Claiming ownership in the technosciences: Patents, priority and productivity

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Abstract

Intellectual property (IP) in and around the sciences is nowadays a matter of high public as well as historical interest. Here we propose an integrative concept of IP that, drawing upon insights scattered across decades of scholarship, forges them into a framework for a new style of historical research. This expanded concept of IP takes in patents, copyright and other legal instruments (or their surrogates)—IP in a narrow sense—but also other kinds of ownership claims relevant in the sciences—IP in a broad sense. The latter include priority claims and what are here called productivity claims, made when a body of theoretical principles is asserted to underpin useful techniques and technologies. Attention to the interaction of patent, priority and productivity claims promises to lead historians to new questions, answers, and sources, as attested in the papers gathered in this special issue, on three technosciences (electrical science, aeronautics, agricultural botany) in Great Britain in the decades around 1900.

1. Intellectual property and historians of science, then and now

It was new inventions that brought most visitors to the old Patent Office Library in London. Housed from the early twentieth century in a sumptuous gallery-style building near Chancery Lane, the Library mainly served inventors and patent agents who wanted to know the details of freshly patented inventions, to discover whether their ideas had been anticipated, or to prepare a case for litigation. A Russian physicist visiting in early summer 1931 had something else in mind. Boris Hessen, Director of the Moscow Institute of Physics, was then in London as part of an eight-member delegation from the Soviet Union to an international congress taking place at the Science Museum (home of the Patent Office’s erstwhile other collection, the mid-nineteenth-century Patent Museum). The meeting was on the history of science and technology, and the Soviet papers sought to showcase dialectical materialism as the key to rethinking science’s past as well as its present. They were scheduled, however, for the very end of the congress, and more than a few presentations were notable for what another participant, the journalist J. G. Crowther, described as their “antiquarian spirit” (with plenty of “reminiscences from the elderly, and trivia from obscure amateurs”). The temptation to miss a few sessions must have been strong. In any event, Hessen’s own paper dealt with the history of English science, and there was, as he explained to Crowther, more research to be done. “Hessen was most anxious to visit the Patents Office Library.” Crowther later recalled, “to see historical material bearing on the influence on British science of patents of the Newtonian period and earlier . . . I took him to the Librarian there.”

Hessen’s paper, entitled “The social and economic roots of Newton’s Principia,” was immediately recognized as the outstanding contribution from the Soviet side. It took aim at the heroic image of science as the key to rethinking science’s past as well as its present.
of Newton as, in Hessen’s words, “an Olympian standing high above all the ‘earthly’ technical and economic interests of his time.” On Hessen’s reading, the Principia is fundamentally embedded in those interests, in that it provided solutions to problems that arose for Newton not as timelessly interesting abstract puzzles about motion but as the most general form of specific technical problems threatening to delay the advance of the trade-based “merchant” capital of his day—problems chiefly in navigation, mining, and warfare. Noticing such links with Newton’s socioeconomic environment thus helped make sense of what got included within his natural philosophy but also, Hessen went on, what got left out. Here his research into Newton-era patents came into play. “As early as 1630,” he reported, “a patent was granted in England to Ramsay for ‘raising water with the aid of fire during deep mining works.’” So, steam engines were around in Newton’s day, and were economically useful too. In principle, they could have become objects of study for Newton and might even have led him, or his followers, to develop thermodynamics. But nothing like that happened. Why? As Hessen suggested, the inefficient functioning of seventeenth-century steam engines posed no serious problems for merchant capital. Only with the later rise of production-based industrial capitalism, and the need for the manufacturing motor power which steam engines promised, did efficient steam engines become economically desirable in a big way, and so scientifically interesting in a big way.2

For Crowther as well as for a number of young leftist scientists at the congress, including Joseph Needham and Desmond Bernal, Hessen’s paper was transformative. It revealed the history of science and technology as a source not just of interesting information but of politically significant insight. Each would go on to lavish huge energies on history as part of his own project for scientific-political reform. Yet the paper’s importance went well beyond its impact on this small, sympathetic group. Even readers unsympathetic to the argument found themselves compelled at least to say why they were unsympathetic. In so doing they engaged exactly the kinds of newly exciting, contextual questions that Hessen had dramatized—questions about connections between scientific change and technological, social, and economic change, and political, philosophical, and religious change too. (Hessen dwelt at length on how Newton’s integrating of God into his mechanistic scheme made sense only against the backdrop of sectarian strife in his England.)3

One reader who was won over to Hessen’s questions, if not answers, was a young American sociologist of science, Robert Merton. A footnote in his Science, technology and society in seventeenth century England (1938) shows just how far from antiquarianism—and how close to the Patent Office Library—Hessen was leading historically minded students of science in the 1930s:

The frequency of disputes concerning priority which, to my knowledge, first becomes marked in the sixteenth century, constitutes an interesting problem for further research. It implies a lofty estimation of “originality” and of competition; values which were very largely foreign to the medieval mind which commonly sought to cloak the truly original under the tradition of earlier periods. The entire question is bound up with the rise of the concepts of plagiarism, patents, copy-rights and other institutional modes of regulating “intellectual property.”4

The closeness was literal: the same page includes information on the high proportion of early modern English patents to do with mining, based on statistics compiled in part “from the Patent Specification files in the Patent Office, London.”

What became of these interlinked interests in how intellectual property, pure and applied science, and social identity played out in the history of science and technology—the “technosciences,” to use the now ubiquitous shorthand popularized by Bruno Latour? One can as easily tell a story of continuous development as of discontinuity and neglect. On the side of continuity, the contextualizing ambition now taken for granted among professional historians when they turn to the technosciences extends back, in a complex but well-understood way, to Hessen and his legacy, as does some of the institutional support their work enjoys.5 Merton’s preoccupation with intellectual property, and the Marxian tradition too, carried forward, notably into Jerry Ravetz’s remarkable, technologically engaged 1971 book Scientific knowledge and its social problems. Ravetz’s book in turn was one of the inspirations for John Pickstone’s project, from the 1990s, to connect what he calls “ways of knowing” and “ways of making,” lately under the banner of “working knowledges.” Still more recently, Pickstone’s former colleague Jon Agar has produced a massive history of twentieth-century science organized around a notion of “working worlds” that, in stressing the role of commerce and the military as sources of the problems that busied twentieth-century scientists, and the role of their abstracted and artificial approaches to these problems as tending to mask those origins, strongly recalls Hessen’s precedent.6 Outside that lineage, meanwhile, public debates over gene patents, internet piracy, open-access scientific publishing and so on have energized studies seeking longer historical perspectives.7 Dan Kevelles, Mario Biagioli and Adrian Johns in particular have done a great deal both to fill in the big picture from the early modern period and to attract others to the task.8

And yet intellectual property has stubbornly remained, within the history of science, a specialized interest and a peripheral topic. Undoubtedly the Cold War has much to answer for here. It was not Hessen that was read on Newton in the new history of science departments of the 1950s and 60s, after all, but the anti-Marxist Alexandre Koyré, who treated early modern science as a


5 For “technoscience” defined, see Latour (1987, p. 28); For a lively discussion of the advantages and disadvantages of this term for historians of science, see the papers collected in two special issues of Perspectives on Science (2013) nos. 2 and 3. On the contextualist, Hessen-inspired vision of the history of science at work in Needham’s efforts to get the subject established at Cambridge University in the late 1930s, see Schaffer (1984, pp. 23–24). After the war, the similarly inspired Sam Lilley helped to set up the British Society for the History of Science, serving on its Council and as the first editor of what became the British Journal for the History of Science: see Ensbahk (2009, esp. pp. 579–580, 586–589).

On how and why their contextualism became attenuated even (indeed especially) at Cambridge, see Mayer (2004, p. 70).


7 American biotech of the twentieth and twenty-first centuries has been unusually well served by historians interested in larger historical stories, including the interplay of publicly funded and entrepreneurial science: see, for example, Cool-Deegan (2000), Rasmussen (2001) and Shapin (2008). Not coincidentally, American biotech has also been the site of some of the most recent controversies about intellectual property and the sciences—and the most visible intervention from a historian of science. On the emergence and structure of public debate over gene patenting, see Radick (2002). For the historian Myles Jackson’s submission to the US court that in 2010 overturned the validity of patents on the genes BRCA1 and BRCA2, associated with breast and ovarian cancer, see Jackson (2010).

technology-free zone, and disdained attempts, as he memorably caricatured Marxist interpretations, to “deduce the existence” of a science from its social setting. The physicist-turned-philosopher–historian Thomas Kuhn came to admire Koyré hugely, and Kuhn’s *The structure of scientific revolutions* (1962)—in so many ways the defining metascientific work of the era—accordingly demonstrated a theory of inquiry that by design had nothing to say about how changes in inquiry connect with changes in technology and society (though Kuhn did address those connections, and the views of Hesen and Merton, in some of his essays). As for Merton, in the post-war period he went on to explore his ideas about priority disputes mainly in connection with the norms that, as he saw it, kept science in the democracies on track. To the extent that, even today, a historical approach which seeks to link technology with science, and to link both with patents and other elements of commercial and governmental modernity, has an air of provocation about it, the Cold War might be seen as an active presence.

Be that as it may, when it comes to intellectual property and the sciences, it is perhaps not a good idea to forget for the gathering in of insights from the accumulated scholarship and the hammering out of something new, general and, for ease of use and transport, compact. What follows is an attempt at such a synthesis and a guide to the set of nine papers that follow and that, in various ways, put it to work. Both arise from a three-year project based at the Universities of Leeds and Bristol. They reflect the interests of those leading the project in recent and historic patent controversies but also in the histories of particular technosciences in Britain in the decades around 1900: electrical science (Graeme Gooday); aeronautics (Christine MacLeod); and agricultural botany (Gregory Radick). We hope that the synthetic proposal, for an expanded concept of intellectual property, will prove stimulating historiographic company for anyone concerned with technoscience, of whatever place or period. The proposal, in itself and as developed in the papers, occupies the next section below. We then turn, in the third section, to consider those papers more fully, surveying their contents and explaining their organization. Finally, for the benefit of readers wanting to go further in investigations of the specific milieu covered in the papers, we provide orientation to the large-scale background changes in British patent law, state funding of scientific research, and the relations between science, technology and the military.

2. Towards an expanded concept of intellectual property

The core of the proposal is an expanded notion of intellectual property, along the lines of Merton’s suggestion in that 1938 footnote, but going beyond it in a crucial respect. Merton was a great student of priority—confusing “multiples” in science—clusters of investigators hitting upon the same idea—so it is all the more fitting to observe how fully our proposal, which came into being in ignorance of his suggestion, takes it forward. Present-day talk of intellectual property, or IP for short, refers in the first instance to patents, trademarks, copyright and the like: all those accustomed, statutory means—or, where these are absent, various surrogates—by which inventive individuals and groups seek to protect their ability to make a profit from their inventiveness or creativity. We shall call the sum total of such means IP *in a narrow sense*, or IP-narrow. IP-narrow plus everything else that is to do with the putative ownership of ideas and public claims to that ownership we shall call IP *in a broad sense*, or IP-broad. The definition of IP-broad is open-ended, as there may well be sorts of ownership claims that can usefully be classified within it beyond the two that will concern us here. These two not only bulk large in the technosciences but, in common with patent claims, they have been associated with inquiry into nature since the early modern period. First—and akin to Merton’s conception—there are *priority claims*: claims to have done something innovative before others did it, independent of the patent system (even though a patent may play a crucial role in constructing and vindicating that claim). Here the ownership asserted is of an individual’s right to public credit for an innovation: Thomas Edison for the light bulb, the Wright brothers for the airplane, Gregor Mendel for the concept of the gene. Such claims, of course, are rarely undisputed, since instances of “simultaneous invention” abound. Second—and here our proposal goes decisively beyond Merton—there are what we shall call *productivity claims*: claims for bodies of scientific knowledge as having inherently useful offshoots. Here the ownership asserted is that of a theoretical-empirical discipline over a domain of technical practice. To cite examples central to this set of papers: electrical science over electrical technologies; aeronautics over aircraft; the design of new agricultural botany.

The rationale for bringing these different kinds of ownership claims under a single concept is heuristic. We wish first of all to highlight the history of topics that arise at their intersection: the distinction, for example, between “applied” and “pure” science; the notion that socially valuable technologies bubble up when inquiry into nature is pursued for its own sake; and the distinction between scientific identity and the ambition to exploit research commercially, or “commodify” it. The title of this special issue, *Owning and disowning invention*, we mean to gesture in part toward what Merton regarded as a signature feature of scientific identity. As he put it: “the more freely the scientist gives his intellectual property away, the more securely it becomes his property.” The common ownership of knowledge in the sciences was for Merton one of the vitality-maintaining norms. When the system works well, in his view, scientists share what they have found, in exchange for which the community recognizes them as having been the finders, most obviously by


10 “[E]xcept in occasional brief asides, I have said nothing about the role of technological advance or of external social, economic, and intellectual conditions in the development of the sciences.” Kuhn (1970, pp. ix–x); on Koyré, see note 9, above. Cf. Kuhn (1977a, pp. 32 n. 1, 58–59; 1977b, esp. p. 115 ff) . On Kuhn and the Cold War, see Fuller (2000, esp. chap. 4).

11 On the shift in Merton’s concerns—large enough that insiders refer to the “two Mertos”—see Schaffer (1984, p. 25); Kaiser (1998, p. 72) and Van den Belt (2010, p. 193).


14 On priority disputes as dating from the early modern period, see, e.g., Ravetz (1973, pp. 247–250) and Grafton (2004, pp. 39–40). On the early modern origins of patent systems, see, e.g., MacLeod (1988, chap. 1). Even so, the general truth that what we call “scientific revolution” since the “Scientific Revolution” (as we have called it since Koyré) has older, usually ancient precedents—experiment, materialization, the hunt for laws of nature, and so on—holds for IP-narrow and -broad too. Archimedes and his later reputation epitomize the latter. On the former, see May (2004).

15 Our examples thread through this set of papers, but they likewise merged for Merton; cf. Merton (1973a, pp. 260–261) on how scientists trained to revere pure science wind up doing it so well that, thanks to technological spin-offs, society gets all kinds of “comforts and conveniences.” On why talk of a “linear model” must nevertheless go in scare quotes, see Edgerton (2004). On debate over what can and cannot be patented as “a remarkable arena where ideas of ‘pure’ and ‘applied’ science square off in high-stakes tournaments,” see Burnett (2007, p. 313). On the commodification of research, see Mirowski (2011) and the papers gathered in Radder (2010).

naming discoveries after them. Our textbooks still proclaim the laws of motion as Newton’s. But Merton also acknowledged that the system does not always work well. Especially undermining, in his view, was exactly that economic potential which Hessen made conspicuous. Once the researchers themselves seek to make a profit—not just a name—out of their research, they become less willing to communicate their findings to the scientific community as a whole. The researchers (or the institutions that employ them) may gain, but the community loses, and so does knowledge. During the Second World War, Merton warned about the incompatibility between what he then called the “communism of the scientific ethos” and “the definition of technology as ‘private property’ in a capitalistic economy.” From a Mertonian perspective, the very generous government funding of research that would subsequently, during the Cold War, characterize the major powers’ science policy represented an admirable solution.17

We also wish, however, to direct attention to the way that each kind of IP claim has interacted with the others. If, for alliteration’s sake, patent claims are allowed to stand in for the whole gamut of IP-narrow claims, then interaction between the three sorts of claim we have described—patent, productivity and priority claims—can be pictured as follows:

![Diagram]

We offer this image as a question generator. Starting at the left, one might be prompted to ask, for instance: how have patent controversies come to involve the calling of expert scientific witnesses, and how, in turn, has the testimony of those experts publicized their sciences as sources of useful truths? Shifting to the right: how has the growth in public esteem for the applicability of some sciences re-

17 Merton (1973b, esp. pp. 273–275), quotations on p. 275. Merton here (p. 275) catalogued a number of responses to this “conflict-situation”, including the securing of patents to safeguard innovations for the public (as Einstein had done), the calling on scientists to embrace their entrepreneurial side (as Vannevar Bush had done), and the calling on them to support socialism (as Bernal had done). “These proposals,” Merton concluded, “... reflect discrepancies in the conception of intellectual property.” One can think that Merton was onto something here without, however, agreeing that industrial science is therefore intrinsically fraught. On the shop-floor science of Merton’s America as belying that exaggerated notion, see Shapin (2004). On Merton’s collaboration with academic radio researchers as the context for his analysis, see Johns (2009, p. 413). On the affinities of powerfu l knowledge of nature. From Bacon deriv ed not just the automatic all y yield incre ased maste ry of it. Some efforts were direc-
toward the one end, some toward the other, and that was that. Well into the nineteenth century, it could strike thoughtful commen-
tators on science as well—nigh miraculous that the two domains—natur-

...
extent, the sciences have managed it, and continue to do so. The point can be encapsulated as an alternative gloss on this issue’s title: the sciences have come to own invention (in the sense of useful technique) thanks in large measure to their reputation for disowning invention (in the sense of fiction, lies, make-believe) in favour of the truths that, however uncomfortable, are the only sure routes to successful intervention in the world.

When a technical practice comes to be seen as the application of a science’s truths, does that practice really become that science’s property? Merton, as we have seen, had no trouble with property talk, which he took to be an actors’ category. “That the notion of property is part and parcel of the institution of science can be seen from the language employed by scientists in speaking of their work,” he wrote in another footnote, this one in a 1957 article on priority. He quoted in evidence James Clerk Maxwell writing to William Thomson: “I do not know the Game laws and Patent laws of science… but I certainly intend to poach among your electrical images.” Merton could as well have quoted from a letter of Antoine-Laurent Lavoisier in 1793: “Once [a savant] has made a discovery, he will exert himself to publish it, and his aim has been achieved when he has secured his property, when it has become established that it is really his.” And lest such examples be written off as belonging to the backstage world of elites, consider the journalist Robert Chambers’ concluding an 1833 article on “Science and labour” with a variation on a Baconian theme. “Knowledge is power,” Chambers advised his readers, “because knowledge is property.”

In any case, our expanded-IP proposal in no way amounts to an endorsement of what it seeks to illuminate as “really property”—whatever that would mean—or as socially, economically, technologically, or cognitively optimal. Rather, it is an invitation to joining-up inquiry into how certain values came to be prized in the technosciences and certain technoscientific prizes came to be valued, the better to inform critical discussion in the future. The papers that follow were written in that spirit. Before considering them in detail—the business of the next section—it will be helpful to indicate how they relate to the larger proposal.

Of the three sorts of property claims delineated above, priority claims get least attention in the papers. Only Radick and Berris Charnley, in a re-examination of the rise of Mendelian genetics, consider the consequences of a priority dispute; and even here, their contribution is to show that a classic analysis of the dispute becomes much more powerfully illuminating when allied to new analyses of the biological, commercial and regulatory realities confronting breeders of new plant varieties. Other papers likewise deal mainly, and in one way or another, with patent claims, productivity claims, their interaction, and the variety of cultures and power relations—disciplinary, legal, governmental (including military), commercial, national (including imperial), and historiographic—that intersect where patent claims and productivity claims interact. Disciplinary culture, for example, is in the spotlight in Stathis Arapostathis and Gooday’s paper charting the changing identity of the electrical physicist over the period, from someone busily inventing and patenting electrical devices to someone seriously indifferent to the grubby business of technology and money. Letal culture comes to the fore in several papers, notably those by Arapostathis on electrical–meter patents and MacLeod on airplane wing design, recounting court trials which brought into the open disagreements about how far technological success could be credited to theoretical knowledge. Patent agents—fixtures of British commercial as well as legal life, yet little studied until now—figure centrally in Arapostathis’ paper and also in Jonathan Hopwood-Lewis’, on the Wright brothers’ British agent. The coming of the Great War brought an interruption to patenting business—as-usual in several technosciences, creating opportunities and difficulties that are here examined in, among other papers, Gooday’s on electrical telecommunications and MacLeod and Hopwood-Lewis’ on aeronautics. Charnley uses the claims of Mendelian geneticists to be able to guide the breeding of better wheat varieties to recover the surprising cultural significance of wheat to Britain as an imperial power. All of the papers challenge and revise existing historiographies; but historiography becomes an object of study in its own right in Radick’s paper, on the Cold War viscidities that explain how a Mendelian geneticist devoted to demonstrating the usefulness of Mendelian truths (not least as an expert witness in a court trial about a pea variety) became exemplary for historians of science of pure-science aloofness from industrial application.

3. Intellectual property, narrowly and broadly construed, in the making of three British technosciences, 1870–1930

The opening paper is Arapostathis and Gooday’s on electrical science. During the 1880s, they observe, there was an overlapping constituency of natural philosophers and engineers concerned with the theoretical-experimental study of electricity and its technological embodiment. Members of both groups regularly looked to the patent system to commercialize their findings and thereby help finance their research. To enforce a patent they sometimes found it necessary to have recourse to the courts. Some of them were also called to testify as expert witnesses. Frequent patent litigation, however, meant that many found patenting irksome, even demeaning. By the 1920s, the situation was radically different: not only had sharper disciplinary distinctions emerged between electrical engineering and physics, but physicists typically pursued “pure science,” enjoyed state funding (a largely wartime innovation), and no longer concerned themselves directly with technological matters or patenting, which had become the sole province of electrical engineers. Electrical engineers nevertheless found it necessary to pursue a new rhetorical agenda, if only to reject any
suggestion that theirs was a subordinate role, one that could be characterized as “applied” physics.

In aeronautics, although the early twentieth century saw disciplinary tensions of a similar type, they were by no means as overt or ferocious, and patents (and their litigation) did not play a similar role in shaping the field. At this early stage there was almost no market for civilian aircraft, and the professions of aeronautical physicist and aeronautical engineer were present only in embryo. A motor engineer, such as F. W. Lanchester, could make insightful contributions to aeronautical theory (even if they were largely ignored); while an aircraft designer, such as Frederick Handley Page, could simultaneously teach aeronautics to college students. The leadership of the influential Aeronautical Society of Great Britain sought to maintain an ethos of open communication among its members, but it did not shun the filing of patents, because it identified secrecy as a greater threat than appropriation and litigation. For this reason and others explored in the second paper, by Hopwood-Lewis and MacLeod, although the number of aeronautical patents soared in the 1910s, there appears—with one important exception—to have been a complete absence of litigation. Subsequently, during the First World War, when military demand drove the aviation industry to new levels of technical achievement, and aeronautical theorists (both within and beyond the industry) to new levels of understanding, the patent system was effectively suspended and publication severely limited by the necessity for military secrecy. By 1919, there was thus a backlog in the apportioning of both profit and credit, such that the following decade witnessed feverish, often highly contentious, activity with a view to settling these scores—not always, of course, to everyone’s satisfaction.

In the third paper, Charnley and Radick investigate how IP arrangements helped shape the debate over the twentieth century’s new master science of heredity, Mendelian genetics. They remind us that the posthumous fame which Gregor Mendel enjoyed after 1900 for his experimental work with hybrid peas was the outcome of a priority dispute among rival botanists of the era and, furthermore, that, as the new, UK-headquartered “Mendelism” gathered momentum, Mendel came to be represented not just as the first person to make certain discoveries about ratios and factors but as the first to study heredity in a truly scientific way. The notion that the monk in the garden had hit upon the truth about heredity acquired credibility in Britain, the USA, and beyond in the first decades of the twentieth century thanks to the much-publicized applicability of his principles, above all to plant breeding. But how useful was Mendelism to the breeders who employed it, really? What exactly were the problems they struggled with in turning a profit from the creation of new plant varieties, and how far did Mendelian principles help them in solving those problems? Charnley and Radick offer original answers—and in so doing demonstrate how much historians of the “Mendelian revolution” have to gain from taking seriously the matter of how breeders have handled controversies over the ownership of new varieties. Reconstructing that hitherto invisible history for British plant breeding in the decades around 1900, they emphasize that a major problem for breeders was the problem of “rogue” plants: plants that diverged from the marketed type, often in directions that made them resemble other types, notably ones used as starting materials. Here was a persistent source of trouble, with customers and with other breeders. And here, Charnley and Radick show, was a source of trouble for early Mendelism, as the critic W. F. R. Weldon insisted. The Mendelians’ later success with the rogue problem, Charnley and Radick argue, was less to do with the application of Mendelian principles to breeding than with the building and running of an infrastructure which functioned to isolate Mendelian seed stock from supposedly rogue-inducing contaminants.

The remaining six papers return to the settings mapped in the initial three in order to pursue certain themes in greater depth. The first of the electrical papers in this part, by Arapostathis, and the first of the aeronautical papers, by Hopwood-Lewis, can usefully be discussed together, since they explore the finer points of patent management and the role played in it by patent agents in, respectively, the electricity meter industry, where litigation was rife, and the aeronautical industry, where it was noticeable by its absence. Arapostathis scrutinizes more closely the co-construction of engineering identities with the management of inventors’ rights. Approaching the courtroom as a “public theatre,” he investigates two of the more important patent disputes that shaped the British electricity meter industry. In so doing, he locates corporate and individual activities in a broader context and, through a comparative approach, addresses issues of IP management and of technological cultures and identities at both the corporate and individual levels. He demonstrates that patent agents and lawyers played a crucial role in strengthening patents in the Patent Office and the law courts, where they contributed to public discussion of inventorship by their strategic attempts to establish narratives about contested inventions and so legitimize particular readings of their specifications. In this process, patent agents and lawyers had the assistance of expert witnesses, both scientifically oriented engineers and more practical engineers. The court proceedings and patent battles both promoted and problematized scientific authority, since the expertise of practical men was also taken seriously. Indeed, Arapostathis shows that practical expertise could be more vital than scientific standing in establishing the identity of a patented technology and in providing it with credentials as a practicable and functional artefact.

Aeronautics, by contrast, presents a case of “the dog that didn’t bark.” Within a few years of starting to patent their inventions, in 1903, the Wright brothers found themselves embroiled in litigation on both sides of the Atlantic—with the exception of Britain. As already noted, the small size of the civilian market for airplanes and the ethos of open communication espoused by the Aeronautical Society of Great Britain together provide sufficient explanation for the absence of patent litigation in general. It is surprising, nonetheless, that the Wrights declined to enforce their frequently infringed UK patent, given their willingness to enforce their patents elsewhere (and many observers at the time feared and expected similar tactics in Britain). Hopwood-Lewis shows that the Wrights owed their non-litigious British strategy to one of the first professional patent agents to specialize in aeronautics, Griffith Brewer (1867–1948). Brewer was an enthusiast for flight and amateur pilot, and Wilbur Wright in France 1908, while, to the world’s astonishment, Wright was demonstrating his “flyer”. Hopwood-Lewis argues that Brewer always balanced the goal of protecting the Wrights’ interests with a determination not to hobble the struggling, pre-war British aviation industry. Dismissing the Wrights from prosecuting infringements by private constructors, Brewer steered them instead to a more suitable and popular target, one that was also better able to pay: the British government, sponsor of the growing market in military airplanes.

Brewer’s government-directed action on the Wrights’ behalf appears to have been the only case of patent litigation in British aviation during this period; and when war broke out in 1914, he made sure the case was quickly settled out of court. Over the next quarter century, Brewer built up a large clientele among British aircraft manufacturers, along the way getting elected to the presidency of both the Chartered Institute of Patent Agents (in 1930) and the Royal Aeronautical Society (in 1940–1). The relationship between the early twentieth-century state and the inventor is further investigated in the second of the electrical papers, by Gooday, and the second of the aeronautical papers, by MacLeod, which track developments through the First World War and into the jurisdiction of the first Royal Commission on Awards to Inventors (RCAI). Gooday’s reassessment of the strategic
importance of telecommunications during the war reveals the strength of the state in determining the nature of patent rights and rewards, and not just for inventors employed in the military services. The British government or its military adjuncts could reserve appropriate inventions for reasons of state and, moreover, decide the terms on which compensation would be given. Even so, Gooday demonstrates, there were key elements of negotiation or discretion that inventors could use to get recompense. At the heart of these manoeuvres was their way of representing inventive creation. The UK Marconi Company provides an especially telling case. Not only did the First World War afford an opportunity to show its patriotic credentials and redeem its reputation after an infamous 1913 scandal but, Gooday contends, the war gave Guglielmo Marconi the platform he needed to pursue the monopolistic agenda for wireless telegraphy that he had not successfully implemented prior to 1914. What is more, by demonstrating the productivity of the new Hertzian wave technologies in the theatre of armed conflict, Marconi (and his associate Oliver Lodge) publicized the viability of their enterprises to the civilian world. A wider lesson for historians here is that understanding the prerogatives and reward structures of military versus civilian invention in “dual-use” domains such as telecommunications will usefully enrich and extend the notion of IP-broad. 

Whereas the telecommunications inventors studied by Gooday generally presented the RCAI with claims for compensation for the military state’s use of patented inventions, the demands of the aviation industry highlighted the difficulty of protecting industrial designs within the framework of British patent and design law. British law in this era understood “design” to refer to the decorative arts, not to the design of complex pieces of machinery such as airplanes, cars or ships. In the early 1920s, following adversarial hearings before the RCAI, large awards (over £20,000) were made to ten aeronautical engineering firms in compensation for the wartime use of their designs—or, in one case, patents—by other government contractors. MacLeod analyses five of these cases to shed light on both the problems faced by the RCAI in adjudicating the claims regarding airframe design, in particular where a firm developed a series of aircraft that shared major features one with another, and on the often invidious position of the expert witnesses who were required to evaluate the significance of subtle changes in design. Although the RCAI failed to reach an agreed definition of airplane “design” (noun or verb) and no attempt was made to extend the law to include it, the large financial awards made to airplane and aero-engine manufacturers in recognition of the resources they spent on “designing” did, she suggests, de facto acknowledge its value (and perhaps a property in design). The awards may also have helped to raise the status, not only of the individual designers and manufacturing firms—several of which became household names—but of aeronautical engineering as a discipline. Collectively, the engineering firms, their lawyers and their expert witnesses fought off attempts by the state’s chief expert witness to appropriate to the science of “applied aeronautics” the credit for the technological triumphs of the wartime aviation industry—a rare defeat for “science’s” takeover of innovation via productivity claims in battles over IP-broad. The victory may also help explain why aeronautical engineering bucked the more general trend of engineering’s decline in status during the twentieth century.27

The final two papers, on agricultural botany, consider another science which operated outside the realm of the patent system. In 1921, the Mendelian-in-chief William Bateson, then near the end of his life, served as an expert witness in a trial in London about whether a certain shipment of peas was or was not the variety sold to the buyer. Radick uses Bateson’s court appearances to frame a dual inquiry, into how Bateson managed to represent the venerable practices of plant breeding as applications of his science, Mendelian genetics, and how it happened that Bateson nevertheless came to stand for historians of science later in the century as the very type of the pure scientist, repelled by trade and its compromises. Both investigations, historical and historiographic, turn up surprises. In the course of a 1911 address on the relations between pure and applied science, in agricultural genetics but also more widely, Bateson, far from sneering at attempts to bring the two kinds of science together, applauded the several “private firms engaged in various industries”:

I may mention especially metallurgy, pharmacy, and brewing—who have set an admirable example in this matter, instituting researches of a costly and elaborate nature, practically unlimited in scope, connected with the subjects of their several activities, conscious that it is only by men in close touch with the operations of the industry that the discoveries can be made, and well assured that they themselves will not go unrewarded.28

How could anyone promoting such a view come to be remembered so differently? Radick’s answer takes our set of papers back to its beginning. He shows that, starting with J. G. Crowther, a succession of historians and sociologists of science, drawing in one way or another on the Marxian canon, ended up minimizing or ignoring Bateson’s campaign on behalf of the utility of Mendelism. The story of how an interpretive tradition whose signature move was the finding of links between scientific theory and capitalist praxis came, in the case of Bateson, to suppress those links is, Radick reveals, a remarkable story of history of science during the Cold War, from the rise of the notorious Soviet anti-Mendelian T. D. Lysenko in the 1940s and 50s to the repudiation of Koyrêan and Mertonian emphases on the autonomy of science in the 1960s and 70s. 

Charnley’s subject is the colonial agricultural enterprise of Bateson’s former student Rowland Biffen, and how Biffen managed to turn genetics into an ally of the British empire and vice versa. Biffen is first encountered in the third paper as the Mendelian who rose most effectively to the challenge laid down by the anti-Mendelian Weldon. Where Weldon found Mendelism wanting as a guide for the practical breeder, and thought that the persistence of rogue plants fatally undermined the science’s conceptual structure, Biffen, stalwart of the Experimental Farm at Cambridge University, championed Mendelism as a boon to breeders and treated rogues as uninteresting aberrations, whose presence had to be due to chance or incompetence. Biffen’s grip on the institutional life of British agricultural science came to encompass far more than the Experimental Farm. As Charnley shows, for all that Mendelism was initially celebrated for its power to help Britain from falling behind in the international wheat trade, it was later exported to the colonies as the key to their agriculture success. And success with wheat production at that time meant much more than mere prosperity. Histories of empire tend to forget how intertwined the British civilizing mission was with the mission of spreading wheat, even to such unlikely locales as Kenya. Biffen was a true believer, in the power of wheat and the power of science. He expected, and received, state support for his research, and in return he worked to make his findings useful for collective benefit. 

Standing back, we can see that, although none of the technologies dwelt upon in the papers that follow were new in the period sometimes known as “the second industrial revolution”
(ca1870—ca1930), all of them—electrical science, aeronautics and agricultural botany—rose swiftly in commercial or military importance, and prompted similar anxieties regarding the ownership of ideas. Moreover, those anxieties took the particular forms they did in the different domains based largely on two variables in their legal and socio-economic context: on the one hand, the provisions of statute law; on the other, the availability of a market for their products. Not until the 1960s did British law offer protection to plant varieties, leaving plant breeders and agricultural botanists before then to find other ways to assert ownership over their innovations and contest one another’s claims. By contrast, the filing of patents was routine in both the electrical and the aviation industries throughout the late nineteenth and early twentieth centuries. But while such activity could be the making of an electrical inventor or firm, it was of minimal commercial significance in aviation (insofar as heavier-than-air flight was concerned) until around 1908, when news of the Wright brothers’ achievement began to gain credibility in Europe. Even then, the lack of a large civilian market for airplanes meant that there was little stimulus to the patent litigation that had been rife in the burgeoning electrical industries since the 1870s, as manufacturers competed fiercely for market share. All this changed with the outbreak of war in 1914 (and to some extent in anticipation of it during the previous decade). Yet, while wartime demand brought long-lasting change into all three technosciences, especially aeronautics, wartime imperatives meant that IP claims and the disputes they normally engendered tended to be sidelined or, at least, postponed until after the war.

We intend the sequencing of the papers to aid readers eager to develop such comparisons and contrasts further. Rather than group the papers into three technoscience-specific chunks, we have placed the three overview papers first, followed by papers offering more focused explorations of the same territories. Such an ordering, though unorthodox, has a couple of points in its favour. For one thing, it mirrors somewhat the sensibilities of our historical actors, who were themselves often aware not just of what was going on in their own technoscientific patches but how it compared with what was happening elsewhere (and we regret not being able to include material on that most industrially important science of all, chemistry). For another, the repeated sequence electrical-science-to-aeronautical-science-to-agricultural-botany, in taking the reader by degrees from the most conventionally IP-oriented domain to the least so, enacts the case made here for a more expanded historiography of the technosciences in Great Britain, 1870–1930.

4. Towards an expanded historiography of the technosciences in Great Britain, 1870–1930

Our expanded IP proposal is by no means tied exclusively to historical materials relating to Great Britain between ca1870 and ca1930. Nevertheless, that place and period offer special attractions. First of all, patents enjoyed an unusually high profile, thanks in part to reforms that, from the middle of the nineteenth century, sought to make Britain’s antiquated patent system fit for purpose in an industrial economy, and in part to a ferocious “patent controversy” which, as late as 1870, menaced that system with abolition. Second, the same period saw the emergence of a campaign among professional scientists for the recognition of “pure science” and its consequent funding by the state in the name of economic efficiency—a campaign that acquired much of its force (and resonated with the contemporary drive to reform the patent system) through a growing sense of alarm at Britain’s loss of technological and industrial supremacy, at a time when new industries had much closer links to bodies of theoretical knowledge than their predecessors, and when British industries were ceding their earlier dominance to rapidly expanding and technically dynamic newcomers, in particular in the US and Germany. Third, the four years of industrialized warfare from 1914 not only accelerated the development of a number of British technologies but illuminated conflicts over the ownership of ideas that were rarely as visible in peacetime. Taken together, these changes brought to public prominence, for the first time, an entangled set of polar positions—for and against patents, for and against the profit motive in scientific research, and for and against a strong role for the state in directing that research—which have shaped discussions of science, technology and the state down to the present. In this final section we sketch the histories and contexts of these generative developments.

At the start we should note that, useful though the term “intellectual property” may be for the historian now, it was used only rarely in Britain in the decades that concern us. A roughly similar term, “industrial property”—referring to patents, designs and trademarks, but not copyright—made a first, limited landing from France only with Britain’s participation in the Paris Convention for the Protection of Industrial Property of 1883. A small first step towards international accord (still incomplete), the Paris Convention expanded the protection available to patents among its signatory countries. But there is much evidence that, in British eyes, long accustomed to seeing a patent as a temporary grant of monopoly (and nothing more), the idea that patents counted as part of a new species of property long remained an alien one. The term was rarely cited, and in general Britons did not use any collective term, or treat the different legal instruments as a unity, but continued to regard a patent as a patent; a trademark, a trademark; and so on. Indeed, despite the best efforts of some Victorian patent barristers to boost the strength of their clients’ position, the British judiciary remained resolute in its view that a patent was not a form of abstract property even today, when the term “intellectual property” is so widely used, it has no official standing in British law.

4.1. Reform of the patent system

Any brief history of the British patent system in the nineteenth century will touch on the Patent Law Amendment Act of 1852 and the controversy it sparked. Repeated calls to simplify the patent system came to a head in 1851 when, in the absence of cheap patent protection, many inventors who feared the exposure of their ideas to piracy threatened to boycott the Great Exhibition. While the new act endorsed the old Statute of Monopolies as the legislative foundation of the patent system, it introduced significant changes, including the unification of the three separate patent systems of England and Wales, Scotland, and Ireland into a single system. It established a dedicated Patent Office (whose library would eventually host Boris Hessen), reduced the initial cost of a patent substantially (from over £100 to £25—still the equivalent of half a year’s wages, or more, for most working men), and authorized the publication of all patent specifications to assist would-be patentees, and their agents. Furthermore, it granted protection from the point of application, subject to the filing of a provisional specification and, within six months, a full, definitive specification. The act did not, however, create a body of official patent-application examiners—and their absence proved decisive. Without the safeguard of examiners who could filter applications, the act’s
facilitating measures served only to resuscitate old fears that “frivolous” inventions would swamp the system and permit mendacious patentees to harass manufacturers. The great engineer-industrialist Isambard Kingdom Brunel had made exactly this complaint during the parliamentary hearings that preceded the new act. What transformed those fears into fully fledged patent abolitionism was the politics of empire—specifically, a clause in the new act that exempted sugar refiners in the colonies from the payment of patent royalties on the machinery they deployed, to the fury of their disadvantaged rivals in Britain. Now the whole system came under attack. Patents, argued the abolitionists, represented at once a damaging restraint on trade, an unjust monopoly that inflated prices, a costly nuisance to manufacturers, and a hollow promise of riches that seduced inventive working men and turned them into paupers. Going further, the abolitionists also took issue with the individualistic or heroic model of invention that implicitly informed the patent system. Technological change, they contended, was a cumulative social process—the incremental accretion of small inventive steps that followed on, one from another, almost automatically. This sustained campaign for abolition provoked an equally determined, pragmatic and ideological defence by interested parties and others who feared that the abolition of the patent system might kill the goose that, they believed, had laid the golden egg of British industrial pre-eminence. Tacitly addressing such fears, during the 1850s and 60s a rising tide of popular literature and commemorative public art celebrated the “genius” of leading inventors and engineers and the role they had played in Britain’s rise to economic and military dominance.

As the patent controversy rumbled on, the total number of patents issued more than quadrupled, from 455 in 1851 to 2113 in 1853, and then gradually rose to nearly 4000 per annum by the early 1880s. Yet even on the pro-patent side of the debate there was disquiet. One problem was that the high renewal fees introduced by the act meant that many inventors still ignored the patent system, finding other, more or less appropriate means for exploiting their invention, including the registration of a design, or secrecy where feasible. Another problem was that the lack of official examination to test the validity of patent claims at the point of application (or specification) implied that the patentee’s position was always liable to be undermined by the assertion of rival patents that covered similar inventions; only an expensive and potentially tedious resort to litigation was available to offer resolution and the opportunity to enforce a monopoly. But in the 1870s, the rise of international competition provoked a retreat from free-trade policies and ideologies across continental Europe, with the eventual consequence for Britain of turning the debate in the patent system’s favour. The new era of patent enthusiasm culminated in the passage of the Patents Act of 1883, and the (disapproving) reference in that year to the phrase “frivolous patents” that were “contrary to natural laws,” and authorized the examiners to refuse a patent for lack of novelty. Inevitably, some wholly or partially anticipated patents continued to escape their scrutiny. Nevertheless, this act has come to be thought of as completing the long and controversial process of modernization begun in 1852. It established a stable framework of patent law and practice for the remainder of our period, subject only to some relatively minor wartime provisions introduced in 1914 (and repealed in 1927), and the extension of the patent term from fourteen to sixteen years by the Patents and Designs Act of 1919.

Those who came of age as scientists and inventors before and after the Great War thus inherited a patent system that was simultaneously more accessible and more exacting than the one familiar to their mid-Victorian counterparts. J. D. Bernal, in his Hessen-inspired The social function of science (1939), nevertheless cast a disapproving eye over past and present alike:

The patent laws envisage a state of small independent producers with inventors capable of finding their own capital. It is doubtful whether for any major invention this has ever been the case. Even in the eighteenth century Watt had to go into partnership with Boulton, who had to use all his influence and spend £70,000 before either saw a penny back on the steam-engine. It is certainly not the case now. The individual inventor still exists, but he has increasing difficulties finding a capitalist... and has to put up with worse and worse terms. The great majority of patents are taken up by corporations. This is not only because... only large firms can now afford to apply science, but because of the patent law itself, which is now so complicated that only those with the longest purses can hope to defend a patent against its certain infringement. The game
can, of course, be worked both ways. Big firms may be willing rather than to go to law to buy up patents, whether valuable or not, that seem to be in their way, and the taking out of obstructive patents... is one of the safest forms of legal blackmail.

4.2. The campaign for “pure science”

As the 1852 Patent Law Amendment Act is to a historical survey of patent reform in Britain in the decades around 1900, so the writings of the biologist T. H. Huxley are to a discussion of the changing relations between “pure” and “applied” science over the same period. In The standard function of science, Bernal quoted extensively from Huxley to illustrate the emergence among the Victorians of what Bernal called “the ideal of pure science”—science as a calling, pursued not for the practical benefits it brings but for the sheer joy of it. More recent historians have also fixed on Huxley, notably his 1880 address “Science as culture.” His words, and the context of industrial education in which they were spoken, merit close attention. The essay originated as a speech that he gave in October 1880 at the opening in Birmingham of Josiah Mason College (now the University of Birmingham). In this address, he presented such new institutions of higher education, which placed what he labelled “pure” science at the centre of their curriculum, as part of a novel, non-clerical and non-classical culture. As for “applied science,” Huxley declared that, [he] often wish[ed] that this phrase, “applied science,” had never been invented. For it suggests that there is a sort of scientific knowledge of direct practical use, which can be studied never been invented. For it suggests that there is a sort of scientific knowledge of direct practical use, which can be studied... MacLeod (1971, pp. 213–217).

Huxley’s claim is understandable in the context of his local obligation to promote the new Birmingham college’s science departments to local youths and their parents as a necessary route to a successful career in industry (his lecture also attacked the industrial celebrants of “rule of thumb”). Yet in fulfilling that duty he did something much more consequential. As he indicated, “applied science” had previously designated not some subsidiary and subservient derivative but an autonomous form of knowledge, running in parallel to a more theoretically driven enterprise, sometimes called “pure science” but also “abstract knowledge” and other names. Deliberately repudiating that older notion of equivalence, Huxley brought into being a new dichotomy, in which “applied science” was annexed as a secondary relation to the “pure science” that he and his allies putatively pursued in their academic laboratories. They would fight hard, and by various ways and means, to re-categorize research in several branches of technology according to this dichotomy and to secure new forms of funding for it.

Funding was indeed the crux of the matter. Historians have learned to be wary of taking the alarmist public statements of Victorian and Edwardian men of science at face value. Behind many dire predictions of British science’s imminent decline and British industry’s consequent loss of international competitiveness lurked campaigns to provide scientific education and research with greater financial resources. Huxley’s re-conceptualization of the pure/applied dichotomy should also be viewed through this financial lens. For Huxley, “pure” meant autonomous: it would be disinterested and objective thanks to its (financial) independence from outside interference, in particular from the demands of industry and commerce for useful knowledge. But with paid positions for men of science in British universities still very rare and philanthropy in this sphere almost unknown, a career in “pure science” usually remained a pipe-dream for those who lacked a private income. Furthermore, as the cost of experimental apparatus escalated, even employment as a university teacher did not guarantee access to the necessary research facilities.

William Thomson (Lord Kelvin) had shown one way to overcome this financial impasse by funding his physics laboratory at the University of Glasgow (and his elegant lifestyle) by filing a number of lucrative patents. But this was scarcely a solution that could—or, to many minds at the time, should—be universalized. At a pragmatic level, few patents were remunerative; many patentees found their hopes of wealth trammeled by costly litigation. As the late nineteenth-century electrical and telecommunications industries, in particular, became highly litigious in prosecuting alleged patent infringements, this hitherto uncontroversial means of funding began to pose major ethical and strategic dilemmas for physicists and others pursuing electrical science. By patenting “applications” of their “pure” research they risked serious losses of time and money in the law courts and, even worse, put at stake their professional reputation and priority of discovery. It is little wonder that Kelvin’s obstinacy in The Times felt it necessary to distinguish him “from that frequent class of patentees who are brimming over with ideas, all crude, most worthless... [unredeemed by his] knowledge of scientific first principles.”

Consequently, the “pure” investigator appeared to have no resort but the state. In time a standard rationale emerged. Elevated, by its supposedly disinterested funding, above the corruption inherent in industry’s relentless pursuit of profit and the cut-and-thrust of litigation, “pure” science would yet earn its keep—and remunerate the British tax-payer—through the technical spin-offs (“applied science”) that would inevitably proliferate as it openly published its theoretical and experimental findings and relinquished any claim to patents. Armed with this rationale, Huxley and his allies in the editorial office of Nature and in what, from the early 1870s, became known as the “endowment of research” movement sought to reverse two centuries of tradition; for since the foundation of the Royal Society, successive British governments had rarely granted the scientific community anything but financial disappointment.

Disraeli’s Conservative government (1874–80) proved encouragingly sympathetic to the campaign. In 1876, the Treasury even agreed to allocate £20,000 in research fellowships over the next five years, to be administered by the Royal Society. Controversially, this unprecedented generosity extended beyond the provision of equip-
ment and materials to the payment of stipends. This move elicited both plaudits and protests from leading scientific figures. While some presciently feared that state aid would lead inexorably to state interference, others worried that the new allocation would be at the expense of current funding for researchers directly employed in the government’s service (by the Admiralty, the War Office and so on), and there were grumblings about self-interested feathering of nests by Huxley’s cronies.54 By the time of Huxley’s 1880 address, the whole question of public funding for science had become an obvious target for retrenchment by Gladstone’s new Liberal government, which came to power earlier that year against a backdrop of rising public distrust of scientific men, accused inter alia of atheism, materialism, cruelty to animals (vivisection) and abrogation of civil liberties (compulsory vaccination). Divisions within the Royal Society over its administration of government funds exacerbated the situation. Although the Treasury did not cancel the existing grant of £4000 per annum, it vetoed further proposals to subsidize research.55 After this blow, the pure-science campaign stalled for a time. But by the end of the 1880s it once more began to pick up momentum; and the 1890s saw, according to Roy MacLeod, “a gradual acceptance of the principle of endowment” by both the state and private philanthropists.56 In 1894, thanks largely to the efforts of Huxley and company, a body called the Commissioners for the Exhibition of 1851 began to allocate funding for a scientific research fellowship scheme. Twenty years later, there were 170 privately endowed fellowships at twenty-four institutions outside Oxford and Cambridge. Meanwhile, government subsidies, given to the universities in aid of teaching from 1889, indirectly benefited scientific research, as did the establishment of such institutions as the Laboratory of the Marine Biological Association at Plymouth (built with funding from the Treasury in 1888), the London School of Tropical Medicine (set up by the Colonial Office in 1899) and the Science Museum (founded in 1909). Most significantly, following several years of renewed pressure and debate, in 1899 Lord Salisbury’s government sanctioned a grant of £12,000 to build the National Physical Laboratory (NPL) and a further £4000 per annum, administered by the Royal Society, to operate it.57 As the Prince of Wales approvingly stated, when opening the Laboratory in March 1902, “I believe that in the National Physical Laboratory we have the first instance of the state taking part in scientific research. The object of the scheme is, I understand, to bring scientific knowledge to bear practically upon our everyday industrial and commercial life, to break down the barrier between theory and practice, to effect a union between science and commerce.”58

By the early twentieth century, then, the endowment-of-research movement could be said to have achieved its aim: to have secured scientific research recognition as a national resource, in the form of a facility for— as the Prince put it— “furthering the application of science to commerce and industry.”59 And the biological sciences soon benefited along with the physical sciences, thanks to the passage in 1909 of the Development Act, in the wake of which came research institutes in the breeding, pathology and nutrition of agriculturally important plants and animals.60 But the triumph should not be exaggerated. There was, for one thing, less freedom to operate independently of the priorities of commerce and industry than Huxley had hoped. And there were still sufficiently few other career opportunities available to researchers that the NPL, for example, was able to recruit young scientists of high calibre despite the poor salaries it offered and the large proportion of routine work it demanded.61 Indeed, its early years were dogged by the Treasury’s penurious assumption that it would soon pay its own way, and by commercial competitors’ anxieties that it might do so by under-cutting them. Survival required extensive donations from private sources.62

4.3. The Great War

What changed the NPL’s fortunes dramatically, leading to the expansion of both its remit and its facilities, was war. In 1910, with anxieties over war mounting, the War Office and the Admiralty decreed that the NPL’s Engineering Department should establish a new Aeronautical Division “for continuous investigation—experimental and otherwise—of questions which must from time to time be solved in order to obtain adequate guidance in construction.”63 The same year, an Advisory Tank Committee was set up to supervise the use of the NPL’s newly constructed ship-testing tank for research in naval architecture, and its facilities for both metallurgical and meteorological research were expanded.64 By March 1917, its duties further inflated by wartime demands, the NPL’s staff numbered 420.65 In the light of such growth, it is clear that the establishment in 1916 of a new Department of Scientific and Industrial Research (DSIR)—widely remembered as an epochal development in the relations between state, industry and science—by no means represented a complete break with the British state’s previous “laissez-faire” past or a sudden recognition of the importance of “pure science.”66 Nevertheless, for many civilian scientists, what industrialized warfare in 1914–18 did represent was an exceptionally good opportunity further to urge on the government the importance of their potential, public contribution; even, according to Andrew Hull, to bid for the control of science policy.67 And when peacetime appeared to be a realistic prospect, it became even more important to maintain the advances secured in wartime.68 Away from the spotlight of the DSIR and civilian research, many more scientists were called upon to contribute their expertise directly to the war effort in the service departments. In 1915, the Ministry of Munitions established a Munitions Inventions Department, and the Admiralty established its own Board of Invention and Research, to be followed in 1917 by the Air Inventions Committee.69

54 MacLeod (1971, pp. 223–225).
56 MacLeod (1971, p. 226).
58 Quoted in Moseley (1978, p. 236). MacLeod suggests that the effect was unintentionally the opposite of this prediction, since “the endowment of research movement had helped drive a barrier between science and its industrial applications”, such that “the best” would pursue “pure research while the rest would go into industry: MacLeod (1971, p. 229); see also ibid., pp. 230–231.
64 Pyatt (1983, p. 57).
68 See Arapostathis & Gooday’s article in this issue.
69 Hull (1999, pp. 464–467), and works cited there; more generally, Hartcup (1988).
It was the responsibility of these bodies to assess the potential value of inventions offered to the government from many different quarters (including men on active service, private citizens and firms).

One direct channel to the Ministry of Munitions already ran through the Patent Office. Back in 1859, the government had introduced a Patents for Invention (Munitions of War) Bill, which, though it prompted an outraged response from the radical Mechanics’ Magazine, was enacted without a debate. It authorized the crown to keep patents for military inventions secret.70 With the outbreak of war in August 1914, Orders in Council were announced that further tightened this control. Applying for a patent first in a foreign country prior to a British application was made illegal. Meanwhile, officials from the Ministry of Munitions made it their business to keep tabs on incoming applications at the Patent Office. Inventors reportedly always co-operated, supplying on request a copy of the application to the War Office or Admiralty.71

Of greater importance from the patentee’s perspective were other innovations of the 1883 Act. For the first time, the crown was no less obliged than its subjects to respect the patentee’s rights when it adopted a patented invention. (“A patent shall have to all intents the like effect as against Her Majesty the Queen, her heirs and successors, as it has against a subject.”)72 Potentially less satisfactory, however, was the award to the Treasury of the right to determine the compensation due from the crown and its officers to the inventor for their contributions (both patented and unpatented) to all intents the like effect as against Her Majesty the Queen, her heirs and successors, as it has against a subject.72 Potentially less satisfactory, however, was the award to the Treasury of the right to determine the compensation due from the crown and its officers to the patentee.73 These provisions assumed pivotal importance during the war, when many inventors sought to combine patriotic duty with private gain, either voluntarily or at the prompting of the War Office’s “spy” at the Patent Office. But the complexity of implementing the provisions on a grand scale proved forbidding; ultimately the difficulties would trigger the establishment of the RCAI, which, between 1919 and 1937, assumed the Treasury’s statutory role of adjudicating such cases.74 The Commission’s archives throw light on the attempts of numerous inventors to secure recognition and reward for their contributions (both patented and unpatented) to the war effort—and the Treasury’s efforts to minimize those debts.

Once again, Bernal’s opinion, from his vantage point in the late 1930s, is instructive. He lauded the conditions of secrecy that the state had increasingly imposed on scientists in its ambit. Not only did it make for gross inefficiency, with groups duplicating each others’ efforts, but it damaged “the scientists themselves and the spirit in which they carry on their work… Suspicion and self-seeking become the order of the day.”75 And yet, for Bernal, the important lesson to learn about the sciences in Britain in the previous war was just how productive they were. Notwithstanding the debilitating demands of secrecy, the lunatic and often lethal misuse of talented scientists as frontline troops, and the slow appreciation by some parts of the military of science’s value to their enterprise (Bernal records that it was not until the nightmare of the disastrously muddy Flanders Field that the army took up a physicist’s offer to establish a meteorological service), applied science thrived, above all in chemistry and aeronautics. Scientists remained inventive, and remained concerned with their intellectual property, narrowly and broadly construed. The conclusion Bernal drew was not so much that war was good for science (though, as a matter of history, he thought it certainly was) but that science was more or less productive depending on collective willingness to support and direct it—and war tended to maximize that willingness. The Great War, he concluded with a Hessesesque flourish, “showed that the progress of science had been limited in peace not by any intrinsic factors but rather by external economic and political factors.”76

It is not difficult, even now, to find such sentiments expressed whenever the ties binding science, technology and society come under pressure. Consider, in closing, a story from the recent past of one of our technosciences, agricultural botany. In August 2010, British newspapers and other media carried the news of the sequencing of the wheat genome by researchers at a number of British institutions (including the John Innes Centre, of which William Bateson was the first director). A project stressed throughout the coverage was that the sequence was available to all, free of charge. “And what did these scientists do with the discovery that the British taxpayer has been funding all these years?” asked one left-of-centre political commentator, in a piece generally decrying the lowly place of science in the nation’s affections. “Instead of seeking patents and jealously guarding their hard-won data, they placed a draft version of the genome online so that wheat breeders, who presently rely on conventional breeding techniques, can benefit from their findings.” If a future of widespread starvation is to be avoided, he continued, it will be thanks to such far-sighted gestures.77 Alas, the moment of moral uplift proved short-lived. A press release appeared, not long after, from the International Wheat Genome Sequencing Consortium—an international consortium of wheat growers, public and private breeders and scientists—expressing disappointment that British contributors to what was a global effort had offered up a sequence which was far too preliminary to be useful and thereby had conveyed an exaggerated sense of their role in the project. At the end was a warning about how “this premature claim [to have sequenced the wheat genome] is jeopardizing the ongoing international efforts to truly achieve a genome sequence with high utility for wheat in the next five years.”78

So, what was represented, at first, as a high-minded disowning (look, here it is, the wheat genome sequence, over which no one has exclusive rights—a patent claim) was subsequently represented as a disguised attempt to shore up a particular group’s claim to ownership (look, here it is, the wheat genome sequence, and we sequenced it, we British scientists funded by a British research council—a priority claim). And what truly concerned the critics, they said, was the potential usefulness of the full sequence data: a usefulness perhaps never to be realized for paltry social reasons, rather than profound intellectual ones (do not judge the usefulness of the wheat genome by this draft; the complete sequence, if we can ever pull together enough to achieve it, will transform wheat breeding—a productivity claim). There, in the mix, too openness and secrecy, collaboration and competition, public and private science, pure and applied science. As a fact of scientific life, IP is a complexifier. Yet for that very reason, when treated as an analytical tool in understanding that life, IP can be a clarifier—not least in prompting the questions that might save us from accepting too simple a version of what happened and why. This special issue is a beginning: some of our answers to our questions. We very much hope that readers will be inspired to pose their own.

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70 O’Dell (1994, pp. 19–22). Henceforth, ostensibly provisional (only) patents were often, in fact, sealed patents, their full specifications kept secret at the behest of the War Office. From 1883, applications and provisional specifications of potential military value were withdrawn from public view: ibid. pp. 43–44, 65.
71 O’Dell (1994, p. 71).
72 Patents, Designs and Trade Marks Act, 1883 (46 & 47 Vic. c.57), Section 27, quoted in O’Dell (1994, p. 42).
73 O’Dell (1994, pp. 42–43). These provisions were retained in the Patents and Designs Act, 1907 (7 Edw 7 c.28), Section 30.
74 See the papers by Gooday and MacLeod respectively in this issue.
75 Bernal (1939, p. 150).
77 Porter (2010); for a sample report, see Connor (2010).
78 International Wheat Genome Sequencing Consortium (2010).
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