Horsley 'one of the greatest mathematicians in Europe', for Wellington a real practical help to his country's armed forces, for Banks a bothersome and 'forward young man' and for Banks's friends a mere technician (Anonymous 1784, 151; Royal Society Archive MM/1/46a; Bruce 1823, Anonymous 1811). And it is why he is not just malleable but fascinating, and worth study, as a historical figure too.

Does Charles Hutton deserve a rediscovery by historians of mathematics? Yes, I think he does. If he is not important as major discoverers are important, he is a key representative of a too-often forgotten world of mathematical publication, discussion and achievement in Georgian Britain. And he illustrates the difficulty of getting history of mathematics right in several ways: the difficulty of taking actors' categories and judgements seriously and the difficulty of characterising achievements in technical disciplines when the networks that once contextualised those achievements and the personal roles that made them meaningful are gone.

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