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Rough Trade

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- *The Man Who Knew Too Much: The Strange and Inventive Life of Robert Hooke 1635-1703* by Stephen Inwood

If you are a scientist at an American research university like mine, you know what to do if you think you've hit on some technique or bit of knowledge that might have commercial potential. You go online to the university's technology transfer office, download an invention and technology disclosure form, and fill in the details. You have to do that because all such intellectual property (IP) discovered by this university's employees belongs to the university. If the local bureaucrats think there's something in it, they will file a provisional patent and, after formally offering it to any government agency that funded the research – which usually declines – they will start hawking the IP about to see if any entrepreneurs or companies want to license it. Priority in your IP is protected at this stage, and you can now go ahead and publish if you wish, but eventually you may proceed to a full (or utility) patent, where property rights are wrapped up more securely, and, while IP lawyers make fortunes from litigation about who in fact owns the property, basically the matter is now in the domain of formal law. If the university does manage to license the IP, you will get perhaps 35 per cent of the royalty stream. Or, if that's not enough for you, you can cut yourself free from academia and take your chances with the venture capitalists as an independent entrepreneur.

In 1675, Robert Hooke, professor of geometry at Gresham College and long-time curator of experiments at the Royal Society, reckoned that he had made a mechanical discovery of enormous significance and commercial potential: a balance-spring watch of such astounding accuracy and robustness that he believed it was capable of solving the

problem of finding the longitude in the open seas. If, with the aid of this watch, your navy and commercial trading fleet could do that, there was little question that you could rule the world. Recognising that he could have IP with world-changing possibilities, Hooke went to see the King and asked him for a patent – that's how you could secure your rights to IP in Restoration England, though it was more customary to work through Crown officials. Hooke gave the King an early version of his watch and rejoiced at the royal reaction: 'The King most graciously pleased with it . . . He promised me a patent' – though the watch never worked as well as Hooke had hoped and no patent was ever issued for his device. In the mid-1670s, a solution to the longitude problem was worth the astounding sum of £4000 to its inventor, at a time when an annual income of £50 would just about qualify you for the middle station of London society. It was a hundred years before Parliament paid out about five times that amount to the 'lone genius' John Harrison in 1773 for the magnificent marine chronometer that provided a working solution to the longitude problem.

The patent Hooke wanted was a type of 'Letters Patent' – literally 'open letters', sealed but not sealed up, conferring the special privilege of monopolistic production rights as a direct expression of the sovereign will. A crucial episode in the restriction of absolutism, the 1624 Monopolies Act had stripped away almost all such acts of royal prerogative, with the important exceptions of printing privileges and inventions. The King might take advice on such matters, but he could basically do whatever he liked, and indeed, in this case, he and his brother, the nautical Duke of York, took a personal interest in the accuracy of various versions of Hooke's watch, monitoring their performance over weeks and months in the royal closet at Whitehall. Charles II had time for repeated discussions with this physically ill-favoured, socially maladroit and reputedly malodorous mechanic because he understood very well what such an invention was worth, and, accordingly, what mechanics who could deliver such goods were worth. If theoretical knowledge was not necessarily power, the King knew that skill of this sort surely was.

By the mid-1670s, Hooke's fertile mind and dextrous hands had

already produced a stream of real and advertised inventions that promised to transform the practice of a range of sciences, the technologies that depended on precision measurement, the possibilities of human transport, and much else: microscopes; astronomical, navigational and meteorological instruments; calculating machines; waterpoises for determining specific gravities; all manner of timekeepers; a universal joint; a diving bell; a bullet-proof vest; a 'sailing chariot'; a velocipede; improvements to the camera obscura, oil lamps and musical instruments, and in techniques for staining marble, printing maps and milling apples; and a formal method for producing an endless supply of such things, an 'Art of Invention, or mechanical Algebra'. In 1658, when he was in his mid-twenties, Hooke was substantially responsible for devising the iconic experimental instrument of the Scientific Revolution – the air-pump, whose proprietorship by his employer and patron, Robert Boyle, caused it to be known as the *Machina Boyleana*. Towards the end of his life, Hooke dabbled in pharmacology, besotted with the medical and psychedelic virtues of marijuana. He also announced, but did not choose publicly to demonstrate, his invention of sprung shoes that would allow the wearer to bound around London in 12-foot-high leaps, and 'thirty several' different ways of flying, mostly involving mechanically flapped wings attached to the aviator. Much earlier, Hooke had expressed confidence that he had cracked the secret of mechanically assisted flight, and in 1674 he was trying to establish his priority while protecting his intellectual property, coyly letting a councillor of the Royal Society know 'that I could fly, not how'. Hooke never claimed that he *had* flown, though, for him, what is now called 'proof of concept' was always far more important than the development (or 'perfection') of any specific technology. In 1676, he went to see the Duke's Company perform Thomas Shadwell's lampoon of Royal Society 'virtuosi' and was mortified because he was convinced it was so obviously directed at him that the audience 'almost pointed'. Shadwell's virtuoso was concerned only with the 'speculative part' of knowledge: 'I care not for the practic. I seldom bring anything to use, 'tis not my way.'

While he repeatedly and aggressively claimed priority for almost all of his inventions and discoveries, there is no evidence that before

1675 Hooke had ever sought the protection of patent, and he did so now because of the scale of the potential rewards and because he was stung into action by formidable competition: a watch invented by the Dutch mathematician and natural philosopher Christiaan Huygens, which similarly promised accuracy adequate to solve the problem of longitude. It was offered to the King for a patent by Henry Oldenburg, Secretary and record-keeper of Hooke's own Royal Society. Hooke was furious with Huygens but livid with Oldenburg. He announced that he had both invented and constructed exactly this kind of watch more than ten years before and that Oldenburg had betrayed the secret of his invention to Huygens. Hooke immediately launched a search through the Society's Register Book for confirmation of his priority, but, finding none that convinced most of his colleagues, he then accused Oldenburg of maliciously doctoring the records. In the canine vocabulary that Hooke greatly favoured, Oldenburg was denounced as a 'Lying Dogg'.

This sort of episode occurred frequently in Hooke's life. More than anything else, it defined who he was. He conducted vicious disputes over intellectual property, institutional rights or technical skill with Leibniz, the astronomers Johannes Hevelius and John Flamsteed, the cartographer Nicholas Mercator and, most disastrously, with Newton, who, Hooke claimed, had plagiarised from him the inverse-square law of gravitation. If you crossed Hooke's interests, you were in for some of the ripest abuse going: his enemies were, variously, 'ignorant coxcombly fools', 'conceited cocks combs', 'raskalls', 'villains', 'spies', 'slugs' and, repeatedly, 'dogs'. Hooke was a notoriously good hater. And what he hated most of all was not to get what was coming to him, to have his intellectual property pirated. When it came to such things, Hooke was, as Stephen Inwood rightly says, 'a rough fighter'.

That attitude was at once wholly natural and deeply problematic in Restoration scientific circles. As Rob Iliffe and Adrian Johns have shown, it was the norm for mechanics and tradesmen vigorously to contest intellectual property rights and to withhold secrets that might lead to financial gain: after all, their business was at stake. Mathematicians followed similar conventions. Those who reckoned they had discovered an important result might announce their

findings in a cypher deposited with a learned society or trusted individual – Latin anagrams were customary – thus establishing ownership and priority while leaving themselves free to 'perfect' the matter at leisure. If the legitimacy of the claim was later challenged, the mathematician could then publicly decode the anagram, which was usually a concise, even oracular, key to the solution. Indeed, the roles of mathematicians, mechanics and tradesmen significantly overlapped in the late Renaissance and early modern periods: while 'pure mathematics' considered quantity in the abstract (arithmetic, geometry and algebra), what Francis Bacon called 'mixed mathematics' dealt with the manifestations of quantitative relations in actual physical entities, so including many investigations and practices central to the trades and the arts of war: astronomy, optics and music; but also surveying, architecture, ballistics, fortification, navigation and pretty much anything that would now come under the heading of 'engineering'. In Bacon's scheme of things, practitioners of mixed mathematics might very well be tradesmen or mechanics. A familiar complaint of university mathematicians about early to mid-17th-century culture was that '*Mathematicks* . . . were scarce looked upon as *Accademical Studies*, but rather *Mechanical*; as the business of *Traders, Merchants, Seamen, Carpenters, Surveyors of Lands*, or the like.'

What made trade attitudes to intellectual property rights so problematic in Restoration England was the ideology of inquiry central to the identity of the Royal Society of which Hooke was an employee, a programme of experimental natural philosophy identified with the work and person of Hooke's patron, the Honourable Robert Boyle. Boyle's first, and anonymous, publication invited 'all true lovers of Vertue & Mankind, to a free and generous Communication of their Secrets and Receits in Physick', and condemned 'the avarice' of those 'secretists' who secured profit through the practice of intellectual privacy. Natural philosophy would progress just insofar as its practice was open, humble and sociable. Among the notorious 'secretists' that Boyle and his colleagues condemned were the alchemists, and among the similarly criticised 'dogmatists' were the mathematicians. Bacon poured scorn on their 'daintiness and pride', while the Elizabethan humanist Roger Ascham

worried about the effects of a mathematical life on good manners: 'all Mathematicall heads, which be onley and wholly bent to those sciences', were 'unfit to live with others' and 'unapt to serve in the world'; as mathematical studies 'sharpen mens wittes over much, so they change mens manners over sore'. Socially, psychologically and culturally, mathematics and philosophy were an uneasy fit.

Inwood isn't a professional historian of science. His magnificently sprawling *History of London* (1998) was the springboard for taking up Hooke's very London life, and, while this generously proportioned biography is well stuffed with detail, Inwood means to spare the general reader certain fine distinctions observed among the specialists. So, crucially, he decides to refer to Hooke as a 'scientist' – a mid-19th-century neologism – and announces that the early modern term this replaces is 'natural philosopher'. The substitution is well-intentioned: it's a fairly standard, and usually innocuous, move in translating archaisms for a contemporary readership. But in this case the effect isn't innocuous, for it precipitates enormous problems in understanding who Hooke was, the codes and conventions which operated on him and which he creatively manipulated to demand his rights and entitlements. And the result is an otherwise valuable and craftsmanlike biography that fails to pin down its subject's motivating identity or, rather, the force-fields of often conflicting identities in which Hooke operated. As Inwood eventually recognises, practically nobody in 17th-century England referred to him as a 'philosopher'. The geometry professorship at Gresham College from 1664, while it established residence rights in the place where the Royal Society held its meetings and gave him an annual income of £50, didn't mean very much in Restoration culture. (Gresham was intended as an academy of useful knowledge for London's mercantile classes, but by the 1660s had become largely moribund. Unlike the Society's Oxford and Cambridge Fellows, Hooke didn't have any real 'academic' standing.)

Far more commonly, his identity was assimilated to his remunerative roles in the Royal Society (as its curator and, more briefly, its secretary); to his early activities as Boyle's paid assistant; to his lucrative work with Christopher Wren as City Surveyor rebuilding London after the Great Fire; and to his independent career as one of

England's greatest architects and civil engineers, responsible for the new Bethlem madhouse, the Royal College of Physicians, the Fish Street Hill Monument to the Fire, the Haberdashers' School, Montagu House in Bloomsbury, Ragley Hall in Warwickshire, Ramsbury Manor in Wiltshire, the Fleet Ditch, the reconstructed Tangier Mole, and possibly several more of the rebuilt City churches than the three (St Benet Paul's Wharf, St Edmund the King and St Martin within Ludgate) that are now fairly reliably ascribed to him, rather than to his many collaborations with Wren (notably including St Paul's). But his enemy John Flamsteed reflected the general assessment when he aimed to insult Hooke as an impudent 'Mechanick Artist', as did his friend John Aubrey when he admiringly called Hooke simply 'the greatest Mechanick this day in the world'.

The distinction between the natural philosopher, on the one hand, and the mechanic or mathematician, on the other was consequential. The former was widely understood to be someone seeking to reveal the real underlying causal and material structure of the world; the latter might discern regular patterns in nature, especially with a view to artificial manipulation, without necessarily being concerned with their causal explanation. Hooke did indeed contribute to natural philosophy: his great 1665 *Micrographia* was a cornucopia of philosophical speculations as well as microscopic observations; he had very definite ideas about the causes of gravity and of earthquakes; he wrote about the physical nature of comets; and the law of springs named after him – *ut tensio sic vis*, or the power of a spring is proportionate to its extension – was an outgrowth of his kinetic theory of matter as well as his mechanical work on the air-pump and the balance-spring watch. But the centre of gravity of his career was in mechanics and 'mixed mathematics' rather than in philosophy: he was a thinker, but he was even more of a doer.

Lacking the bureaucratic and legal structures that secure intellectual property in late modernity, Hooke felt obliged to perform his entitlement to those rights, and it was those successive performances that made him so abrasive and so uncongenial to the gentlemanly manner of doing experimental philosophy applauded by his colleagues in the early Royal Society. Inwood writes that Hooke was

'more a mechanic than a gentleman', but, in truth, he wasn't a gentleman at all, and didn't pretend to be. (He had come to London at the age of 13 from the Isle of Wight, with little more than his genius and a recommendation for an apprenticeship with the portraitist Peter Lely.) For wealthy gentlemen like Boyle, the pursuit of natural knowledge might be open and generous, but for Hooke the limits to openness and civility were set by the fact that this was his way of making a living: he was one of the first entrepreneurial professionals in a world of amateurs, and, as Inwood says, he had at times 'to earn his money like a tradesman'. There is evidence that in the late 1670s he was retailing his watches directly to customers. For all the Royal Society's celebration of the links it was going to forge between the worlds of trade and of reformed natural knowledge, actually being 'in trade' was a cultural handicap: 'sordid Interests' were considered to compromise the integrity and generosity proper to the new intellectual order, and Hooke was pointedly criticised by the Royal Society's President for 'minding business and profit too much'. There were times when his behaviour became so irritating that the Society considered chucking him out, but, as their major source of instrumental skill, he was too valuable.

Hooke himself understood the proper form. In the dispute with Huygens, he accused Oldenburg of making a 'trade' in scientific intelligence; in 1678, he scolded Leeuwenhoek, the Dutch microscopist (and draper) for failing freely to communicate his instrumental secrets; and in the 1690s, he felt able to condemn the mercenary Generation X of contemporary London culture who insisted that natural inquiries were worthwhile only insofar as they contributed to the bottom-line: 'all other notions are insipid with them, besides such as bring ready Money.' At the same time, Hooke knew very well how to deal with mathematicians, mechanics and, indeed, philosophers who were wary of the public sphere, seeing it as a forum encouraging dispute and threatening wholly legitimate concerns for intellectual property. The contest with Huygens and Oldenburg convinced him that the Royal Society was dangerously open. How could you encourage inventors to communicate their knowledge in a place so likely to leak? So he plotted the formation of a new coffee-house 'club' comprising like-minded fellows who would

bind themselves to absolute secrecy, even about the club's very existence. And, although he eventually infuriated Newton enough to keep him away from the Royal Society until Hooke was dead, the two mortal enemies agreed about the dangers of a public space for the safe exchange of scientific views: civility was more easily maintained when the public was excluded. In the mid-1670s, Hooke attempted to assure Newton that any exchanges would remain private if he preferred, and Newton concurred. 'What's done before many witnesses is seldome without some further concern than that for truth: but what passes between friends in private usually deserves ye name of consultation rather than contest.'

Two years after Samuel Pepys gave up keeping his diary in 1669, Hooke began his. The two men knew, and generally admired, each other. Pepys, a future President of the Royal Society, who had great respect for instrumental skill, remarked of the deformed Hooke that he 'is the most, and promises the least, of any man in the world that ever I saw'; intermittently noted that he found Hooke's discourse 'noble' and 'mighty fine'; and accounted *Micrographia* 'the most ingenious book that ever I read in my life'; while Hooke's generally mean-spirited diary briefly acknowledged occasions when Pepys was 'very civill and kind' to him. Both diaries document daunting work-rates and severe shortages of sleep; frantic circulations through the City's coffee houses, taverns and workshops; and the manipulation of networks of acquaintance that cut right across Restoration distinctions of social station. And both matter-of-factly record the sexual exploitation of female domestic servants. Hooke, who never married, and who probably never had sex with any woman not working for him in his own house, commenced sexual relations with his own niece (and housekeeper) Grace Hooke when she was 16 and he 41, and probably maintained such relationships with each of the housekeepers who preceded and followed her. Each coupling (or 'wrastling') was meticulously signalled by the zodiacal sign of Pisces, occasionally with specifications as to position ('Nell supra', on top), causal mode of ejaculation ('mane', by hand) and effect ('Hurt small of Back').

Pepys's and Hooke's diaries were both budgets of their authors' lives;

ledgers of physical, financial and commercial comings-in and goings-out; of justices and injustices; of the authors' constantly shifting standing in the world's esteem. But they were distinguished by the mode and manner in which such things were accounted. Pepys cast up his financial accounts annually, and sometimes monthly, while Hooke rarely let a week go by without noting what was owed him, by whom, for what goods and services, precisely what the bill was at the coffee house or tavern, and who had neglected to pay their fair share. Pepys was capable of acts of spontaneous generosity and of losing himself in the sheer joy of living, but, while Hooke was not without a gift for long-standing friendship, his diary documents a view of the world that was overwhelmingly cynical, melancholy and resentful: his inventions stolen, and, when properly attributed to him, insufficiently appreciated; moneys owing him unpaid; contractual obligations to him unfulfilled; lesser men securing the preferment and acclaim that were rightfully his. If Hooke enjoyed his life, his diary offers little evidence of it.

He was more concerned with intellectual property than with his colleagues' opinion of him, and history has served him accordingly. The Newton biographies defy counting; there are scores of biographies of Galileo and Descartes; more than ten biographies of Wren have been published since the 1930s; and the revived 'Boyle industry' pumps out more academic product every year. Hooke was, beyond question, one of the towering figures of the Scientific Revolution, but Inwood's is the first serious biography since that of Margaret Espinasse almost half a century ago. Academic history has always tended to favour truth over skill, the philosopher over the engineer, and, even now, the attractive over the repellent personality, just as it finds it easier to cope with history's hedgehogs than its foxes. The sprawl of Hooke's career – his refusal to stick to any one definable discipline or trade – annoyed his masters at the Royal Society and it would defeat all but the most versatile modern biographer. Inwood does his very best, and, dry and unfocused as it is, *The Man Who Knew Too Much* is nevertheless a genuine attempt to cover the full range of Hooke's professional work, taking the architecture, the mechanical inventiveness and the civil engineering as seriously as the contributions to mechanics and microscopy, and

treating the pathos of the end of his life as well as the promise and massive achievement of his early manhood. Inwood is no hagiographer, and, while he cannot bring himself, unlike Espinasse, to represent Hooke as 'generous' or 'noble', he still feels that Hooke needs defending from his detractors and offers the best excuses he can for the disputatious pattern of his career. Yet there is still room for another Life of Hooke, one that is more attuned to contemporary social and cultural distinctions, more interested in how and why he situated his various activities between public and private domains, and more sensitive to the contemporary meaning, and means of owning, intellectual property.

Hooke lived his last years, as a friend wrote, 'Miserably, as if he had not sufficient to afford him foode & Rayment', dying alone and lice-infested in the cluttered Gresham rooms which he had occupied continuously for almost forty years. His associates had heard him say from time to time that he intended to leave his estate to support the activities of the Royal Society whose employee he had been for so many years, and so, when the books and the mechanical bits and pieces had been inventoried and disposed of, a thorough search was made for his will. None was found, and there was no evidence that one had ever been made, but when a great iron chest was opened in Hooke's rooms, the searchers discovered a small fortune: £8300 in cash, equivalent to well over a million pounds in current value. Over a lifetime, Hooke had succeeded in turning his enormous mechanical skill into a mountain of money. However, what 'the man who knew too much' did not know was how to enjoy the fruits of his labours, or how finally to dispose of the property he had accumulated with such difficulty. Dying intestate, all that cash, all that condensed and monetised intellectual property, went to his next of kin, probably a cousin, an illiterate woman who signed her name by drawing a pirate's hook.

Steven Shapin teaches at Harvard and has written several books on the history of early modern science. His next will be *The Life of Science: A Moral History of a Late Modern Vocation*.

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