BJHS **50**(1): 23–60, March 2017. © British Society for the History of Science 2017
doi:10.1017/S0007087417000012 First published online 16 February 2017

How lives became lists and scientific papers became data: cataloguing authorship during the nineteenth century

ALEX CSISZAR*

Abstract. The *Catalogue of Scientific Papers*, published by the Royal Society of London beginning in 1867, projected back to the beginning of the nineteenth century a novel vision of the history of science in which knowledge was built up out of discrete papers each connected to an author. Its construction was an act of canon formation that helped naturalize the idea that scientific publishing consisted of special kinds of texts and authors that were set apart from the wider landscape of publishing. By recovering the decisions and struggles through which the *Catalogue* was assembled, this essay aims to contribute to current efforts to denaturalize the scientific paper as the dominant genre of scientific life. By privileging a specific representation of the course of a scientific life as a list of papers, the *Catalogue* helped shape underlying assumptions about the most valuable fruits of a scientific career. Its enumerated lists of authors' periodical publications were quickly put to use as a means of measuring scientific productivity and reputation, as well as by writers of biography and history. Although it was first conceived as a search technology, this essay locates the *Catalogue*'s most consequential legacy in its uses as a technology of valuation.

> If any one desires merely to ascertain how many papers have been written by any 'scientist', as the Americans say, he has only to turn to this catalogue to find all he wants.
>
> *Manchester Times* (1869)[1]

In April 1867 the young physiologist Michael Foster reviewed the career of Karl von Baer. While he lavished praise on the pioneering embryologist's magnum opus, the *History of the Development of Animals*, Foster had little time for his shorter periodical works. He glossed his many 'stray papers published here and there' as 'specimens of those broken pieces of fact, which every scientific worker throws out to the world, hoping that on them, some time or other, some truth may come to land'.[2]

Foster was not alone in this lowly assessment of the value of periodical authorship. In 1863, Charles Lyell wrote to Charles Darwin about the plight of their younger friend, Thomas Henry Huxley. Not having 'leisure like you and me', Huxley was forced to spread his writings across several, mostly periodical, works just to keep up with obligations. If only these works had 'been all in one book', Lyell went on, 'what a position he

* Department of the History of Science, Harvard University, Science Center 371, Cambridge, MA 02138, USA. Email: acsiszar@fas.harvard.edu.

I am grateful for suggestions on versions of this work by Mario Biagioli, Thomas Broman, Emily Dolan, Aileen Fyfe and Steven Shapin, as well as to Jim Secord and Simon Schaffer for earlier conversations that set me on my way.

1 *Manchester Times*, 16 January 1869, p. 24.

2 'Autobiography of a physiologist', *Quarterly Review* (1867) 122, pp. 335–347, 343.

would occupy!' Periodical authorship was a distraction, albeit one increasingly necessary for those required to make a living by science or to engage in races for priority.[3] For both Lyell and Darwin, scientific reputations were built on the hard backs of books which established one's mastery of a subject. Likewise, Foster predicted, it was von Baer's great monograph 'by which he will always be remembered'.[4]

But the fortunes of the humble scientific paper were just then on the rise. At the beginning of 1868, talk was spreading about an unprecedented and recklessly ambitious project launched by the Royal Society of London. The first volume of their *Catalogue of Scientific Papers* was advertised as a complete list – organized by author – of all the scientific papers that had appeared in scientific periodicals since the year 1800. Its appearance was certainly evidence of the ascendance of the scientific paper as the preeminent genre of science. But in giving new form to the course of a life in science as an enumerated list of papers, it was also an agent in that ascent.

The *Catalogue* was the most resource-intensive special project that the Royal Society undertook during the nineteenth century.[5] As James Secord has argued, its construction reshaped the past according to a novel vision of the bounds of scientific publishing.[6] It projected backward to 1800 a vision of the history of science in which the edifice of knowledge was built up out of individual papers each connected unambiguously to an author. It did as much as anything else to cement the idea that scientific publishing involved special kinds of authors and special kinds of texts, both of which were easily demarcated from the wider publishing landscape in which much scientific communication nevertheless remained embedded. And it encouraged men of science to embrace specific authorial habits in the future.

As an act of canon formation, the publication of the *Catalogue of Scientific Papers* is among the most significant moments in the history of scientific publishing.[7] But because bibliographical tools tend to become part of the invisible infrastructure of research, the *Catalogue*'s significance has been overlooked. By recovering the work that went into its construction, and the difficulties and dissonances experienced by its architects, the first half of this essay aims to contribute to current efforts to denaturalize the scientific paper as the dominant genre of scientific life.[8] Next, the focus will be on the uses that

3 Lyell to Darwin, 15 March 1863, in Frederick Burkhardt *et al.* (eds.), *The Correspondence of Charles Darwin*, vol. 11, Cambridge: Cambridge University Press, 1999, p. 231.

4 'Autobiography of a physiologist', op. cit. (2), p. 343.

5 The government undertook the costs of printing the first volumes, but the Royal Society funded all other labour and materials costs.

6 James Secord, 'Science, technology and mathematics', in David McKitterick (ed.), *The Cambridge History of the Book in Britain*, vol. 6: *1830–1914*, Cambridge: Cambridge University Press, 2009, pp. 443–474, 459.

7 I use the term 'canon formation' in analogy to its use in literary history to refer to genres and texts which achieve cultural prestige through inclusion in a select list. See, for example, John Guillory, *Cultural Capital: The Problem of Literary Canon Formation*, Chicago: The University of Chicago Press, 1993; and Jonathan Brody Kramnick, *Making the English Canon: Print-Capitalism and the Cultural Past, 1700–1770*, Cambridge: Cambridge University Press, 1998.

8 Geoffrey C. Bowker, 'Emerging configurations of knowledge expression', in Tarleton Gillespie, Pablo J. Boczkowski and Kirsten A. Foot (eds.), *Media Technologies: Essays on Communication, Materiality, and Society*, Cambridge, MA: MIT Press, 2014, pp. 99–118; Christopher Kelty, 'This is not an article: model organism newsletters and the question of "open science"', *Biosocieties* (2012) 7, pp. 140–168; Alex Csiszar,

the *Catalogue* found as a biographical and a historical tool. Although first imagined as a means of improving information access, its enumerated lists of authors' periodical publications proved invaluable to those looking for ways to measure scientific productivity as well as to writers of obituaries and other biographical genres. Later, it became a key part of the bibliographical apparatus used by historians of science, not only for biographers but also in efforts to study the history of science quantitatively. The *Catalogue* and similar lists did not merely make such research easier. By privileging a certain representation of the course of a scientific life it helped shape underlying assumptions about the most valuable fruits of this calling. What began as a tool for searching the literature found its most consequential legacy as a tool for assessment and valuation.

Lists as technologies of valuation

The history of catalogues and bibliographical tools in the sciences is often narrated as a history of information access and of battles waged against information overload.[9] This approach is not simply incomplete; by portraying bibliographical tools as neutral maps of stable classes of objects, it is also misleading. Catalogues have the capacity not simply to organize and improve access to objects of knowledge but also to define and delimit them, and thus to transform the shape of knowledge itself. First, by laying down particular rules for inclusion and exclusion, and arranging those contents in specific ways, the producers of lists encourage particular visions and appraisals of knowledge and of its producers. Second, the uses to which such lists might be put have never been limited by the expectations of their producers. Because search technologies usually involve making a selection of what is most relevant, valuable or worthy of trust, they are frequently repurposed as technologies of valuation.[10]

List genres have recently received attention from historians of science, especially among students of the early modern period. This work has shown that lists and related non-syntactic genres can generate knowledge not only through their capacity to organize information in new and unexpected ways, but also by generating new kinds of research questions. At the same time, the representations of knowledge in lists can 'pose limitations to inquiries' by similar means. This new focus on lists has

'Seriality and the search for order: scientific print and its problems during the late nineteenth century', *History of Science* (2010) 48, pp. 399–434; Secord, op. cit. (6). To be clear, I understand 'work' primarily as the work to construct the administrative and conceptual scaffolding that made such a catalogue possible. Hannah Gay has recently produced something closer to a labour history of the *Catalogue*'s fourth series, with a focus on the individuals who participated in its day-to-day construction: 'A questionable project: Herbert McLeod and the making of the fourth series of the Royal Society *Catalogue of Scientific Papers*, 1901–25', *Annals of Science* (2013) 70, pp. 149–174.

9 See, for example. the essays in W.B. Rayward and M.E. Bowden (eds.), *The History and Heritage of Scientific and Technological Information Systems*, Medford, NJ: Information Today, 2004.

10 For recent instances of this phenomenon see Konrad Becker and Felix Stalder (eds.), *Deep Search: The Politics of Search beyond Google*, Innsbruck: Studien Verlag, 2009; and Eric Archambault and Vincent Larivière, 'History of the journal impact factor: contingencies and consequences', *Scientometrics* (2009) 79, pp. 635–649.

also arisen as historians look to document precursors to current trends in data-driven science.[11]

While much of this work has focused especially on lists of natural objects such as specimens, species and compounds, these insights also apply to lists of paper objects. Bibliographical lists – perhaps because their contents are at one level of remove from objects of scientific research – have not yet received as much attention among historians of science. But by the nineteenth century such tools were becoming essential elements in the apparatus of scientific research. In natural-historical fields, such as zoology, the act of publishing a paper was proclaimed as essential to establishing the identity of a species. The 'Law of Priority', set out by a Zoological Committee of the British Association in 1842, formalized the idea that a name and description were valid only once they had been published, preferably in a periodical. Even outside natural history, the idea spread – especially through the Europe-wide controversy over the discovery of Neptune in 1846 – that a discovery only counted once it had been published, and that the essential date for priority claims was the date of publication, rather than that of original discovery. Knowing the periodical literature was increasingly perceived not simply as an aid to discovery but also as an essential constituent of the act of discovery itself.[12]

But bibliographical lists are not only lists of objects of knowledge; when they include names of authors, they double as lists of people. James Delbourgo has recently argued that for early modern naturalists such as James Petiver, a London-based broker of botanical specimens who circulated lists not only of his specimens but also of his suppliers, 'listing people was an art of self-construction through collective association'.[13] While Delbourgo focuses on lists produced by individuals, this point takes on new meaning when the lists are themselves produced by collectivities.

During the second half of the nineteenth century, the *Catalogue* was one among many collective endeavours to map out the bounds of knowledge in fields of research, including bibliographical projects, nomenclature commissions and compilations of astronomical data.[14] In Britain, and to various extents elsewhere, practitioners of science were working to define and delimit what constituted genuinely active men of science, and

11 See the essays in 'Listmania', a Focus section of *Isis* edited by James Delbourgo and Staffan Müller-Wille (December 2012) 103, pp. 710–752. Quotation from Staffan Müller-Wille and Isabelle Charmantier, 'Lists as research technologies', ibid., pp. 743–752, 743. See also Vera Keller, *Knowledge and the Public Interest, 1575–1725*, New York: Cambridge University Press, 2015.

12 On the Zoological Nomenclature Committee see Gordon McOuat, 'Species, rules and meaning: the politics of language and the ends of definitions in 19th century natural history', *Studies in History and Philosophy of Science* (1996) 21, pp. 473–519. Whether dates of printing trumped date of reading remained a point of controversy for decades. For example, in 1867, George Bentham, then president of the Linnean Society, denied the admissibility of public reading, 'because it does not give fixity; the author himself … may alter his names before or during the printing'. *Address of the President, Linnean Society*, London, Taylor & Francis, 1867, p. 7–8. On the discovery of Neptune see Robert W. Smith, 'The Cambridge network in action: the discovery of Neptune', *Isis* (1989) 80, pp. 395–422.

13 James Delbourgo, 'Listing people', *Isis* (2012) 103, pp. 735–742, 736. On other genres of lists of people see Jean-Luc Chappey, *Ordres et désordres biographiques: Dictionnaires, listes de noms, réputation des Lumières à Wikipédia*, Seyssel: Champ Vallon, 2013.

14 Other examples include the *Index Kewensis* project (Kew Gardens, 1881–) and the *Carte du ciel* Commission (1887–).

in this context catalogues of names could become acts of collective self-definition. By focusing on 'scientific papers' and deciding what kinds of objects that category ought to encompass, the editors of the *Catalogue* implicitly privileged a specific notion of what constituted a contribution to science. As the *Catalogue*'s utility as a basis for measuring scientific productivity caught on, other forms of contribution were progressively obscured by this definition of scientific authorship. If there is a modern legacy to this listing activity it is not so much the data-driven sciences but rather the quantification – or datafication – of identity and reputation.[15]

The production of the *Catalogue of Scientific Papers* extended over sixty years, from initial data collection in the 1860s through to the appearance of the final volume in 1925. The *Catalogue* was published in four series, the first covering 1800–1863, the second 1864–1873, the third 1874–1883, and the final series – which did not begin to appear until 1914 – finishing out the nineteenth century. There were also repeated attempts to produce a subject index as a companion to the author index, although only a small portion of the subject catalogue was ever completed.[16] This essay focuses on the production and reception of the first series of the author catalogue, published between 1867 and 1872 in six volumes of about a thousand pages each. It was in this period that its builders hammered out the form the *Catalogue* would take, and the years immediately following established enduring patterns of use to which the *Catalogue* could be put.

Literary projectors

In 1854, Edward Bissell Hunt, a young engineer working for the US Coast and Geodetic Survey, began to dream of an information utopia. Hunt had succumbed to an increasingly common tendency among younger researchers: he had become a literary hoarder. At first, he gathered references relevant to his own research interests – the physics of gases and cartographic techniques – but things had escalated and he was soon indexing whole runs of periodicals. Whether due to youthful exuberance or to the uncomfortable feeling of being on the periphery of a research community, Hunt had become so keen to prove his command of the literature that accumulating references had become an end in itself. Looking to turn his obsession into a calling, he began to promote a plan by which the US government would fund a comprehensive catalogue of the literature of the physical sciences. Hunt was inspired in part by a recent effort by a young American librarian, William Frederick Poole, to do something similar for

15 For a celebratory definition of datafication, the process by which aspects of the world are transformed into data, see Viktor Mayer-Schönberger and Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work and Think*, London: John Murray, 2013. On current algorithms for the management of reputations and relevance see Tarleton Gillespie, 'The relevance of algorithms', in Gillespie, Boczkowski and Foot, op. cit. (8), pp. 167–193.

16 On the first failed attempt to build the subject index see W. Boyd Rayward, 'The search for subject access to the Catalogue of Scientific Papers, 1800–1900', in Rayward (ed.), *The Variety of Librarianship*, Sydney: Library Association of Australia, 1976, pp. 146–170.

the general periodical press.[17] His idea gained some traction among other American researchers, many of whom were keen to establish closer ties to the main lines of active research in Europe.[18] Hunt suggested that such a catalogue could serve as a crucial step towards men of science regaining a lost utopia where scholarship exhibited a harmonious balance of breadth and depth: 'Our general views would keep pace with our special investigations, and our minds would attain that harmony of culture, characteristic of the well developed man'.[19] Cataloguing would be a form of collective therapy for the social body of science.

Hunt convinced Joseph Henry, founding secretary of the Smithsonian Institution, that a catalogue of scientific memoirs would be a great idea. But Henry was less sanguine about saddling the fledgling Smithsonian with such an undertaking. Not only might it drain funds that could otherwise be invested in actual research, but it might also be risky for the new national scientific institution to be so closely associated with a literary project. In September 1855 Henry travelled to Glasgow for the annual British Association meeting and described the proposal for a catalogue of philosophical memoirs published by learned societies. But he suggested that the best plan was for the British Association to lead the project itself, with the Smithsonian helping to index the American publications.[20]

The British Association took the bait and appointed a committee – Arthur Cayley, Robert Grant and George Stokes – to investigate. At the following year's meeting in Cheltenham they presented their report, focusing on the tricky problem of scope. They began by urging restraint, suggesting that such a catalogue ought not to cover all branches of science but only physics, astronomy and mathematics. Caution soon gave way, however. Although their mandate had been to consider a catalogue of memoirs contained in the transactions of learned societies, they suggested that the bounds should be expanded to take in many other kinds of serial works, including 'Mathematical and Scientific Journals', ephemerides, and 'volumes of Observations'. The only texts explicitly set aside were separate works – books and pamphlets.[21]

Building a catalogue of the vast array of serial publications associated with science was nearly unprecedented. It meant treating independent scientific journals – normally published by commercial publishers for a profit – on a par with the publications of scientific societies, valuable not simply for their ability to circulate knowledge quickly but also as contributions to the permanent record of science. This was an enormous undertaking and it meant drawing a boundary around a group of publications that were not all easy to assimilate. Some objected that such imprudence would cripple the venture. As

17 E.B. Hunt, 'On an index of papers on subjects of mathematics and physical science', *American Journal of Science* (1855) 20, pp. 344–348, 347; William Frederick Poole, *An Index to Periodical Literature*, New York: Charles B. Norton, 1853.

18 On this and more on the American prehistory of the *Catalogue* see Donald deB. Beaver, 'The Smithsonian origin of the Royal Society *Catalogue of Scientific Papers*', *Science Studies* (1972) 2, pp. 385–393.

19 Hunt, op. cit. (17), p. 348.

20 Beaver, op. cit. (18), pp. 390–391; *Report of the … Meeting of the British Association for … 1855*, London: John Murray, 1856, p. lxvi.

21 *Report of the … Meeting of the British Association for … 1856*, London: John Murray, 1857, pp. 463–464.

James David Forbes suggested, it was one thing to deal with the memoirs appearing in transactions: carefully vetted, substantial works that were intended by their authors as permanent contributions to knowledge. It was a waste of time, however, to include every article in the French Academy of Science's *Comptes rendus*, he went on, 'or even in the better class of scientific periodicals'. William Thomson agreed, urging 'condemnation on the planners of the Scientific catalogue': strict selection criteria ought to be exercised to make the thing at all useful.[22]

Simply put, the 'scientific paper' was not a natural kind. Early descriptions used the term 'memoir' to describe the objects to be collected together, but what that meant left room for interpretation. For Forbes and many of his contemporaries, the term 'scientific journal' was reserved for commercial publications unaffiliated with any society (although usage had begun by then to shift). Many such journals – especially earlier in the century – were dedicated as much to news and excerpts as to original contributions.[23] And proceedings journals – the Parisian *Comptes rendus* was a signal example – had begun as venues for abstracts and summaries of memoirs. To index these alongside full-blown memoirs could be seen as a category mistake.[24] Documents describing the project resorted to awkward descriptions such as 'A Catalogue of the Scientific Memoirs contained in the Transactions of Learned Societies and Scientific Journals' to capture what was intended.[25]

Although catalogues and other lists of books had a long history, catalogues dedicated to the separate contents of periodical publications remained rare in the mid-nineteenth century.[26] In the mid-sixteenth century Conrad Gesner had torn the word *bibliotheca* out of its concrete architectural casing and applied it to a virtual library – Roger Chartier has called it the 'library without walls' – to be represented within the binding

22 J.D. Forbes, 'Catalogue of philosophical memoirs', *Athenaeum*, 20 September 1856, pp. 1166–1167; William Thomson to Forbes, 6 October 1856, James D. Forbes Papers, University of St Andrews (hereafter JDF), 1/2693.

23 Jonathan R. Topham, 'Anthologizing the book of nature: the circulation of knowledge and the origins of the scientific journal in late Georgian Britain', in Bernard Lightman, Gordon McOuat and Larry Stewart (eds.), *The Circulation of Knowledge between Britain, India, and China*, Boston: Brill, 2013, pp. 119–152.

24 A word on terminology: in its strict sense, the word 'transactions' referred to the collections of memoirs published by learned societies that were modelled on the *Philosophical Transactions* post-1752 (when the Royal Society took over the publication and overhauled it on the model of the collections of memoirs published by the French Academy of Sciences). Although this was a specifically British format, the term was often used by English-speaking actors to refer to memoir series published by Continental societies as well. Unless indicated otherwise, this broader meaning is the one I use in this essay. For similar reasons, by 'proceedings' I am grouping together a variety of publications that arose beginning in the 1820s and 1830s and which were also called *Monthly Notices, Comptes rendus*, *Bericht*, *Bulletin*, or *Notizblatt*, inter alia. These were modelled on commercial journals and often were printed in a smaller or cheaper format than transactions, appeared more frequently, and tended to contain shorter papers or abstracts.

25 W.H. Miller (circular to scientific societies), January 1864, MM/14/183.

26 For a survey of the early history of bibliographies see Luigi Balsamo, *Bibliography: History of a Tradition* (Berkeley, CA: Bernard M. Rosenthal, 1984). For the natural sciences see W.H. Brock, 'Scientific bibliographies and bibliographers, and the history of the history of science', in Andrew Hunter (ed.), *Thornton and Tully's Scientific Books, Libraries, and Collectors*, Aldershot: Ashgate, 2000, pp. 298–332. For a recent account see Ann Blair, *Too Much to Know: Managing Scholarly Information before the Modern Age*, New Haven, CT: Yale University Press, 2010.

of a book.[27] Gesner hoped to merge the concept of the library (real, but inevitably incomplete) with a universal project of knowledge that was not simply about recording all that had been written on any topic, but about making knowledge into a tool for producing new knowledge. His *Bibliotheca Universalis* would be a guiding model for many subsequent literary catalogues.[28]

Gesner's catalogues, as well as most scholarly *bibliotheca*, picked out important, enduring works from long swathes of time. Until learned journals appeared in the seventeenth century, catalogues documenting more recent publications were normally the preserve of commercial booksellers – they were lists of commodities. In a sense, the learned journals of the late seventeenth century represented the fusion of Gesner's calls for universal accessibility with the Baconian mandate to sift new facts as they were produced.[29] Many scholarly journals were themselves a form of bibliographical guide, often consisting of reviews and news of the literary and scientific world, and thus their contents were not often perceived as worthy matter for such virtual *bibliothecae*. There were, in contrast, several attempts to collect and reorganize the publications of learned societies during the eighteenth century.[30] The *Philosophical Transactions* was a particularly frequent subject of reprints, translations and digests (whether authorized or not).[31] Such anthologies were perhaps the most characteristic synthetic genre related to serial publications during the eighteenth century. Denis Diderot complained about the colossal bulk of the publications that the major learned societies had amassed, but rather than calling for an index, he wanted compression, and looked forward 'to the first *abréviateur* of taste and skill who comes along, [causing] them all to collapse'.[32]

It was at the end of the eighteenth century that comprehensive indexes, rather than selective compilations, were seriously contemplated for memoirs associated with natural knowledge. In 1800, J.D. Reuss, an ambitious cataloguer at the University Library in Göttingen, began publishing the *Repertorium Commentationum a Societatibus Litteriis Editarum*, an index to works in learned-society publications that covered their beginnings in 1660 and ran up to 1800. The *Repertorium* was organized loosely by subject and consisted of sixteen volumes, each devoted to specific fields of knowledge – natural history, astronomy and so on. Articles appearing in the relatively

27 Roger Chartier, *The Order of Books: Readers, Authors and Libraries in Europe between the Fourteenth and Eighteenth Centuries*, Stanford, CA: Stanford University Press, 1994, pp. 61–88.

28 *Bibliotheca Universalis, sive Catalogus omnium scriptorum locupletissimus, in tribus linguis, Latina, Graeca, et Hebraica* (1545–1549) was organized by author, but a second part, the *Pandectarum sive Partitionum universalium Conradi Gesneri* (1548), never completed, was organized according to topic entries. See Balsamo, op. cit. (26), pp. 37–42.

29 Paul Neave Nelles, 'The library as an instrument of discovery: Gabriel Naude and the uses of history', in Donald R. Kelley (ed.), *History and the Disciplines*, Rochester, NY: University of Rochester Press, 1997, pp. 41–57.

30 The grandest such effort was the massive *Collection académique*, published between 1755 and 1779. These volumes contained a selective compilation (including translations) of works in the publications of European learned societies.

31 Adrian Johns, *The Nature of the Book: Print and Knowledge in the Making*, Chicago: The University of Chicago Press, 1998, pp. 516–621.

32 Denis Diderot, 'Encyclopédie' [1755], reprinted in J. Assézat (ed.), *Oeuvres complètes de Diderot*, vol. 14, Paris: Garnier frères, 1875–1877, pp. 414–503, 420. (All translations from French and German are my own.)

few independent scientific journals then in existence were generally left out. And while savants did use this index – there was a copy in the Royal Society's library, and Charles Darwin was still using it in the middle of the nineteenth century – Reuss intended his *Repertorium* largely for the use of fellow librarians.[33]

While other specialized catalogues of scientific publications existed, these tended to focus on monographs and separate works and many had an explicitly commercial intent (even, frequently, including sale prices). Indexes of periodical works remained rare. In the sciences, the other crucial genre of reference work was the annual report, or *Jahresbericht*. These were annual summaries of progress in specific branches of knowledge, organized by subfield, with text often consisting of abstracts of – or commentaries on – key discoveries and papers on those topics. These engaged extensively with the periodical literature, although they were not primarily bibliographical works. The earliest well-known example of these were the annual reports on science compiled by the Swedish chemist Jöns Jacob Berzelius, beginning in 1822. These achieved European fame via regular German translations; other editors and publishers, especially in Germany, soon produced similar guides focused on a variety of subjects.[34]

In the field of zoology, there were two other key precursors. In Leipzig, the naturalist Julius Carus had assembled a massive collection of references to zoological literature in his *Bibliotheca Zoologica*, which was organized loosely by subject. In Britain, the *Bibliographia Zoologiae et Geologiae* was published in four volumes by the Ray Society between 1848 and 1854. An author-ordered collection of bibliographical references to zoological and geological works, it was based on the personal bibliographical notes of the Swiss naturalist Louis Agassiz. Significantly, the project was spearheaded by Hugh Edwin Strickland, who had led the 1842 British Association rules of zoological nomenclature committee that enshrined the law of priority for the naming of species. Strickland was convinced that order could not be brought to zoological names without bringing order to zoological literature.

In 1857 the British Association offloaded the catalogue project onto the Royal Society of London, an organization looking to reassert its relevance in a quickly changing scientific landscape. Since the 1830s, the society had pursued multiple reforms that focused especially on its reading publics. It undertook a major renovation of its library, transforming it from a haphazard collection of books, periodicals and manuscripts into something like a research site. It sold off valuable manuscript collections and invested much of the profit into improving its collection of specialized journals. To go along with the new content, it also made the library navigable, creating a systematic catalogue of its holdings. At the same time the society launched its own scientific journal, the *Proceedings*, to keep fellows and the public up to date concerning meetings and papers.

But these measures had only gone so far. In Paris, by comparison, the weekly *Comptes rendus* of the Académie des sciences had quickly become well known across Europe for

33 Darwin comments on its format in his 'Books to be read' notebook (1838–1851), noting its availability at the Royal Society. See Frederick Burkhardt *et al.* (eds.), *The Correspondence of Charles Darwin*, vol. 4, Cambridge: Cambridge University Press, 1989, p. 447.

34 There were also, for example, *Jahresberichte* for medicine (Erlangen, 1841–), physiological botany (Berlin, 1838), and chemical technology (Leipzig, 1855–).

its numerous short notes published not only by academicians but also by anyone else who had the support of an academician. Although a great deal of scientific commerce occurred beyond the ken of the academy's meetings, it was easy to suppose that the *Comptes rendus* represented all that was new and important in Parisian science. The Royal Society's *Proceedings* were neither as frequent nor as sweeping as the *Comptes rendus*, and the proliferation of strong specialized scientific societies in Britain made it clear that the Royal Society's publications by no means represented a clearing house of the most important discoveries in England or even in London. But the *Comptes rendus* was incredibly expensive for the academy to maintain; it survived only because of French state support.[35] Although attempts at imitations were widespread, efforts to found something like it in London in 1848 had foundered.[36]

If the council of the Royal Society wished to extend its reach over the world of natural knowledge, it needed a different strategy. When its treasurer, Edward Sabine, brought to the council the lavish plan to produce an exhaustive catalogue of scientific memoirs, they saw an opportunity.[37] The council was certain that such a catalogue would be 'generally acknowledged as a highly creditable service rendered by the Royal Society to Scientific Literature'.[38] The newly formed Catalogue Committee warned that the society ought only to go ahead with the project if it could commit to going the distance; otherwise 'it had better not be undertaken at all'.[39] In 1831 Charles Babbage had encouraged the society to compile a 'Grand Cat[alogue] of Science', but he only imagined that it would include scientific books.[40] His idea went nowhere, but now the far more ambitious project of cataloguing the periodical literature of science seemed to the society both feasible and worthwhile. Having systematically built up their scientific library, the council thought the society in a good position to make it happen. Periodicals had been the focus of its acquisitions strategy for over two decades; this had perhaps even come 'to constitute its chief distinction'.[41] In taking up the project, the Royal Society was beginning to fashion itself as a third-party manager of scientific information.[42]

35 The recurrent financial problems engendered by the *Comptes rendus* are documented in the minutes of the Académie's Commission administrative: Registre de procès-verbaux, 1829–1877, Archives de l'Académie des sciences, Paris. See also Maurice Crosland, *Science under Control: The French Academy of Sciences, 1795–1914*, New York: Cambridge University Press, 1992, pp. 279–299.

36 On the abandoned 1848 plan for major London societies to band together to publish a collective *comptes rendus* to rival Paris see T.G. Bonney, *Annals of the Philosophical Club of the Royal Society*, London: Macmillan, 1919, pp. 27–38.

37 Royal Society Council Minutes, 5 March 1857, in *Council Minutes Printed*, Vol. 2, Royal Society of London (subsequently CMRS).

38 'Report to the Council from the Library Committee', read 14 January 1858, CMRS.

39 'Preliminary report of the committee appointed March 5, 1857, to consider the formation of a Catalogue of Philosophical Memoirs', read 18 June 1857, CMRS.

40 Babbage to John William Lubbock, 23 December 1831, John William Lubbock Papers, Royal Society of London, JWL/3.

41 'Report to the Council from the Library Committee', op. cit. (38).

42 The next major step in this evolution was the International Catalogue of Scientific Literature, a project that the society launched in 1895. At the time, some were calling for the Royal Society to get out of the journal publishing business altogether. See Csiszar, op. cit. (8).

The scope of the task turned out to be enormous indeed. The committee finally decided that the limitation to the mathematical and physical sciences would not stand: the *Catalogue* ought to be a complete list of all 'scientific papers' that had appeared since 1800, whether published in Britain, Europe or beyond.[43] They also decided to treat the short notes and abstracts that made up most proceedings journals as index-worthy publications as well. Setting the vision for what the *Catalogue* should be, working with foreign academies, and negotiating with publishers were the responsibility of the senior officers (especially William Allen Miller, William Hallowes Miller, Edward Sabine, William Sharpey and George Gabriel Stokes). A section of the library was transformed into a bibliographical workshop, pumping out bibliographical slips by the thousands. Work on the ground to assemble the contents was directed by Walter White, the assistant (later head) librarian. Soon the society hired Henry White (his distant relative) to focus exclusively on *Catalogue* work. Under their direction an expanding troupe of 'boys' produced individual slips containing references to papers from the society's vast collection of periodicals. Using carbon paper and copy paper, they prepared four slips per entry, expecting that they would eventually arrange their material according to several schemes. When they found gaps in a series, the Library Committee in many cases purchased the missing volumes.[44] Not content with the contents of the Royal Society's library, in 1864 White's bibliographical workforce fanned out across London in pursuit of catalogue-worthy periodicals to be found in other libraries, including the British Museum, and the Chemical, Linnean, and Medical and Chirurgical Societies.[45] By 1865 printing had not yet begun and the society had already spent £1,626 (about equal to the total cost of publishing the *Transactions* and *Proceedings* each year).[46]

The bibliographical black box

The decision that the *Catalogue* should be a complete listing of papers not only in transactions but also in scientific journals did not resolve the question of what, specifically, would actually get into the catalogue. There was no settled definition of the 'scientific journal', nor of the 'scientific paper'. Moreover, since the role of periodicals in science had changed a great deal since the beginning of the century, any decisions that made sense for the present would not necessarily translate easily to the past.

43 The day-to-day decisions regarding the *Catalogue*'s construction are detailed in the Minutes of the Library and Catalogue Committee, 17 June 1858–1 June 1875, Committee Minute Book 47C (hereafter MLCC) and Miscellaneous Manuscripts 14 (hereafter MM), both at the Royal Society of London. See also Marie Boas Hall, *The Library and Archives of the Royal Society*, London: Royal Society, 1992.

44 MLCC, 17 June 1858; Edward Sabine, 'Anniversary address, 1 December 1862', *Proceedings of the Royal Society* (1863) 12, p. 286. For details on the progressive hiring of indexers see MLCC, *passim*. As the cataloguing work went on over the next half-century, this indexing workforce gradually expanded and it also changed its character in key ways. Eventually, much of the indexing and clerical work was done by a staff of women, and for a period it was a woman, Evelyn Chambers, who was effectively directing the project. For details on the later workforce see Gay, op. cit. (8).

45 MLCC, 29 January 1864.

46 'Anniversary meeting', *Proceedings of the Royal Society* (1865), 14, p. 483.

Aspirations to totality require strict definitions of a boundary. The society had nearly lost an opportunity for governmental support of the project when an official assumed that their intention was to catalogue all serial publications that mentioned scientific topics – including newspapers – a task that everyone recognized as foolhardy.[47] Officially, the idea was to include papers relating 'to all branches of knowledge for the promotion of which the Royal Society was instituted, excluding matter of a purely technical or professional character'.[48] But the directions from the committee were more specific than that. The non-society periodicals they had in mind were those 'containing memoirs, published by individuals': these were the sort of thing to be found in transactions, which were supposed to be original contributions to knowledge.[49] News and reviews were to be left out. Since the work would consist largely of indexing the contents of periodicals, what was needed was a process by which to decide which journals would count.

While it was relatively straightforward to distinguish society publications from commercial journals, it was more difficult to differentiate independent scientific journals that contributed to the progress of knowledge from those that contained news, synthesis, education or entertainment. The tendency of commercial journals to mingle the popular and the scientific had driven Hugh Strickland to despair when editing the *Bibliographia Zoologiae*. 'Our popular "Magazines" of Natural History', he wrote, 'teem with trifling notices, often anonymous, sometimes brief and indefinite, sometimes wordy and inflated, but which do not contain a single fact of scientific importance'.[50] But since the bulk of the indexing would be done with relatively unskilled labour, it was in the selection of periodicals that the council and the Catalogue Committee played the largest role in shaping the *Catalogue*'s contents. If all else failed, the committee pointed out that simply settling on 'a perfect list of the scientific periodicals' would itself be a worthy outcome of all their troubles. For 'those who have frequent occasion to consult serial works', such a list could itself set rough limits on the task of searching the literature.[51] The recorders amassed a core set of publications to be indexed by trawling the catalogues and shelves of important libraries in London, and picking out those publications that seemed to fit the bill. Periodicals deemed ambiguous were forwarded first to the Library Committee and then if necessary to the Royal Society's council for a final verdict.[52]

By 1864, the clerks had indexed most of the serials in the Royal Society Library. The society produced a large sheet containing a list of these serials and dispatched it to societies, academies and select individuals for feedback (Figure 1). The list, containing 453

47 Edward Sabine reported to William Sharpey that a report 'misapprehending our object dwelt much on the impossibility of a catalogue which should include all periodical literature (newspapers amongst other classes of information)'. Letter dated 7 November 1864, MM/19/39, underlining in original.

48 'Preface', *Catalogue of Scientific Papers*, vol. 1, London: Eyre and Spottiswoode, 1867, p. iv.

49 'Report of the Committee to consider the formation of a Catalogue of Philosophical Memoirs', CMRS, 11 June 1857.

50 H.E. Strickland, 'Preface', in *Bibliographia Zoologiae et Geologiae*, vol. 1, London: Ray Society, 1848, p. ix.

51 'Preliminary Report', op. cit. (39); 'Report to the Council', op. cit. (38).

52 Some that were explicitly rejected in this process were *Paxton's Horticultural Register* and Férussac's *Bulletin*. It seems that the verdict in the latter case was reversed at some point, however, as it appears over five hundred times in the first series.

JOURNALS.

American Med. Reg.
Annales de Chimie.
Annales des Sci. Nat.
Annales des Sci. Phys.
Annals of Botany (König and Sims).
Annals of Nat. Hist.
Annuaire des Mines de Russie.
Archiv f. Ophtalmologie.
Archives des Missions Scientifiques.
Atlantis (The).
Auteurieth—Tübinger Blätter.

Ballenstedt—Archiv.
Baumgartner—Zeitschr.
Bégin—Journ. univ. de Méd. et Chir.
Beitr. z. Kennt. Russ. Reich
Bib. Univ. de Genève & Archives.
Boston Med. & Surg. Journ.
Boué—Journal de Géol.
Brit. & For. Med.-Chi. Review.
Brocha—Zeitschr.
Broussais—Annales.
Brown-Séquard—Journ. Physiol.
Brugnatelli—Giornale.
Bulletin & Journal de Pharmacie.

Calcutta Journ. Nat. Hist.
Cambridge & Dublin Math. Journal & Quarterly Journ. Math.
—— (U.S.) Math. Monthly.
Canadian Nat. & Journal.
Chemical News.
Christiania—Norsk Mag. Lægevid. (1st & Second Series).
Connaissance des Temps.
Copenhagen—Tijdskrift.
Crelle—Journal.
Crichton—Russ Samml.

Edinburgh—Nat. & Geogr. Sci. Journal.
—— Journal of Sci.
Edinburgh Phil. Journal—Brewster and Jameson.
Encke—Astron. Jahrbuch.
Erdmann—Journal (prak. u. tech.).

Flora—Bot. Zeitung.
Flörke—Repertorium.
Frorip—Notizen.

Gehlen—Journal.
Gendrin—Trans. Méd.
Gergonne—Ann. Math.
Gerstar—Mag. & Zeitschr. f. Entomol.
Gilbert—Annalen.
Gill—Tech. Repos.
Gistl—Faunus.
Glasgow Med. Journ. (Mackenzie).
Gleanings in Science.
Gould—Astron. Journ.
Graefe—Archiv.
Günsberg—Zeitschr. Klin. Med.

Hall, Vrolik & Mulder—Bijdragen.
Heller—Archiv.
Henle u. Pfeufer—Zeitschr.
Hesninger—Zeitschr.
Hoeven & Vriese—Tijdschr.
Hooker—Journ. Bot., Second Series.
Horuschuch—Archiv.

Intellectual Observer.

Jardine—Mag. Nat. Hist.
Journal de Pharmacie.
Journal de Physique.
Journal des Savans.
Journal de Méd. & heb. de Méd.
Journal heb. des prog. des Sci. Méd.
Journal Ind. Archipel.

Karsten—Archiv.
Kastner—Archiv.
Kröyer—Nat. Tidskr.

Leonhard—Jahrb., Taschenb. & Zeitschr.
Leonhard u. Bronn—Jahrbuch.
Liebig—Annalen.
Lindenau & Bohnenberger—Zeitsch.
Liouville—Journal Math.
London—Geol. Journ.
London—Mag. Nat. Hist.

Mackie—The Geologist.
Madras—Journ. Lit. & Sci. (incomplete).
—— Quart. Med. Journ. (Rogers & Lorimer).
Magasin de Zool.
Magendie—Journ. Physiol.
Meckel—Archiv.
Meisner—Annalen.
Meyer—Paleontographica.
Micros. Journ. 1841.
Midland—Med. & Surg. Reporter.
Milan—Ephem. Astron.
Miquel—Bull. des Sci. Phys.
Modena—Cannon.
Mulder—Archief & Scheik. Verhandel.
Müller's (Reichert's) Archiv.
Nautical Almanac.
Nederlandsch Lancet (Donders & others).
New Med. & Phys. Journ., or Ann. of Med., Nat. Hist. & Chem. (Shearman).
New York Med. and Physical Journ., New Series (Pennitt).
Nicholson—Journal.
North American Med. & Surg. Journ. (Hodge, Bache, Meigs, and others).
North of Engl. Med. & Surg. Journ.
Nuovo Cimento—Giorn. di Fis. (Matteucci & others).

Oersted—Tidsskr.
Oken—Isis.
Omodei—Annali univ. di Med.

Palæontographica.
Paris—Archives gén. de Méd.
—— Journ. de Chir. (Malgaigne).
—— Revue Méd.-Chir.
—— Rev. Méd. Franç. et étr.
Petermann—Mittheil.
Pharm. Central. Blatt.
Philadelphia—Med. and Physical Journ
Phil. Mag.
Poggendorff—Annalen.
Pommer—Archiv & Zeitschr.
Pringsheim—Journal.

Quart. Journ. Meteorol.
Quarterly Journ. Micr. Sci.
Quarterly Journal Sci.
Quetelet—Corresp. Math.

Reil—Archiv.
Reuss & Mar. Zool.
Rhein. Jahrb.
Roser u. Wunderlich—Archiv.

Schlechtendal—Linnæa.
Schlömilch—Zeitschr.
Schumacher—Astron. Nachr.
Schweigger—Jahrbuch & Journal.
Siebold u. Kölliker—Zeitschr.
Silliman—Journal.
Sowerby—Zool. Journ.
Sprengel—Jahrb.
Strambio—Giorn. crit. di Med.
Sturgeon—Ann. Elect.
Swart—Verhandel.

Tasmanian Journal.
Taylor—Scientific Memoirs.
Temminck—Verhandel.
Terquem—Nouv. Ann. Math.
Thomson—Ann. Phil.
Tiedemann—Zeitschr.
Tilesius—Jahrb.
Tilloch—Phil. Mag.
Turnbiini—Annali.
Trommsdorff—Journ.

Virchow—Archiv.

Wagner—Archiv d. Heilk.
Walker—Elect. Mag.
Weber—Archiv.
Wiedemann—Archiv & Mag. do Zool.
Wiegmann—Archiv.

Zach—Monatl. Corresp. & Corresp. Astron.

TRANSACTIONS.

Abbeville—Soc. Emulat. Mém.
—— Soc. Linn. Bull.
Aix—Soc. Sci. Mém.
Albany—Inst. Trans.
Amiens—Acad. Sci. Mém.
Amsterdam—Koninkl. Inst. Verhandel. & NeueVerhandel. hat Inst. Versl. & Tijdschr.
Angers—Soc. Linn. Annales.
Anvers—Soc. de Méd. Annales.
Arcueil—Soc. d'Arc. Mém.

Basel—Naturf. Gesell. Berichte & Verhandl.
Batavia—Bat. Genootsch. Verhandel. & Tijdsch.
—— Naturf. Ver. Verhandel. & Tijdsch.
Bayeux—Soc. Agric. et Sci. Bull. & Mém.
Berlin—Acad. Sci. Mem. & Abhandl. & Bericht & Monatsber.
—— Deutsch. Geol. Gesell. Zeitschr.
—— Gesell. f. Geburtsh. Verhandl.
—— Versamml. deutscher Aerzte &c. Ant. Ber.
Bern—Naturf. Gesell. Mittheil.
Berwickshire—Nat. Field Club Proc.
Besançon—Acad. Sci. Sciences.
Bologna—Mem. Ist. Naz. Ind.
—— Novi Comm. Mem. Acead. & Rendiconto.
—— Soc. Med. Mem.
Bombay—Geog. Soc. Trans.
Bonn—Naturhist. Ver. preuss. Rheinl. Verhandl.
—— Niederrhein Gesell. f. Nat. u. Heilk.—Organ.
Bordeaux—Soc. Sci. & Acad. Sci. Mém. & Actes.
Boston (U. S.)—Amer. Acad. Mem.
—— Journal Nat. Hist.
Breslau—Acad. Leop. Nat. Cur. Nov. Act.
—— Schles. Gesell. Uebersicht u. Jahresb.
Brussels—Acad. de Méd. Mém. & Bull.
—— Acad. Roy. des Sci. Mém. & Mém. Couronnés & Bull.

Caen—Acad. Sci. Travaux & Mém.
Calcutta—Agric. & Hortic Soc. Ind. Journal.
—— Asiat. Soc. Beng., Asiatick Res. & Journ.
—— Mem. Geol. Survey of India.
Calvados—Soc. Linn. Mém.
Cambrai—Soc. Emulat. Mém.
Cambridge—Phil. Trans.
Catania—Accad. Gioen. Atti.
Cherbourg—Soc. Sci. Nat. Mém.
Christiania—Mag. f. Videnskab., NytMag., & Norsk Mag.
Connecticut—Acad. Mem.
Copenhagen—Dansk. Vid. Selsk Afh., Skrift, & Oversigt.
—— Naturhist. Skriv. & Tidsskrift.
—— Reg. Soc. Med. Acta.
Cornwall—Geol. Soc. Trans.
—— Polytech. Soc. Reports.

Danzig—Nat. Gesell. Neueste Schrift.
Darmstadt—Ver. f. Erdk. Notizbl. & Ergunzungsbl.
Dijon—Acad. Sci. Mém.
Dresden—Gesell. Nat. & Heilk. Ausztge.
Dublin—Geol. Soc. Journal.
—— Roy. Irish Acad. Trans. & Proc.

Edinburgh—Roy. Soc. Arts, Trans.
—— Roy. Soc. Trans.
—— Wernerian Soc. Trans.
Epinal (Vosges)—Soc. Emulat. Annales.
Erfurt—Acad. Moguut. Sci. Nova Acta.
—— Akad. gem. Wiss. Abhandl.
Erlangen—Phys. Med. Gesell. Verhandl.

Flushing—Zeeuwsche Genootsch. Verhandel.
Frankfurt-a-M.—Phys. Ver. Jahrb.
—— Senckenb. Naturf. Gesellsch. Abhandl.
Freiburg (Breisgau)—Beiträge & Berichte.

Geneva—Soc. de Phys. Mém.
—— Soc. Méd. Recueil des Trav.
Genoa—Soc. Med. & Emulat. Mem.
Giessen—Oberhess. Gesell. Bericht (incomplete).
Glasgow—Phil. Soc. Proc.
Göttingen—Soc. Reg. Sci. Comm., Abhandl. & Nachr.
—— Gött. Ver. Studien. (incomplete).
—— Göttinger Studien (1847).
—— Ver. f. gem. Arb. z. Förd. d. wiss. Heilk. Archiv.

Haarlem—Nat. Verhandel. 8vo & 4to.
Halifax—Nov. Scot. Lit. & Sci. Soc. Trans.
Halle—Naturf. Gesell. Neue Schrift. & Abhandl.
—— Naturw. Ver. f. Sachsen u. Thür. Abhandl.
—— Zeitsch. f. d. ges. Naturw.
Hamburg—Naturw. Gesell. Mittheil.
—— Med. Chir. Gesell.
Hanau—Wetterauischen Ges. Jahresb.
Heidelberg—Nat. Med. Ver. Verhandl.
Helsingfors—Soc. Sci. Acta.

Jura—Soc. d'Emulat. Sciences & Travaux.

Karlsruhe—Bad. Arzl. Ver. Mittheil.
Kiel—Univ. Schriften.

Lancashire & Cheshire Hist. Soc. Trans.
Lausanne—Soc. Vaud. Bull.
Leipzig—Nat. Gesell. Schrift.
—— Königl. Sächs. Gesell. Wissensch. & Berichte über Verh.
Le Puy—Soc. Agric. &c.
Leyden—Acad. Lugd. Bat. Annales.
—— Verhandel. Nat. Gen. der Nederland. overzee. Bezit. (Temminck).
Liége—Acad. Leod. Annales.
—— Soc. Roy. Sci. Mém.
Lille—Soc. Sci. Trav. et Mém.
Lisbon—Mem.
Liverpool—Lit. & Phil. Soc. Proc.
London—Agric. Soc. Journal.
—— Allelodidactic Soc. Trans.
London—Astron. & Mem. & Monthl. Not.
—— Brit. Assoc. Rpts.
—— Chem. Soc. Journal & Mem.
—— Electrical Soc'ness. & Proc.
—— Entomol. Soc'ness.
—— Ethnol. Soc. ans. (incomplete).
—— Geogr. Soc. Journal.
—— Geol. Soc. Fy & Quart. Journal.
—— Geol. Soc. Trs.
—— Geol. Survey etc.
—— Hortic. Soc.'ns, Journal & Proc.
—— Inst. Civ. En. Trans.
—— Linnean Soc. ans. & Journ. of Proc.
—— Med. Bot. Soc. Trans.
—— Med. Chir. Soc. Trans.
—— Med. Soc. Trs.
—— Med. Trans.
—— Meteorol. Soc. Trans.
—— Microscop. Soc. Trans. & Journal.
—— Roy. Asiat. Soc. Journ. & Proc.
—— Royal Inst. Journal.
—— Royal Soc. Pl. Trans. & Proc.
—— Soc. Med. Improvement.
—— United Serv. t. Journ.
—— Zool. Soc. Trs & Proc.
Lyon—Soc. Roy. d'ric. Mém.
—— Soc. Linn. Actes.

Madrid—Mem.
Manchester—Lit. & Phil. Soc. Mem.
—— Geol. Soc. Mr
Mans—Soc. Roy. Trans.
Marburg—Nat. Ges. Schriften.
Mauritius—Roy. Soc. Trans. (incomplete).
Meklenburg—Verein. Naturg. Archiv.
Milan—Scienz. Italiti.
—— Soc. Geol. & I. Atti.
—— Soc. Patr. Atti
—— Ist. Lomb. & Wt. Mem. & Giornale.
Modena—Soc. Ital. m.
Montpellier—Acad. Mém.
Montreal—Canad. J. Journal.
Moscow—Soc. Imyat. Mém., Nouveaux Mém. & Bulletin.
Munich—K. B. Akadekache & Sitzungsb.
—— Nat. Tech. Cos. Abhandl.
Munster—Artzl. Ges. Abhandl. u. Beob.

Nancy—Travaux, & Roy. Sci. & Acad. Stanislas. Mém.
Naples—Acad. RodMem. & Rendiconto.
—— Accad. Sci. Att
—— Ist. Incorrag. i.
Nassau—Ver. f. Nat. Jahrb.
Neuchatel—Soc. Scient. Mém. & Bull.
Newcastle—North Engl. Inst. Mining Eng. Trans.
Newcastle—Tyneside Field Club (incomplete).
New York—Lit. & I. Soc. Trans.
—— Lyc. Nat. Hist.
Orléans—Soc. Sci. & & Mém. & Annales.
Oxford—Ashmol. S. Trans. & Proc. (incomplete).

Paris—Acad. Roy. Méd. Mém.
—— Acad. Sci. de ist. Mém. & Mém. Sav. étr.
—— Cercle Médicalan.
—— Comptes Rendu
—— Congrès Sci. géance.
—— Ecole des Mineurs. & Ann.
—— Ecole Polytechnoal.
—— Fac. de Méd. H.Soc. de Méd. Mém. & Bull.
—— Mus. Hist. Naturales & Archives.
—— Séances des Ecoles.
—— Soc. Biol. Comt. Rend. et Mém.
—— Soc. de la Fac. Méd. de Paris, Mém.
—— Soc. Entomol. anles.
—— Soc. Géog. Bull
—— Soc. Géol. Mém. Bull.
—— Soc. d'Hist. Natém.
—— Soc. Médicale de.
—— Soc. Méd. Allemde, Recueil des Trav.
—— Soc. Méd. d'Emt. Mém. & Bull.
—— Soc. Méd. Mémicante & l'Hôtel de Ville).
—— Soc. Météorol. I.
—— Soc. Philom. B.
—— Soc. Savantes, Is.
—— Trans. méd. Jou. de Méd. prat. et Actes Soc. Méd.
Petersburg—Acad. ImSci. Mém., & Mém. Sav. étr., Recueil des sa Comptes Rendu.
—— (& Hamburg)—acad. pract. Aerzte.
—— Verm. Abhandl. naturhiste d. Heilk.
—— K. mineral. Ges Verhandl.
—— Russ. geog. Ges Denkschr.
Philadelphia—Acad. : Sci. Journ., Second Series.
—— Amer. Phil. Society & Proc.
—— Coll. Pharm. Joual.
Prague—Böhm. Ges Abhandl. & Sitzungsber.

Regensburg—Zool. m Ver. Korr. Blatt.
Rome—Acad. Nuov. ln. Atti.
Rotterdam—Bat. Gestach. Nieuws Verhandel.
Rouen—Acad. Sci. Trans.

St. Quentin—Soc. S. & Acad. Stanos, Annales & Mém.
Savoie—Acad. Sci. M.
Steiermark—Geog. ml. Ver. Bericht (incomplete).
Stockholm—Kongl. Vi. Acad. Handl. & Öfversigt.
—— Svensk. Lak-Skil Handl., Forhandl. & Nya Handl.
Strasburg—Soc. Hist.nt. Mém.
—— Soc. Sci. & Agricôm. & Journal.
Stuttgart—Wirt. Ass Ver. Mittheil.
Switzerland—Allg. Swiz. Gesell. Neue Denkschr.
—— Schweiz. Gesell. chandl.

Toulouse—Acad. Sci. des.
Tübingen—Naturf. Ges ubens, Denkschr.
—— Naturw. Abhanl
Turin—Mine. Tour.
—— Acad. Sci. Mem

Upsal—Soc. Reg. Sci. or. Act. & Årskrift.
Utrecht—Acad. Rhen Proj. Ann.

Valenciennes—Soc. Agric. et Sci. Mém.
Van Diemen's Land—oy. Soc. Papers (incomplete).
Venice—Ist. Ven. Mo & Atti.
—— Ateneo.
Victoria (Melbourne)—Trans. Phil. Inst. & Roy. Soc.
Vienna—Geog. Gesellschaft.
—— Geol. Reichsanst. Abhandl. & Jahrb.
—— Gesell. der Aerzte zu Wien & Verhandl.
—— Wiss. & Phramch.
—— Med. Chi. Acad. Abhandl. & Beob.
—— Zool.-bot. Ver. Abhandl.

Washington—American Soc. Proc.
—— Smithsonian Contrib. & Misc. Coll.
Wirtemberg—Verein. Naturk. Jahresh. & Abhandl.
Würzburg—Verhandl.

Zurich—Med.-chir. Gell. d. Kantons, Verhandl.

Figure 1. Preliminary list of journals (1864) to be indexed for the *Catalogue of Scientific Papers*. Reproduced by permission of the Royal Society of London, MM/14/184.

https://doi.org/10.1017/S0007087417000012 Published online by Cambridge University Press

items, was dominated by publications of learned societies, which made up nearly two-thirds of the titles listed. In terms of geographical distribution, the list was made up mostly of serials from western and central Europe. The remainder were scattered throughout the rest of Europe, North America and the British colonies.[53]

Responses flowed in from across Europe and America, usually with praise for the project along with scores of publications that they had missed. Johann Christian Poggendorff, the long-time editor of the important *Annalen der Physik* in Berlin, was very supportive, though he suggested that they ought to separate out the exact sciences from the rest. The Austrian mineralogist Wilhelm von Haidinger successfully lobbied the society to include an entire genre – the yearly *Programms* published by German and Austrian *Gymnasiums* which often included research papers of instructors – and he offered to do the indexing himself. Joseph Henry, whose report from the Smithsonian helped sparked the project, was scandalized by how meagre the Royal Society's list of periodicals was. He complained that the number of scientific serials excluded from the list was larger than the number that was included, and he sent a copy of the Smithsonian's own published list of scientific serials in hopes of convincing them to adopt a more expansive vision of their undertaking.[54]

In principle, the society wanted to include worthy papers even when they had appeared in serials that fell outside the bounds of properly 'scientific' publications. Borderline cases – 'Medical and Technological journals' in particular – were to be scanned 'for the sake of a few strictly Scientific papers scattered through them'.[55] But there were strict limits: while there are indeed about two hundred periodicals that are represented by three or fewer entries in the *Catalogue*, none are from the general periodical press. In filtering publications, social and scientific respectability seems to have been as operative a criterion as format. Proceedings publications – which were often made up mostly of abstracts – were indexed extensively, while periodicals such as the *Mechanics' Magazine* – which did contain many articles that might be deemed contributions to scientific knowledge – were entirely excluded. The same went for nearly any journal not focused on scientific or technical subjects. The *Athenaeum*, an important venue for reports on scientific meetings and lectures, was ignored, as were the quarterly review journals even though these often employed prominent scientific investigators to write on scientific topics. No encyclopedia articles were included, and newspapers reports were left out entirely. The spirit of these criteria is exemplified by the rare cases in which excluded publications did find a fleeting mention. A handful of papers from the *Mechanics' Magazine* and the *Magazine of Popular Science* (1836–), for example,

53 Preliminary list of journals, MM/14/184. Of those listed, 20 per cent were published in Britain and Ireland; 24 per cent in German states, and 21 per cent in France. These figures are relatively meaningless, however, since many periodicals on the list were short-lived. For example, weighting each periodical in the list by the span of years indexed in the *Catalogue* puts France ahead of Germany.

54 The responses to the circular are preserved in MM/14/184 ff. Haidinger's response is dated 3 April 1864 (MM/14/217); and Henry's is dated 23 March 1864 (MM/14/199). Poggendorff's response is summarized by William H. Miller in a note written on 6 May 1864 (MM/14/202).

55 Miller, op. cit. (25).

found their way into the *Catalogue* but only because they had appeared in German translation in the *Polytechnisches Journal* edited by the chemist Johann Gottfried Dingler.[56]

In cooperating with foreign societies, the council was somewhat more liberal in what it would accept, even allowing some periodicals explicitly geared towards popularization, such as *Cosmos*, edited by the Abbé Moigno in Paris. In some cases, societies and individuals abroad indexed periodicals themselves, shipping the citations to the society. By the time the *Catalogue* went to print, the list of serials had about tripled in size, reaching 1,378. Much of this increase stemmed from the addition of independent journals which now made up about half the entries in the printed list of periodicals included in Volume 1.

Because the model for the *Catalogue*'s contents was memoir collections published by learned societies, ingenuity was required to transform many of the journals in their lists into the sort of thing commensurate with such publications. Throughout the period, but particularly early in the century, independent journals often relied on reprints, summaries and translations for much of their content. For example, in the case of early nineteenth-century chemical journals, Iain Watts has shown that circles of editors across Europe collaborated in reproducing key discovery claims as quickly as possible, in a fashion similar to the copying of political news in dailies.[57] It was thus not straightforward to identify what should count as a genuine original memoir. Publication dates were not always helpful in this regard: it happened regularly that a memoir published by an academy or society was preceded by an earlier summary in an independent journal that might appear without the author's knowledge. The committee ultimately chose to include reprints and translations along with the originals under a single entry. Including everything reduced the difficulty of deciding what was truly an original paper, but there was still no consistent criterion for deciding similarity itself (titles were also often inconsistent).[58] The *Catalogue* nonetheless provides an interesting (if imperfect) window into the extent to which papers were reprinted, excerpted and translated over the course of the century. In the case of an author such as Jöns Jacob Berzelius, who had an international reputation but wrote in a language with relatively few readers, the majority of his entries listed in the *Catalogue* included references to multiple periodicals (as many as ten) published across Europe.

Shorter versions of a paper were generally listed along with extended versions, even if the former was an abstract or a summary prepared by an editor or journalist rather than

56 Jacob Perkins, 'Description of Mr. Perkins' new steam-boiler', *Magazine of Popular Science* (1836) 1, pp. 48–55, appeared in the *Catalogue* as 'Ueber die Vortheile des neuen nach dem Circulations-Principe gebauten Dampfkessels', and a series of letters from William Lassell on 'Casting and grinding specula' from the *Mechanics Magazine* in 1837 appeared as 'Ueber das Giessen und Schleifen von Spiegeln für Teleskope'.

57 Iain Watts, '"Current" events: galvanism and the world of scientific information, 1790–1830', unpublished PhD dissertation, Princeton University, 2015. On copying networks of newspapers see Will Slauter, 'The paragraph as information technology: how news traveled in the eighteenth-century Atlantic world', *Annales : Histoire, sciences sociales* (2012) 67, pp. 253–278.

58 Similarity was interpreted liberally at times. For example, alongside the famous fragment in the Linnean Society's *Proceedings* corresponding to Charles Darwin's species theory in 1858 was listed a German translation of Chapter 10 of the *Origin of Species* that appeared in the *Zeitschrift für die gesammten Naturwissenschaften* in 1860.

by the original author. In the case of certain periodicals, third-party summaries were the more common form for papers. Consider the example of the Paris journal *L'Institut*. Founded in 1832, when many Paris dailies and weeklies employed journalists to report on academic meetings, it consisted largely of reports of academic meetings with summaries of papers (often written by a third party). The indexers nevertheless chose to include many of these extracts and journalists' accounts alongside memoirs. They did the same for the *rapports* written by French academicians on papers and inventions presented at meetings. From one point of view, these were simply commentaries and judgements, and thus not original contributions. On the other, they were viewed by many as excellent abstracts of papers – more valuable in many cases than the original papers themselves.

In cases of reports and summaries, the problem of attributing authorship became a perilous task. Was the report writer the rightful author? Or was it the author of the paper being reported? Or perhaps it was the academician who actually presented the work at the meeting. Authorship proved too restrictive a concept to contain these possibilities: the committee attempted to set rules of attribution but these proved difficult to follow in practice. The problem of authorship is all the more significant in that this became the organizing principle for the whole enterprise.

Listing authors

Just as tricky as the problem of bounding was the question of arrangement. Resolving this matter would have an enormous effect on just what readers would see when they opened the *Catalogue*, not to mention how they would interact with it. The temptation to produce a subject classification, or even an alphabetical title keyword index, loomed large, but the committee ultimately decided to focus on the author. Augustus De Morgan – so respected for his bibliographical acumen that he was a member of the Catalogue Committee despite not being a fellow of the society – had long warned of 'heavy and numerous difficulties' entailed by subject classification. Names were the most rational basis for cataloguing books; this was the only ordering principle that De Morgan felt would generate universal assent.[59]

But even names, De Morgan admitted, could result in trouble. 'The variety of modes by which names are altered and disguised is great', he lamented, with authors sometimes changing objectionable names ('Abraham is made Braham, Israel D'Israeli, Bernales Bernal'), Latinizing their names, or concealing names 'in acrostics'. There was also 'mock-modesty which but half reveals its name … yet still contrives to leave a trace behind'.[60] Full anonymity was even worse. But these practices, De Morgan insisted, were particular failures of authorial propriety; the ambiguities that came from subject classification were more fundamental. There was hope that authors could be prevailed upon to put aside such invidious practices in the future.

59 Augustus De Morgan, 'Libraries and catalogues', *Quarterly Review* (1843) 72, pp. 1–25, 14–15.
60 Ibid., pp. 8–13.

But when it came to periodicals, attributing authorship was more problematic. The difficulties were not limited to proceedings and reports; they extended to the many journals that published original papers anonymously or pseudonymously. The list of such journals reads like a who's who of what some called the 'higher class' of scientific journals, including the *Philosophical Magazine*, the *Quarterly Journal of Science*, the *Bibliothèque universelle*, the *Edinburgh Journal of Science*, the *Annales de mathématiques pures et appliquées*, the *Annalen der Physik*, and the *American Journal of Science*. Although anonymous attribution of original research papers was especially common earlier in the century, the practice had by no means disappeared by mid-century.[61] The *Catalogue*'s editors publicly expressed their exasperation that many of the journals with which they were forced to deal did not correspond to their vision: 'None but those who have been engaged in a task of this kind can form any idea of the difficulty occasioned by such omissions.'[62]

While the editors did include a section for anonymous papers at the end of Volume 6, they did what they could to incorporate them into their system: 'No pains have been spared', they wrote, 'to assign the Memoirs to their respective Authors'.[63] But this was a Herculean task; while the number of fully anonymous entries was only about 1,400, there were vast numbers of entries signed with initials or with otherwise incomplete or misleading names. Some authors, such as the early-century natural philosopher Thomas Young, had used pseudonyms in most of their contributions to periodicals.[64] In ambiguous cases, such as articles signed by initials, the editors often made educated guesses. But assigning authorship in this way proved perilous, especially when dealing with publications outside Britain. The French statistician Irénée-Jules Bienaymé later uncovered various cases of misattribution of French authors in the *Catalogue*. Specifically, seventeen papers written by Antoine Augustin Cournot that had appeared in Férussac's *Bulletin universel* under the signature A.C. had been attributed to the mathematician Augustin-Louis Cauchy. Bienaymé pointed out that such problems stemmed from foreigners' unfamiliarity with the French scientific scene; only abroad 'would it be possible to make this mistake'.[65]

The cataloguers reached out to editors, societies, publishers and likely authors themselves to uncover clues about authorship. They asked authors to confirm their contributions, sending them proofs for corrections, and even asking them to send in their own publication lists.[66] The autobiographical publication list was not a very common

61 The end of Volume 6 contains 1,398 anonymous entries (those for which the cataloguers were able to ascertain the author also appear under that author's list). These are distributed about evenly over the years 1800–1863, but because the number of entries in the *Catalogue* doubles about every two decades, this represents a significant proportional reduction over time.

62 'Preface', op. cit. (48), p. ix.

63 'Preface', op. cit. (48), p. ix.

64 Of seventy-four publications listed under Young's name, thirty-nine were originally published anonymously or using a variety of initials.

65 Irénée-Jules Bienaymé, 'Rectification de listes d'articles détachés de M. Cauchy, publiées dans deux Catalogues différents, et restitution à M. Cournot de quelques-uns de ces articles', *Comptes rendus hebdomadaires* (1871) 72, pp. 25–29.

66 LCCM, 28 January 1869.

genre for most scientific writers, and such requests prompted some to reflect on their identities as authors in a new way. The geologist Roderick Murchison noted that the first time he had been prompted to make up such a list was in 1845, for the *Bibliographia Zoologiae et Geologiae*. Strickland had also reached out to authors for help after the first volume of that work was criticized for inaccuracies and omissions. Murchison wrote to him that after updating the proof he felt 'quite appalled at the list under which I am buried', and he went on to reflect on what he still wished to accomplish as a geologist. Charles Darwin was likewise surprised by the 'awfully long' list that had resulted, and recommended deleting less important items.[67] When the society began requesting authors' publication lists they were sometimes greeted with similar reflections. While some – such as George Douglas Campbell – rejected such a list as a waste of effort, others such as David Brewster took 'much pleasure' in helping to get their publication history exactly right.[68] Some even requested separate copies or proofs of the list for their personal use.[69]

Many authors expressed confusion and even frustration over just what kinds of publication were supposed to be included. James David Forbes tried to add his encyclopedia articles, reviews and separate works, but was informed that none of these were admissible. John Herschel also expressed confusion over what counted: 'I do not know what are the limitations under which the citations are made further than that they … exclude books & separate publications'. He observed more specifically, 'whether an Encyclopaedia is to be considered a Book more than a Vol of Memoirs by various authors I do not know'.[70] In practice, the contents of many nineteenth-century encyclopedias were hard to distinguish from other periodical genres; many authors used the opportunity to write for them to establish original scientific claims. Herschel had written extensively for the monumental *Encyclopaedia Metropolitana*, put together by Samuel Taylor Coleridge, on topics such as light, sound and physical astronomy. Coleridge himself had singled out Herschel's contributions to show that his *Encyclopaedia* was 'enlarging the boundaries of our scientific knowledge'.[71] Herschel understandably wanted them counted among his scientific contributions: 'I should be very glad of their inclusion'.[72] In subsequent decades, authors who published in genres outside the bounds of the *Catalogue* continued to complain that it misrepresented their publishing history. The French chemist Marcellin Berthelot pointed out 'a series of very important omissions which seem to be due to the system that has been adopted, excluding works published

67 Roderick Murchison to H.E. Strickland, July 1852, H.E. Strickland Papers, University Museum of Zoology, Cambridge, E1110; CD to H.E. Strickland, 29 January 1849, H.E. Strickland Papers, N168.

68 G.D. Campbell to White, 13 April 1876, Royal Society of London, MS/769; Brewster's responses were sent 27 May and 5 June 1867, Royal Society of London, MC/8.

69 Herschel and Forbes requested copies of proofs. See Herschel to Royal Society, 1 March 1869, MM/14/217; and W. White to J.D. Forbes, 13 July 1868, JDF/1/4686.

70 White to Forbes, op. cit. (69); Herschel to Royal Society, op. cit. (69), underlining in original.

71 Samuel Taylor Coleridge, *Cabinet Edition of the Encyclopaedia Metropolitana: Prospectus*, London: Griffin & Company, 1849, p. 7.

72 Herschel to Royal Society, op. cit. (69).

as volumes'.[73] He provided a list of his books in the hope that the editors might make an exception. They did not.

Accounts of an author's publications were not unheard of in Britain. Publishers and authors occasionally appended to books lists of other publications by the same writer, although these did not normally include works in periodicals unless they had also been published separately. It was also common to suggest that one's publishing history was an indicator of scientific reputation. In 1830 Charles Babbage and Augustus Bozzi Granville made the case that scientific eminence might be measured by one's contributions to the *Philosophical Transactions*. Contributing to the transactions of societies became a formal qualification for membership in groups such as the exclusive Philosophical Club. It also became known as a factor in Royal Society elections.[74] In 1840 the Royal Society introduced a standard form for those seeking election as a fellow. It included five categories: 'The Discoverer of …', 'The Author of …', 'The Inventor or Improver of …', 'Distinguished for his acquaintance with the science of …', and 'Eminent as a …' Those who filled out the form tended to fill up the space with information about authorship more than any other, sometimes colonizing the space given to the other categories for this purpose (see Figure 2, for example). But these rarely took the form of bibliographical lists in mid-century. Nearly all references were to books, pamphlets or memoirs in transactions. Candidates rarely mentioned works from commercial journals, although they gradually began to do so in the 1840s, and such references became more common in the 1850s.[75]

Some authors, such as Herschel, had already developed a keen interest in their history as scientific authors. Since the 1850s, Herschel had taken to keeping lists not only of his publications, but also of his correspondence and drawings as well. Herschel even kept a record of the quantity – and recipients – of separate copies of his periodical publications. Herschel's lists were long and elaborate, and he organized his bibliographies according to several different schemes, including by date, venue and subject (see Figure 3).[76] But he did not discriminate based on format: Memoirs in the *Philosophical Transactions* were listed alongside not only encyclopedia articles, but also notes and letters in the *Athenaeum* and *The Times*.

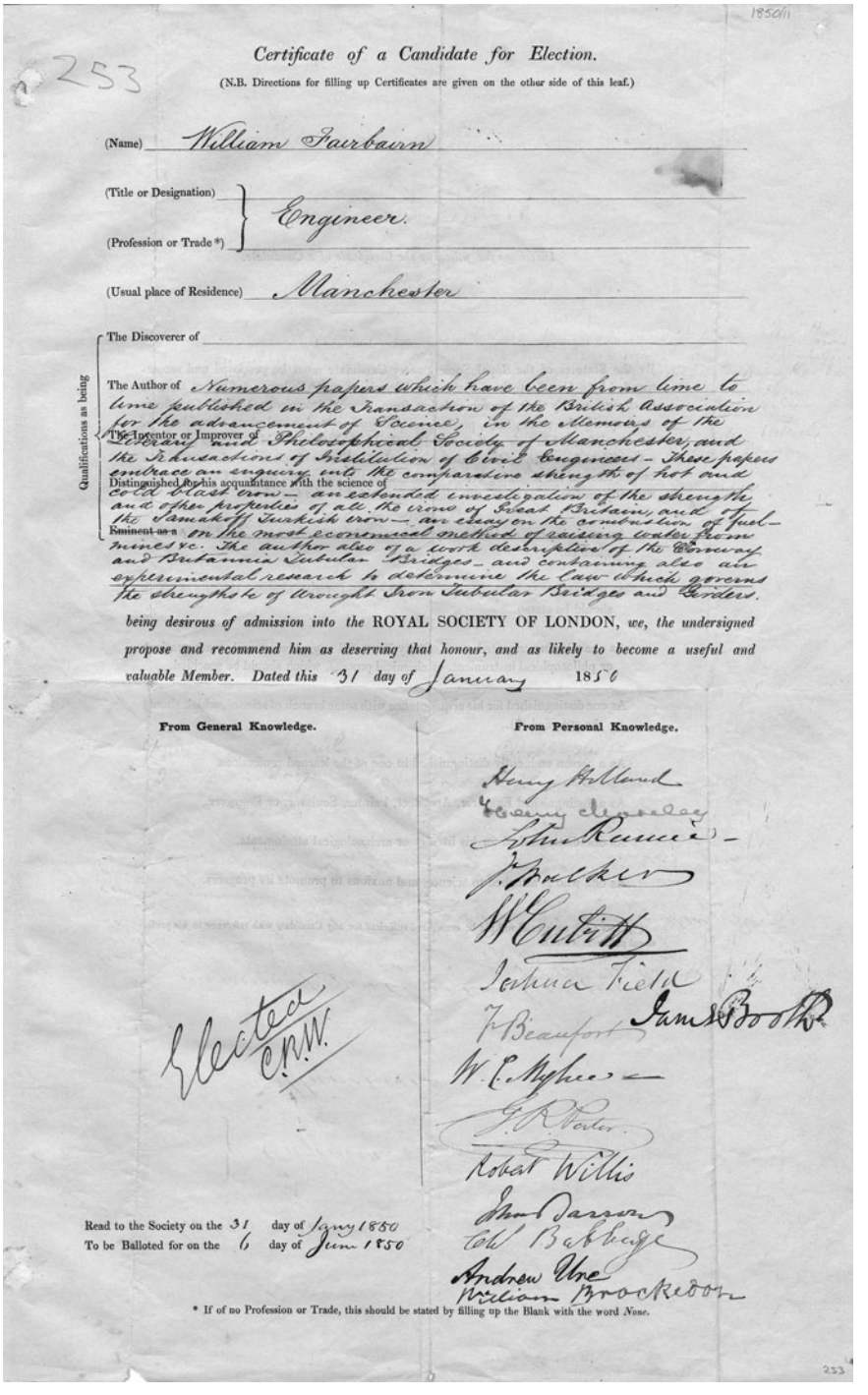
Although Herschel's self-documentation may have been particularly elaborate, it was not unique. In 1864 another astronomer, William Henry Smyth, published a catalogue

73 Marcellin Berthelot to RS, 19 December 1889, Royal Society of London, MS/539.

74 Charles Babbage, *Reflections on the Decline of Science in England and on Some of Its Causes*, London: B. Fellowes, 1830, pp. 154–156. Michael Faraday refused to sign election certificates except of those who had published in the *Transactions*. See Faraday to James Sheridan Muspratt, 8 May 1846, in Frank A.J.L. James (ed.), *The Correspondence of Michael Faraday*, vol. 3, London: Institution of Electrical Engineers, 1996, p. 510. T.G. Bonney, *Annals of the Philosophical Club of the Royal Society*, London: Macmillan, 1919, p. 1.

75 The first instance of an explicit mention of a commercial journal in these certificates that I have identified is in 1835 (to the *Philosophical Magazine*, by Jon Hamett), but there are only about twenty such mentions through 1849. These and subsequent observations on the election certificates are based on those, mostly of successful candidates, archived and transcribed by the Royal Society of London under the call mark EC.

76 Herschel's lists, or transcriptions of them, are preserved at the Harry Ransom Center (Austin, TX), Herschel Papers, 21/1–7. For a subject classified list see 21/1 (a transcription); for a list organized by publication venue, 21/1; and chronological, 21/6.



1850/11

253

Certificate of a Candidate for Election.

(N.B. Directions for filling up Certificates are given on the other side of this leaf.)

(Name) William Fairbairn

(Title or Designation) Engineer.

(Profession or Trade *)

(Usual place of Residence) Manchester

Qualifications as being

The Discoverer of

The Author of Numerous papers which have been from time to time published in the Transaction of the British Association for the advancement of Science, in the Memoirs of the Literary and Philosophical Society of Manchester, and the Transactions of Institution of Civil Engineers - These papers embrace an enquiry into the comparative strength of hot and cold blast iron - an extended investigation of the strength and other properties of all the irons of Great Britain, and of the Russian Iron - an essay on the combustion of fuel - on the most economical method of raising water from mines &c. The author also of a work descriptive of the Conway and Britannia Tubular Bridges - and containing also an experimental research to determine the Law which governs the strengths of wrought Iron Tubular Bridges and Girders.

The Inventor or Improver of

Distinguished for his acquaintance with the science of

Eminent as a

being desirous of admission into the ROYAL SOCIETY OF LONDON, we, the undersigned propose and recommend him as deserving that honour, and as likely to become a useful and valuable Member. Dated this 31 day of January 1850

From General Knowledge.

Elected C.R.W.

From Personal Knowledge.

Henry Holland
Henry Chapman
John Rennie -
J. Locker
W Cubitt
Joshua Field
James Booth
J. Beaufort
W. E. Mylne -
G. R. Porter
Robert Willis
John Barrow
Edward Sabine
Andrew Ure
William Brockedon

Read to the Society on the 31 day of Jany 1850
To be Balloted for on the 6 day of June 1850

* If of no Profession or Trade, this should be stated by filling up the Blank with the word *None*.

253

Figure 2. The election certificate of the engineer William Fairbairn (1850). Reproduced by permission of the Royal Society of London, EC/1850/11.

https://doi.org/10.1017/S0007087417000012 Published online by Cambridge University Press

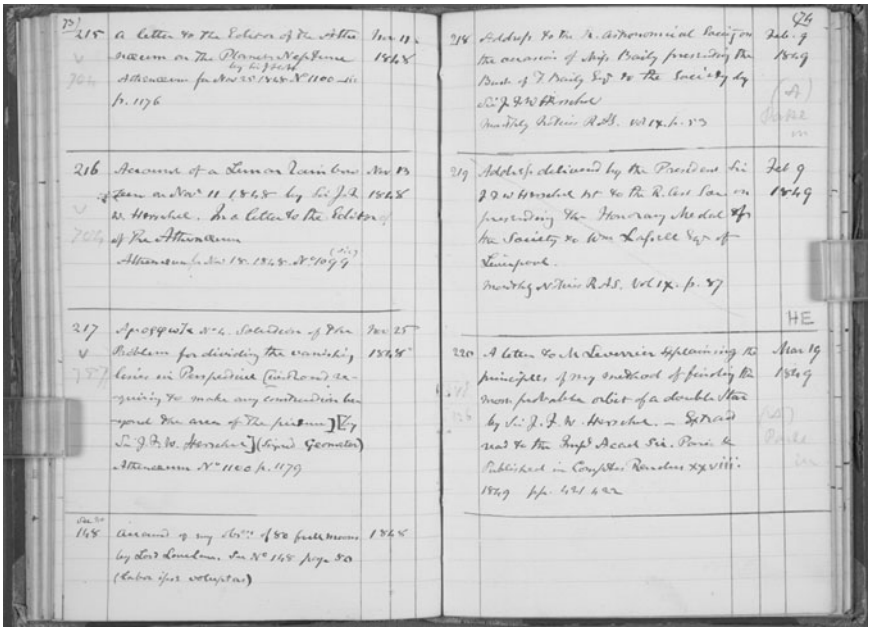


Figure 3. Pages 73–74 of John Herschel's MS catalogue of his publications (*c.*1870), including contributions to the *Athenaeum* alongside contributions to the *Monthly Notices of the Astronomical Society* and the *Comptes rendus*. Reproduced by permission of the Harry Ransom Center, the University of Texas at Austin. Herschel Family Papers, 21/6.

of his scientific works. Smyth viewed his catalogue as a means of setting the record straight, and annotated his list with commentary and correspondence to put his works into the context in which he felt they could be best understood.[77] These items focused especially on his many anonymous contributions to the *United Services Journal*, but also included books, self-published works and even summaries in the *Literary Gazette* of papers read. Neither Herschel nor Smyth thought to separate out their authorship in scientific serials from other kinds of content.

Still, this meticulous attention to one's record as a scientific author remained relatively rare in mid-century Britain. French authors had been printing *notices des travaux* for several decades as part of the ritual involved in winning election to an academy or a faculty, and by mid-century these were coming to resemble lists of publications.[78] In Britain, it was more common for printed credentials to take the form of personal testimonials.[79] But the editors of the *Catalogue* hoped that their work might change

77 William Henry Smyth, *Synopsis of the Published and Privately-Printed Works by Admiral W.H. Smyth*, London: John Boyer Nichols and Sons, 1864.

78 See Maurice Crosland, 'Scientific credentials: record of publications in the assessment of qualifications for election to the French Académie des Sciences', *Minerva* (1981) 19, pp. 605–631.

79 For a discussion of national differences in credentialing genres see *Annales d'hygiène publique et de médecine légale* (1900) 44, pp. 198–199.

https://doi.org/10.1017/S0007087417000012 Published online by Cambridge University Press

authorial practice itself, that it might at least 'have some effect in inducing contributors to Scientific Journals to give their names in full', and thus encourage a more careful attitude toward their authorial identities.[80]

By 1866, printing for the first volume of the *Catalogue* was under way. The work was done by Eyre and Spottiswoode, printers to the queen, at the expense of the government.[81] An edition of a thousand copies was ordered, of which the society was allowed 250 to be distributed to institutions and individuals, the rest to be sold at a rate to recoup printing costs.[82] Profit was beside the point; the council was more concerned that the *Catalogue* command assent from the scientific world. As they readied subsequent volumes for the press, the committee was eager to learn how the *Catalogue* was received. The committee would soon find that its remarkable attention to problems of authorship had been quite justified.

Counting what counts

When the first volumes of the *Catalogue* (Figure 4) appeared in the late 1860s, reviewers hailed it as a grand and monumental work.[83] According to a review in the *Athenaeum*, the *Catalogue* quashed any lingering notion that the Royal Society had become an 'effete body'.[84] *Chambers's Journal* reported in December 1867 that it would revolutionize literary research: 'Any student desirous to know what has been written on any scientific subject since the year 1800 will have only to look into the great *Catalogue of Scientific Papers*'.[85]

Reviewers were quick to reflect on what science looked like through the lens of the *Catalogue*. Two things stood out: science was growing out of control, and it was not the sort of thing that any individual could be expected to follow. An expansive review in the *Athenaeum* warned, 'The sciences are breaking down under their own weight'. Because 'the mass of publications containing original investigation has increased so much, and is increasing so much faster', no one could be expected to be an infallible authority, even in any one branch.[86] In consequence, 'Those who are not aware of the state of things go with confidence to men of name with the question whether a little matter … be original or not'.[87] But in the view of this reviewer it was sheer naivety to believe that scientific knowledge was what the leading authorities on a

80 'Preface', op. cit. (48), p. ix.

81 William Gladstone, Chancellor of the Exchequer, recommended that the Treasury approve the project on 28 November 1864. In doing so, they cited the 'the importance of the work, with reference to the promotion of scientific knowledge generally', but also that they expected the volumes to be sold at a price that 'will repay the cost of printing'. See copy of Treasury minute pasted into MLCC, 23 December 1864.

82 MLCC, 23 December 1864; 24 January 1868. Volume 1 was put on sale for twenty shillings (cloth binding) and twenty-eight shillings (Morocco binding).

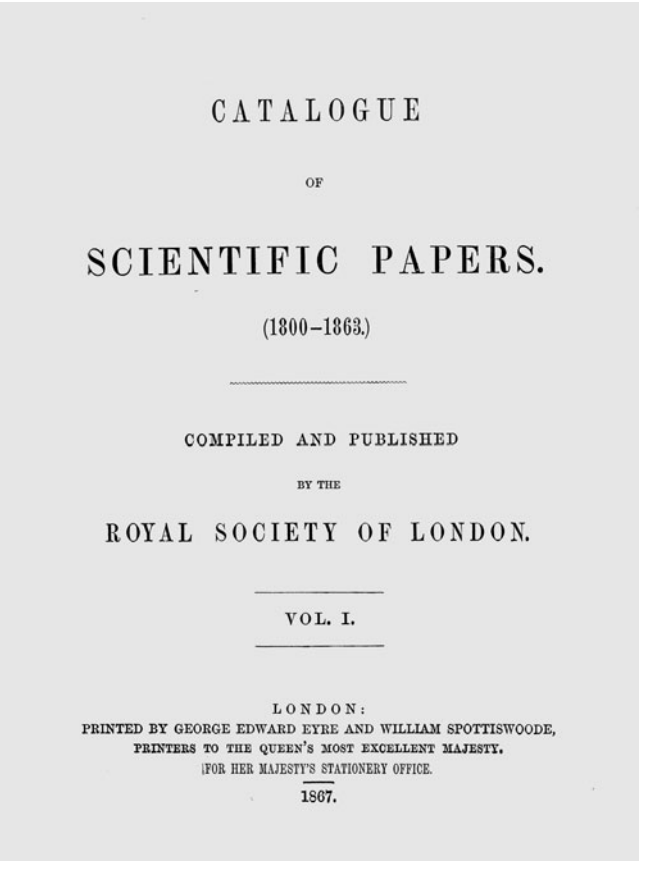
83 For example, 'Catalogue des brochures scientifiques', *Les Mondes* (1868), 17, p. 410; 'Catalogue de mémoires scientifiques', *Revue des cours scientifiques de la France et de l'étranger* (1868), 5, pp. 487–488.

84 'Societies,' *Athenaeum*, 20 November 1869, p. 667.

85 'The month: science and arts', *Chambers's Journal*, 28 December 1867, p. 830.

86 'Catalogue of scientific papers', *Athenaeum*, 6 June 1868, pp. 790–791.

87 'Catalogue of scientific papers', op. cit. (86), 791.



CATALOGUE

OF

SCIENTIFIC PAPERS.

(1800–1863.)

COMPILED AND PUBLISHED

BY THE

ROYAL SOCIETY OF LONDON.

VOL. I.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.
1867.

Figure 4a. Title page of the first volume of the Royal Society's *Catalogue of Scientific Papers*, London: Eyre and Spottiswoode, 1867.

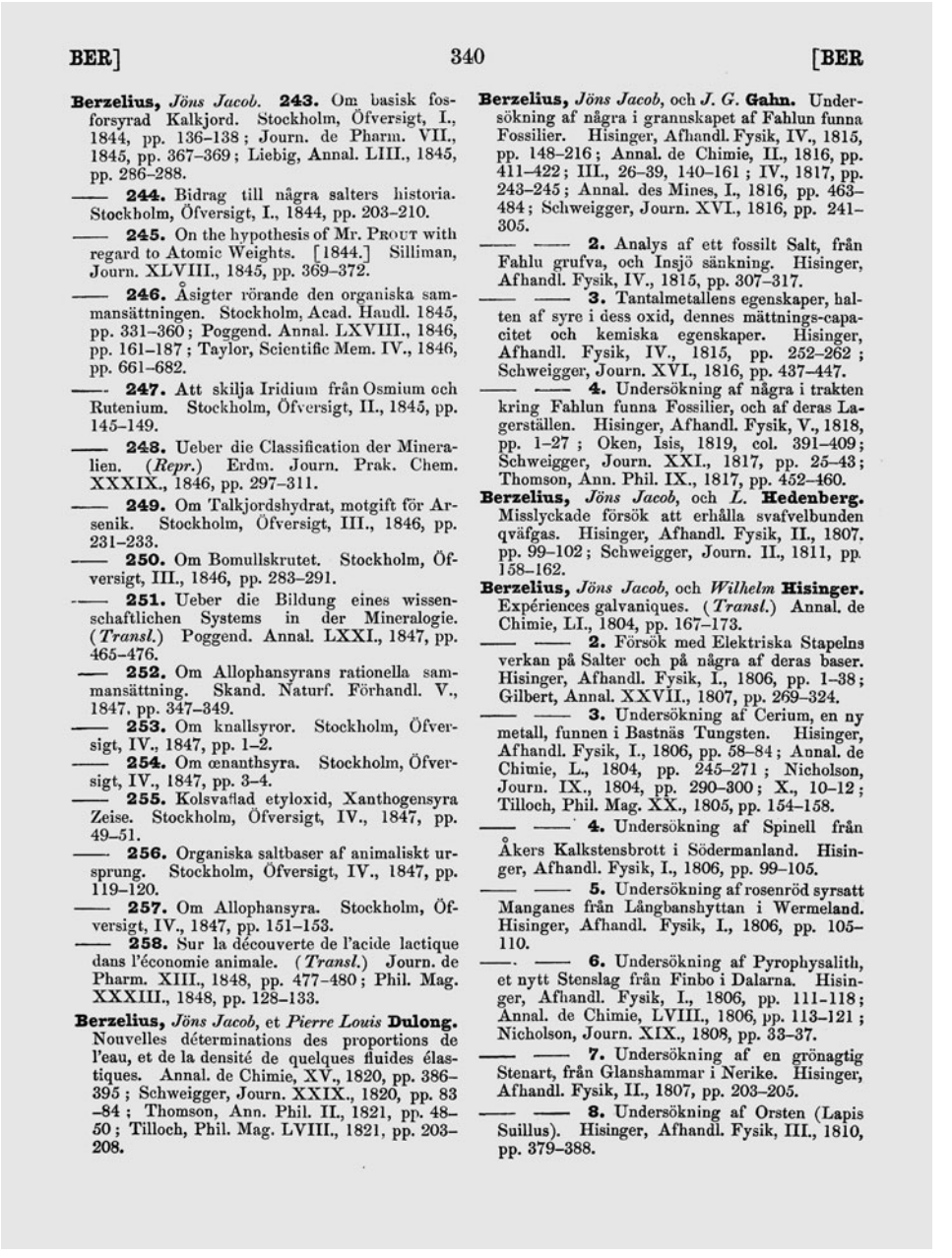
subject thought to be the case. Authentic knowledge was lodged in printed sources, and by this measure it was growing at such a rate that no individual could be expected to keep pace.

While any individual's knowledge of important periodicals might be quite limited, the *Catalogue* seemed to reveal just how vast the world of serials had become. Readers who thought that the number of scientific serials was small, perhaps a few dozen, would 'be surprised to hear that the number of blackbirds baked in this scientific pie is about *fourteen hundred*':

> Looking roughly at the number of entries in a page of the Catalogue, we surmise that there will be not far from 200,000 scientific communications registered in the whole work, being 2,500 for each year which is contained in 1800–1863. What a coral-island science will be![88]

88 'Catalogue of scientific papers', op. cit. (86), 791, original emphasis.

https://doi.org/10.1017/S0007087417000012 Published online by Cambridge University Press



BER] 340 [BER

Berzelius, *Jöns Jacob.* **243.** Om basisk fosforsyrad Kalkjord. Stockholm, Öfversigt, I., 1844, pp. 136–138; Journ. de Pharm. VII., 1845, pp. 367–369; Liebig, Annal. LIII., 1845, pp. 286–288.

—— **244.** Bidrag till några salters historia. Stockholm, Öfversigt, I., 1844, pp. 203–210.

—— **245.** On the hypothesis of Mr. PROUT with regard to Atomic Weights. [1844.] Silliman, Journ. XLVIII., 1845, pp. 369–372.

—— **246.** Åsigter rörande den organiska sammansättningen. Stockholm, Acad. Handl. 1845, pp. 331–360; Poggend. Annal. LXVIII., 1846, pp. 161–187; Taylor, Scientific Mem. IV., 1846, pp. 661–682.

—— **247.** Att skilja Iridium från Osmium och Rutenium. Stockholm, Öfversigt, II., 1845, pp. 145–149.

—— **248.** Ueber die Classification der Mineralien. (*Repr.*) Erdm. Journ. Prak. Chem. XXXIX., 1846, pp. 297–311.

—— **249.** Om Talkjordshydrat, motgift för Arsenik. Stockholm, Öfversigt, III., 1846, pp. 231–233.

—— **250.** Om Bomullskrutet. Stockholm, Öfversigt, III., 1846, pp. 283–291.

—— **251.** Ueber die Bildung eines wissenschaftlichen Systems in der Mineralogie. (*Transl.*) Poggend. Annal. LXXI., 1847, pp. 465–476.

—— **252.** Om Allophansyrans rationella sammansättning. Skand. Naturf. Förhandl. V., 1847. pp. 347–349.

—— **253.** Om knallsyror. Stockholm, Öfversigt, IV., 1847, pp. 1–2.

—— **254.** Om œnanthsyra. Stockholm, Öfversigt, IV., 1847, pp. 3–4.

—— **255.** Kolsvaflad etyloxid, Xanthogensyra Zeise. Stockholm, Öfversigt, IV., 1847, pp. 49–51.

—— **256.** Organiska saltbaser af animaliskt ursprung. Stockholm, Öfversigt, IV., 1847, pp. 119–120.

—— **257.** Om Allophansyra. Stockholm, Öfversigt, IV., 1847, pp. 151–153.

—— **258.** Sur la découverte de l'acide lactique dans l'économie animale. (*Transl.*) Journ. de Pharm. XIII., 1848, pp. 477–480; Phil. Mag. XXXIII., 1848, pp. 128–133.

Berzelius, *Jöns Jacob,* et *Pierre Louis* **Dulong.** Nouvelles déterminations des proportions de l'eau, et de la densité de quelques fluides élastiques. Annal. de Chimie, XV., 1820, pp. 386–395; Schweigger, Journ. XXIX., 1820, pp. 83–84; Thomson, Ann. Phil. II., 1821, pp. 48–50; Tilloch, Phil. Mag. LVIII., 1821, pp. 203–208.

Berzelius, *Jöns Jacob,* och *J. G.* **Gahn.** Undersökning af några i grannskapet af Fahlun funna Fossilier. Hisinger, Afhandl. Fysik, IV., 1815, pp. 148–216; Annal. de Chimie, II., 1816, pp. 411–422; III., 26–39, 140–161; IV., 1817, pp. 243–245; Annal. des Mines, I., 1816, pp. 463–484; Schweigger, Journ. XVI., 1816, pp. 241–305.

—— —— **2.** Analys af ett fossilt Salt, från Fahlu grufva, och Insjö sänkning. Hisinger, Afhandl. Fysik, IV., 1815, pp. 307–317.

—— —— **3.** Tantalmetallens egenskaper, halten af syre i dess oxid, dennes mättnings-capacitet och kemiska egenskaper. Hisinger, Afhandl. Fysik, IV., 1815, pp. 252–262; Schweigger, Journ. XVI., 1816, pp. 437–447.

—— —— **4.** Undersökning af några i trakten kring Fahlun funna Fossilier, och af deras Lagerställen. Hisinger, Afhandl. Fysik, V., 1818, pp. 1–27; Oken, Isis, 1819, col. 391–409; Schweigger, Journ. XXI., 1817, pp. 25–43; Thomson, Ann. Phil. IX., 1817, pp. 452–460.

Berzelius, *Jöns Jacob,* och *L.* **Hedenberg.** Misslyckade försök att erhålla svafvelbunden qväfgas. Hisinger, Afhandl. Fysik, II., 1807. pp. 99–102; Schweigger, Journ. II., 1811, pp. 158–162.

Berzelius, *Jöns Jacob,* och *Wilhelm* **Hisinger.** Expériences galvaniques. (*Transl.*) Annal. de Chimie, LI., 1804, pp. 167–173.

—— —— **2.** Försök med Elektriska Stapelns verkan på Salter och på några af deras baser. Hisinger, Afhandl. Fysik, I., 1806, pp. 1–38; Gilbert, Annal. XXVII., 1807, pp. 269–324.

—— —— **3.** Undersökning af Cerium, en ny metall, funnen i Bastnäs Tungsten. Hisinger, Afhandl. Fysik, I., 1806, pp. 58–84; Annal. de Chimie, L., 1804, pp. 245–271; Nicholson, Journ. IX., 1804, pp. 290–300; X., 10–12; Tilloch, Phil. Mag. XX., 1805, pp. 154–158.

—— —— **4.** Undersökning af Spinell från Åkers Kalkstensbrott i Södermanland. Hisinger, Afhandl. Fysik, I., 1806, pp. 99–105.

—— —— **5.** Undersökning af rosenröd syrsatt Manganes från Långbanshyttan i Wermeland. Hisinger, Afhandl. Fysik, I., 1806, pp. 105–110.

—— —— **6.** Undersökning af Pyrophysalith, et nytt Stenslag från Finbo i Dalarna. Hisinger, Afhandl. Fysik, I., 1806, pp. 111–118; Annal. de Chimie, LVIII., 1806, pp. 113–121; Nicholson, Journ. XIX., 1808, pp. 33–37.

—— —— **7.** Undersökning af en grönagtig Stenart, från Glanshammar i Nerike. Hisinger, Afhandl. Fysik, II., 1807, pp. 203–205.

—— —— **8.** Undersökning af Orsten (Lapis Suillus). Hisinger, Afhandl. Fysik, III., 1810, pp. 379–388.

Figure 4b. Page 340 of the first volume of the Royal Society's Catalogue of Scientific Papers, op. cit.

Here was an awe-inspiring image: science as coral, a massive edifice built up invisibly over time by the constant addition of tiny polyp-like papers. Representations of science as serial accretion would become massively popular in the following decades,

https://doi.org/10.1017/S0007087417000012 Published online by Cambridge University Press

epitomized by the positivism of Ernst Mach and Henri Poincaré. But this vision of knowledge was not simply revealed by the *Catalogue*'s construction; rather, in raising the profile of the scientific paper, the *Catalogue* offered a medium by which this scientific imaginary could come to prominence.

It was not self-evident, however, that scientific knowledge – even science as it was represented in serials – really did correspond to the *Catalogue*'s representation of it. Like Herschel and Forbes, some commentators were mystified by the logic of the *Catalogue*. What purpose could there be in simply grouping together the publications of learned societies with a selection of commercial journals? Of course, monographs and larger works were missing. But in the view of at least one Royal Society fellow who protested in the *Athenaeum*, the principles of selection used by the editors had distorted 'the progress and history of discovery both in Physical and Natural Science' in several other ways.[89] Why had they excluded 'the many short, but frequently important communications sent to journals not professedly scientific, such as are to be found in the columns of the *Times*, and more especially in the *Athenaeum* itself?' And then there were the many 'important books of "Voyages and Travels"' which often contained 'Papers relating to almost every branch of Science'. Not to mention that much good science was published in government documents: 'Scientific Reports published in the Proceedings of Royal Commissions and Parliamentary Committees, which are little known to the world at large, [are] frequently very valuable'. These kinds of documents were not only central to scientific communication, but they were 'far more difficult to discover in the mass of miscellaneous matter with which they are surrounded, and in which they may almost be said to be buried, than those which have appeared in the specially scientific journals'.[90] Another commentator noted that, with more care, the editors might have been able to include 'many valuable memoirs now in great part unknown, or, at all events, forgotten'.[91] According to these criticisms, if the *Catalogue* was truly meant to be an aid to scientific research, then it had missed the mark.

Some might have argued that there was value in just such forgetting. By ignoring the diversity of formats in which science got into print, the *Catalogue* put bounds on what should be preserved, simplifying the record and pushing scientific authors to embrace certain publications and scorn others. While evidence suggests that many did use the *Catalogue* as a research tool, it found uses of other kinds.[92] Nearly all early reviewers, for example, used the *Catalogue* to become auditors of scientific productivity. Reviewers scanned each new volume's pages looking to discover the most prolific authors, reporting what they found. 'Brewster numbers 299 in this century; Cauchy, who belonged

89 Letter to editor (signed F.R.S.), *Athenaeum*, 16 January 1869, pp. 99–100.

90 Letter to editor, op. cit. (89).

91 *The Annual Register … for the year 1868*, London: Rivingtons, 1869, p. 348.

92 George Gore's 1878 guide, *The Art of Scientific Discovery*, London: Longmans, Green, and Co., p. 298, instructs readers in a method for using the *Catalogue* to find papers on a given subject. More comments on both the utility and inadequacy of the *Catalogue* as a research tool can be found in correspondence received by the Royal Society in 1894 in response to a survey regarding the possibility of creating an annual successor to the *Catalogue* (which became the *International Catalogue of Scientific Literature*). See letters collected in MS/531, Royal Society of London.

entirely to this century, 478; Challis, 190; Cayley, 308', read a typical report. Some reviews, such as one in the new journal *Nature*, read like laundry lists:

> Does a mathematician wish to know how many mathematical papers have been written by Grunert, the well-known editor of the 'Archiv', he turns to this volume, and finds 343. Guérin Méneville, the naturalist, figures for 326; Hagen, entomologist, for 102; the veteran Haidinger has 286 on minerals and meteorites; while Henwood, a Cornish celebrity, shows 55 papers on geological and mining subjects; and Heer, of Zurich, to whom we are indebted for admirable descriptions of fossil flora of the primeval world, numbers 46; Sir William Hamilton heads a list of 69 papers; Hansen, 103, probing deep into astronomy; Hansteen, the Norwegian, who lives to see in Sir Edward Sabine's researches, a grand outcome of his own early investigations of terrestrial magnetism, has 141 papers; Dr. Hooker appears for 58 papers; his late father for 72; and the late W. Hopkins, who did so much in mathematical geology, for 33. Dr. Hofmann, the eminent chemist, has made himself responsible for 156 papers; Mr. Lassell for 66, and Leverrier for 88. Kummer, recently elected a foreign member of the Royal Society, is down for 51; Leuckhart for 64; the indefatigable Isaac Lea, of Philadelphia, for 106, mostly about shells; and Lamont, of Munich, for 90, on magnetism, meteorology, and various questions in physical astronomy.[93]

This phenomenon was not limited to English-language reviews – the same thing happened on the Continent.[94] The *Catalogue*'s layout seemed to encourage such score-keeping; it not only grouped together papers under authors' names but numbered them for each author. In later decades, as new series of the *Catalogue* appeared covering later years, the total publication count for each author from the previous series was carried over, such that observers could easily keep track of the running totals.[95] Some reviews, for example in the *Wiener Zeitung*, allowed that 'the mere comparison of numbers is no basis for final judgements of value, which lie rather in the content of each communication'. But who, in truth, could resist? He reassured the reader that a 'quick glance is no less stimulating'.[96] Another reviewer noticed that many of the articles catalogued – especially of the biggest contributors – were exceedingly short, but no matter: 'in pure science a few words may represent a week of hard thought'.[97]

Although the *Catalogue* made it easiest to compare the publication counts of individual authors, enterprising statisticians found ways around this. The running tallies of entries published in each series were a source of quantitative evidence about the progress of science more generally. In *Degeneration*, the Austrian social critic Max Nordau argued that it could be proved 'by numbers that science does not lose, but continually gains ground'. His English translator backed up this statement by referring readers to the *Catalogue*.[98] In 1870, the Austrian mineralogist and editor Wilhelm von Haidinger 'took a statistical look into this grand work' and derived a rubric by which

93 *Nature* (18 November 1869) 1, p. 86.

94 See, for example, 'Zur Statistik der Naturwissenschaftlichen Litteratur', *Wiener Zeitung*, 5 February 1870, p. 437.

95 For example, see *Athenaeum*, 7 June 1879, p. 732.

96 'Ein Verzeichniß sämmticher naturwissenschaftlichen Abhandlungen aus den Jahren 1800 bis mit 1863', *Wiener Zeitung*, 18 July 1868, p. 201.

97 'Catalogue of scientific papers', op. cit. (86), p. 791.

98 Max Simon Nordau, *Degeneration*, London: Heinemann, 1895, p. 114 (translation of *Entartung* (1893)).

	I. Bd.	II. Bd.	III. Bd.	Zusammen
Oesterreich	4	2	6	12
Deutschland	30	22	39	91
Frankreich und Belgien	38	49	27	114
Grossbritannien und N.-Amerika	24	25	35	84
Deutsche in Russland	2	4	2	8
Italien	8	4	—	12
Dänemark	—	2	1	3
Schweden	1	1	—	2
Niederlande	2	1	2	5
	109	110	112	331

Figure 5. Data table derived by Wilhelm von Haidinger from the *Catalogue*'s first three volumes showing the number of contributors in selected regions of Europe who had amassed at least fifty publications. *Archiv der Mathematik und Physik* (1870) 51 (*Literarischer Bericht* CCIII), p. 14.

the *Catalogue* could be used to compare productivity by geopolitical region. Counting each author who had published at least fifty papers, he organized these into a table according to region (Figure 5).[99]

Haidinger bemoaned his table's 'unfavourable portrait of the role which Austria has played in the promotion of science'. But then he showed how a more detailed investigation of key individual authors' careers showed that there was much recent improvement, and that earlier obstacles to publishing in Austria were gradually being removed. 'The result of these comparisons therefore appears to us as a judgment on the history of our previous and current standing', he concluded, 'which is wholly calculated to fortify us in our efforts and work'.[100]

The use of publication counts to serve as a measure of productivity that could be pursued across time and geography continued to gain ground. Even in the mid-twentieth century the *Catalogue* remained a resource for those interested in researching such topics as 'Men's creative production rate at different ages and in different countries'. More generally, 'the number of scientific papers a man publishes' became a favoured measure for 'generating, in an objective fashion' ranked lists of scientific productivity.[101] Although this came to compete with other metrics such as citation analysis in the 1960s, many of these continued to treat the scientific paper as the fundamental genre through which scientific outputs might be turned into numbers.

Yet measures such as Haidinger's likely revealed more about the varied uses that authors and editors made of periodicals across time, geography and subject matter than they did about the comparative scientific productivity of individuals and nations. Looked at from another angle, they revealed a great deal about the choices that the cataloguers themselves made about what to include and how to delimit scientific authorship.

99 Wilhelm Ritter von Haidinger, 'Catalogue of scientific papers (1800–1863)', *Verhandlungen der K.K. Geologischen Reichanstalt* (15 February 1870), 4, pp. 70–74.

100 Haidinger, op. cit. (99), p. 74.

101 Harvey C. Lehman, 'Men's creative production rate at different ages and in different countries', *Scientific Monthly* (1954) 78, pp. 321–326; Donald deB. Beaver, *The American Scientific Community, 1800–1860: A Statistical-Historical Study*, New York: Arno Press, 1968, p. 1. See also Wayne Dennis, 'Bibliographies of eminent scientists', *Scientific Monthly* (1954) 79, pp. 180–183.

To see why the French, for example, did particularly well according to Haidinger's metric, consider the most prolific French author (and second-most-prolific overall) in the first series, Augustin-Louis Cauchy. The mathematician had become notorious for his use of the Paris *Comptes rendus* after it was launched in 1835. Rather than submitting short summaries of larger works, Cauchy chose to use the new weekly to publish his research the way a writer of fiction might publish a serialized novel, putting two- to five-page instalments into print on a weekly basis. (For academicians, the only publication limit imposed was number of pages per week.) As a result, whole pages of the *Catalogue* comprise nothing but references to his short notes in the *Comptes rendus*.[102] Some French savants, such as Jean-Baptiste Biot, condemned Cauchy for his lack of authorial decorum; Biot worried more generally that the academy's shift to publishing very short papers in the style of a commercial journal would turn it into a purveyor of advertisements instead of evidence-based memoirs.[103] Yet Cauchy's publishing habits were only the most extreme instance of a general trend. (Ironically, Biot himself was the second-largest contributor to the *Comptes rendus* after Cauchy during this period, having published 121 notes over twenty-five years.) Outside France, many condemned the French for their obsession with publishing short notes staking out priority claims without confirming their findings.[104] But in London, Philip Sclater, John Gould and John Edward Gray (the most prolific author in the first series) also spawned massive publications lists due largely to their numerous publications in the *Proceedings of the Zoological Society*. In Berlin, meanwhile, Christian Ehrenberg and Heinrich Rose used the Prussian Academy's *Monatsbericht* in a similar fashion.

The *Comptes rendus* of Paris dominated the *Catalogue* like no other publication. Although the *Catalogue* listed over 1,400 periodicals, about one out of every eighteen entries in the first series contained a reference to the *Comptes rendus* (despite its having existed for less than half the time span covered by the first series). This rate was much larger than that of the next most cited source, the *Annales de chimie*. Next followed a long list of commercial journals: Poggendorff's *Annalen der Physik und Chemie*, the *Philosophical Magazine*, the *Journal für praktische Chemie*, Liebig's *Annalen der Chemie und Pharmacie*, the *Journal de pharmacie*, the *Astronomische Nachrichten*, Silliman's *American Journal of Science and Arts*, and the *Annales des sciences naturelles*. The *Comptes rendus* was alone among society publications in the top ten, although several proceedings journals – including those of the Zoological

102 After 1836, 391 of his 405 entries in the *Catalogue* are references to the *Comptes rendus*. To be clear, criticism of Cauchy was not the same as contemporary criticism of authors who engage in so-called 'salami science' to pad their CV. There was little or no sense at that time that having published very many short articles (as opposed to longer memoirs or books) was in itself something to be rewarded. For the twentieth-century version of such criticism see, for example, William J. Broad, 'The publishing game: getting more for less', *Science* (1981) 211, pp. 1137–1139.

103 J.-B. Biot, 'Comptes rendus hebdomadaires', *Journal des savans*, November 1842, pp. 641–661, 659–660.

104 See, for example, Jöns Berzelius, *Jahres-Bericht über die Fortschritte der physischen Wissenschaften* (1828) 7, p. 87; and reported speech of Felix Klein in letter from Georges Brunel to Henri Poincaré, 7 July 1881, in 'La correspondance d'Henri Poincaré avec des mathématiciens de A à H', *Cahiers du Séminaire d'histoire des mathématiques* (1986) 7, p. 92.

Society of London, the British Association, the Société géologique de France, and the Akademie der Wissenschaften in Vienna – made the top twenty. Although the *Catalogue* had begun as a project to index the memoirs contained in society transactions and memoir series, these made up only 10 per cent of the *Catalogue*'s references, while independent journals accounted for 58 per cent of them. When all was said and done, the *Catalogue*'s representation of the world of science in print inclined unmistakably towards the commercial press.

If it was tricky to compare productivity across geographical distances, it was not much easier to do so locally. Then, as now, publishing habits varied across fields. Those who studied the very large (astronomers) or the very small (entomologists), and for whom it was customary to dispatch short notes of observations to journals on a regular basis, were especially well represented among the biggest contributors. But the most common attribute of prolific authors as measured by the *Catalogue* was that they directed periodical publications themselves. The list of the biggest contributors includes a who's who of editors of journals, making up approximately half of the authors whose list numbered at least two hundred: Pieter Bleeker, David Brewster, Johann August Grunert, Félix-Edouard Guérin-Méneville, Wilhelm von Haidinger, Justus von Liebig, Joseph Liouville, Louis Pfeiffer, Adolphe Quetelet, D.F.L. von Schlechtendal, Thomas Thomson, Johann Trommsdorff, Louis-Nicolas Vauquelin.[105] To publish in one's own journal was no abuse of privilege; many understood it as a prerogative and even the duty of editors to set the tone by including their own work and by making public judgements about the works of others. 'I know of no one more obligated to engage in the duty [of writing criticism]', explained Justus von Liebig in 1834, 'than the editors of periodicals, who stand as sentinels to signal both what is Good and what is in error'.[106]

For similar reasons, editors were also among those most likely to be involved in multiple authorship. While most papers in the *Catalogue* were connected to a single name, a significant number (3 per cent) of entries were attached to multiple names (of which just over 95 per cent involved only two names).[107] But even this small figure overstates the frequency of co-authorship in the strict sense of two names listed alongside one another at the front of a text. The indexers sometimes had difficulty isolating a single author, since a variety of individuals might be connected to a periodical article in diverse ways. The cataloguers had no easy way to account for this diversity, and instead maintained a fluid working definition of what constituted 'authorship'. Thus journal editors who introduced or commented on a paper were sometimes given the status of co-authors. Similarly, a report on a memoir could be attributed both to the writers of the report and to the author of the original memoir. A paper written by one individual that was based on a specimen collection might also be attributed to the

105 Of the thirty-six authors with at least two hundred publications listed, seventeen were editors and all of these published extensively in the periodicals with which they were associated. See Appendix below.

106 'Bemerkungen zu der vorstehenden Abhandlung des Herrn Dr. Reichenbach', *Annalen der Pharmacie* (1834) 10, pp. 315–323, 315.

107 Notably, French authors accounted for nearly half of all co-authored papers. For details on the calculation, see the Appendix below.

collector. (Similarly, astronomical papers based on a collection of observations were sometimes also attributed to the collector, especially if that collector was named in the title or description of the piece.) A paper presented at a meeting might be attributed both to its author and to the individual who presented it. In some cases, a book review was indexed and attributed both to reviewer and to author reviewed. Even obituaries were sometimes indexed and attributed not only to the writer but also to the deceased subject.

The category of 'author' thus became a label that might cover a variety of roles an individual might play in the production of a periodical text. But by shining new light on periodical authorship, the *Catalogue* likely had the effect of reinforcing the growing sense that papers in scientific periodicals – and by extension discovery claims – were properly attributed to particular individuals who took both credit and responsibility for them.

Curriculum vitae ab indici

The attraction of using the *Catalogue* to compare the productivity of individuals and groups went alongside what might have been its most enduring role: as an aid in assessing and narrating a scientific life. 'The cataloguer is the *vates sacer* of these heroes', wrote one reviewer. 'Without him they are lost in the bulk of periodicals which are not at hand'.[108] In the 1860s Michael Foster and Charles Lyell had imagined the fruits of a life in science to be grand treatises, but the availability of authors' publication lists suggested a different vision that repositioned periodical authorship at the heart of a scientific life.

In the 1870s, obituary notices and appreciations of researchers across Europe began routinely to invoke the *Catalogue*. Proofs of a productive scientific life often cited the numerical count of a subject's papers appearing in the *Catalogue*. When Justus von Liebig died in 1873, a eulogist wrote, 'the mere list of Liebig's contributions to Science covers nearly eleven large quarto pages of print, and embraces 317 titles'. When the Belgian statistician Adolphe Quetelet passed away in 1874, a remembrance in *Nature* also turned, appropriately, to numbers: 'The many-sidedness and fertility of his mind may be seen from his scientific memoirs enumerated in the Royal Society's *Catalogue of Scientific Papers*, amounting at the close of 1863 to 220'.[109]

The *Catalogue* was not simply a resource that writers of *éloges* used for numerical analysis. It also provided a ready-made itinerary by which to follow the unfolding of a career. The chronological list of Liebig's papers, for example, was used to map his path from his first paper on 'A peculiar green colour' to his last, on fermentation. When Wilhelm von Haidinger – who had vigorously promoted the *Catalogue* himself – passed away in 1871, two detailed obituaries followed the *Catalogue* closely in narrating his life. Franz Ritter von Hauer and Eduard Döll both referred to the periods and changing foci of Haidinger's research career by grouping together subsets of papers in

108 *Athenaeum*, 6 June 1868, p. 791.

109 This obituary appeared in *Nature* (1874) 9, pp. 403–404. But see also the *Athenaeum*, 28 February 1874, p. 297.

the *Catalogue* and giving paper counts in each case. (Döll even included a footnote explaining to readers what the *Catalogue* was and how they could obtain a copy for themselves.)[110]

Listings of literary output had precedents both in the sciences and beyond. In Berlin, the first series of Johann Poggendorff's *Biographisch-literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften* had appeared in 1863. Ordered alphabetically by name, the handbook included small biographical statements along with a listing of the principal published works of each subject. His earlier historical project, the *Lebenslinien zur Geschichte der exacten Wissenschaften* – timelines of the life and death of key figures in the exact sciences – usually included references only to a single separate work, or an important discovery. But Poggendorff chose to emphasize periodical publications in his handbook, noting that 'they are usually of more importance for science than independent works'. His lists were neither chronological nor enumerated, however, and he eschewed any claim to completeness, not only because this was impractical for an individual editor but also because it might distract from his biographical aim.[111]

Poggendorff was influenced by the biographical–historical dictionaries and encyclopedias that had been growing in popularity since the late eighteenth century. In a masterful study of the genre in France, Jean-Luc Chappey has argued that these works were key implements in 'battles for control over legitimate modes of dividing up the social world'. They had the capacity to 'rank, hide and consign to oblivion whole classes of actors, practices and modes of production', and as such they provide a heretofore neglected window onto the changing shape of political culture in France and elsewhere.[112] Such dictionaries often focused on figures of public renown, particularly in politics and the fine arts. Poggendorff explained that while such dictionaries might cover the great scientific luminaries sufficiently, they 'passed in silence over the large number of men who, though not as eminent, were still highly valuable to the development of science'.[113] To import this genre into science was implicitly to make a claim about the cultural significance of the collectives that produced knowledge of the physical world.

In Britain, the lives of men of science depicted in encyclopedias and historical dictionaries had shifted in form through mid-century, coming routinely to exclude personal details of character and upbringing to focus especially on their contributions to knowledge and their place in the history of discoveries.[114] Although the *Catalogue*'s builders

110 Franz Ritter v. Hauer, 'Zur Erinnerung an Wilhelm Haidinger', *Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt* (1871) 21, pp. 31–40; Ed. Döll, *Wilhelm Ritter von Haidinger*, Vienna: Realschule, 1871.

111 Johann Poggendorff, 'Vor- und Schlusswort des Verfassers', in *Biographisch-Literarisches Handwörterbuch für Mathematik, Astronomie, Physik mit Geophysik, Chemie, Kristallographie und Verwandte Wissensgebiete*, Band 1, Leipzig: J.A. Barth, 1863, p. v.

112 Chappey, op. cit. (13), pp. 10, 13.

113 Poggendorff, op. cit. (111), p. vi.

114 Richard Yeo, 'Alphabetical lives: scientific biography in historical dictionaries and encyclopaedias', in Michael Shortland and Richard Yeo (eds.), *Telling Lives in Science: Essays on Scientific Biography*, Cambridge: Cambridge University Press, 1996, pp. 139–170.

made no claim to its being a biographical dictionary, this background is central to understanding its full historical significance. Not only was it perceived by some as following from and expanding on Poggendorff's handbook,[115] but also it had an impact on the form that scientific entries in these dictionaries later took. Already in 1872, when a supplemental volume of biographical entries appeared for the popular *English Cyclopaedia*, the *Catalogue*'s influence was unmistakable. It was cited dozens of times, and even when it was not cited directly, the structure of many entries corresponding to men of science hewed closely to its chronological lists of periodical titles.[116]

Other biographical genres came to resemble the *Catalogue*. Many election certificates for the Royal Society began to consist largely of publication lists. Titles of authors' publications had dominated these documents since the 1850s, but they were still integrated into narratives in the form of sentences and paragraphs that normally described the substance of their contributions. During the 1860s some candidates did away with these paragraphs and syntactic connections, leaving a bare list of titles of papers and periodicals (sometimes adding more bibliographical information such as year, volume and page number). The trend progressed rapidly after 1870, and by about 1876 nearly all regular election certificates were made up of bibliographical lists (Figure 6).[117] By around that time, most printed *notices des travaux* that French savants compiled to support their candidacy for membership in scientific academies and for university chairs included an exhaustive, enumerated list of their publications, usually dominated by periodicals. Figure 7 shows the first few pages of the *notice* compiled by the mathematician Henri Poincaré in 1886. An enumerated list of all his publications, it is organized by periodical, and it begins with the *Comptes rendus*. Six years into his publishing career, he could already claim to have published 102 papers.[118]

My claim in this essay is not that the *Catalogue* caused the ascendancy of the publication list as a privileged measure of a scientific career. But by treating authorship as a form of data, it provided a ready template for imagining an individual's life in science as a history of these authorial acts. By flattening out the diverse landscape of scientific publishing it became imaginable that scientific productivity could be quantified. The astonishing idea emerged that the scientific paper might be treated as a standardized unit, not only uniform enough, but also important enough, that it was the kind of thing that might be counted and compared.

By 1903, Michael Foster himself, in his role as leading publicist for the *International Catalogue of Scientific Literature*, the ambitious successor project to the *Catalogue*, had

115 'Johann Christian Poggendorff', *Proceedings of the American Academy of Arts and Sciences* (1877), 12, p. 331.

116 *Biography, or Third Division of 'The English Cyclopaedia', Supplement*, London: Bradbury, Evans, & Co., 1872. The *Catalogue* was most relevant for those names in the first part of the alphabet, since authors of entries would only have had access to about the first three volumes.

117 In 1863, the Royal Society made it easier to include such lists by introducing a new form that did away with the various categories of qualifications and simply left a large blank space which candidates almost invariably used for publications. Election certificates for foreign members and those of the 'privileged class' did not require qualifications.

118 *Notice sur les travaux scientifiques de Henri Poincaré*, Paris: Gauthier-Villars, 1886. On the gradual transformation of this genre toward the form of a publication list see Crosland, op. cit. (78).

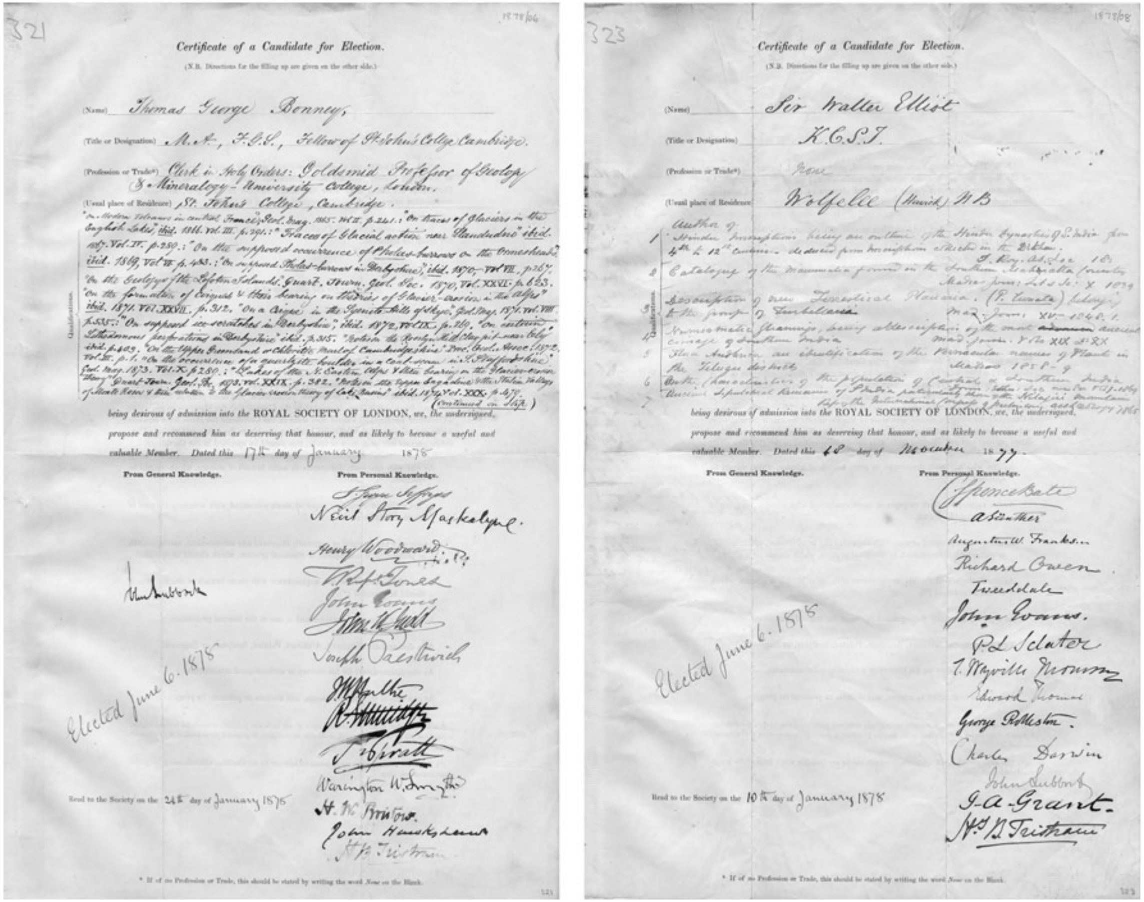
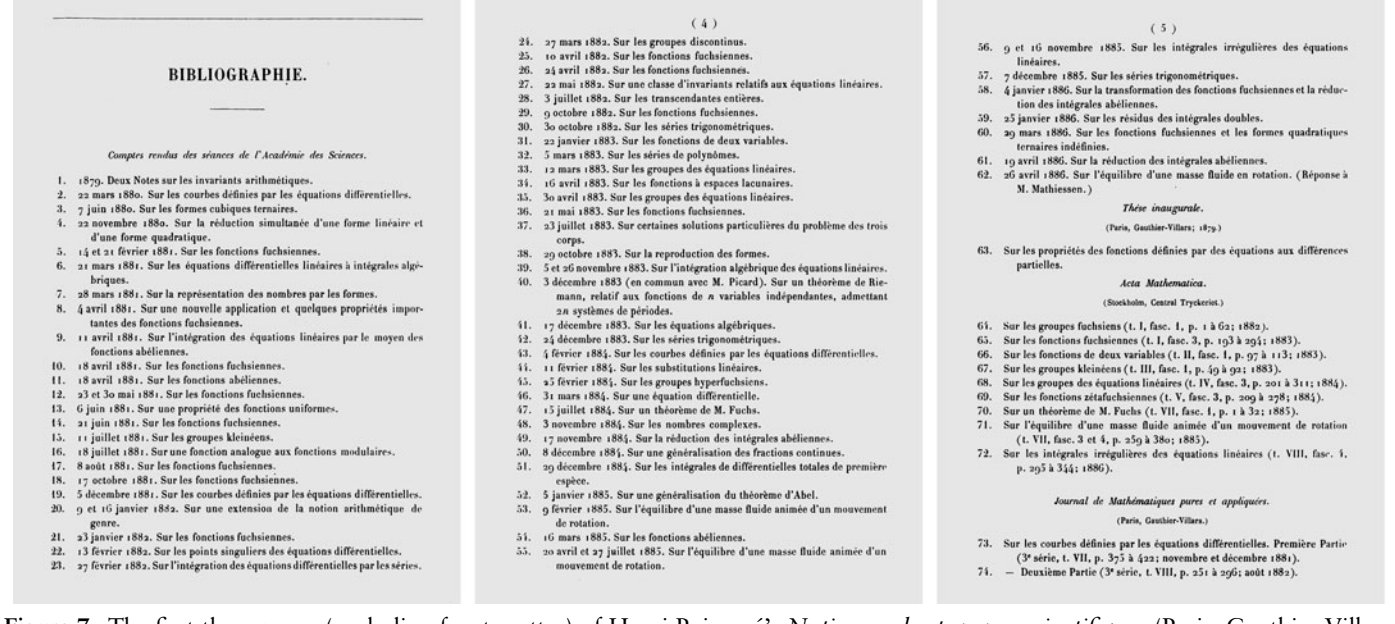


Figure 6. The election certificate as bibliographical list. Those of Thomas George Bonney and Sir Walter Elliot (both 1878) also included supplemental sheets with more entries. Royal Society of London, EC/1878/06 and EC/1878/08.



BIBLIOGRAPHIE.

Comptes rendus des séances de l'Académie des Sciences.

1. 1879. Deux Notes sur les invariants arithmétiques.
2. 22 mars 1880. Sur les courbes définies par les équations différentielles.
3. 7 juin 1880. Sur les formes cubiques ternaires.
4. 22 novembre 1880. Sur la réduction simultanée d'une forme linéaire et d'une forme quadratique.
5. 14 et 21 février 1881. Sur les fonctions fuchsiennes.
6. 21 mars 1881. Sur les équations différentielles linéaires à intégrales algébriques.
7. 28 mars 1881. Sur la représentation des nombres par les formes.
8. 4 avril 1881. Sur une nouvelle application et quelques propriétés importantes des fonctions fuchsiennes.
9. 11 avril 1881. Sur l'intégration des équations linéaires par le moyen des fonctions abéliennes.
10. 18 avril 1881. Sur les fonctions fuchsiennes.
11. 18 avril 1881. Sur les fonctions abéliennes.
12. 23 et 30 mai 1881. Sur les fonctions fuchsiennes.
13. 6 juin 1881. Sur une propriété des fonctions uniformes.
14. 21 juin 1881. Sur les fonctions fuchsiennes.
15. 11 juillet 1881. Sur les groupes kleinéens.
16. 18 juillet 1881. Sur une fonction analogue aux fonctions modulaires.
17. 8 août 1881. Sur les fonctions fuchsiennes.
18. 17 octobre 1881. Sur les fonctions fuchsiennes.
19. 5 décembre 1881. Sur les courbes définies par les équations différentielles.
20. 9 et 16 janvier 1882. Sur une extension de la notion arithmétique de genre.
21. 23 janvier 1882. Sur les fonctions fuchsiennes.
22. 13 février 1882. Sur les points singuliers des équations différentielles.
23. 27 février 1882. Sur l'intégration des équations différentielles par les séries.

24. 27 mars 1882. Sur les groupes discontinus.
25. 10 avril 1882. Sur les fonctions fuchsiennes.
26. 24 avril 1882. Sur les fonctions fuchsiennes.
27. 22 mai 1882. Sur une classe d'invariants relatifs aux équations linéaires.
28. 3 juillet 1882. Sur les transcendantes entières.
29. 9 octobre 1882. Sur les fonctions fuchsiennes.
30. 30 octobre 1882. Sur les séries trigonométriques.
31. 22 janvier 1883. Sur les fonctions de deux variables.
32. 5 mars 1883. Sur les séries de polynômes.
33. 12 mars 1883. Sur les groupes des équations linéaires.
34. 16 avril 1883. Sur les fonctions à espaces lacunaires.
35. 30 avril 1883. Sur les groupes des équations linéaires.
36. 21 mai 1883. Sur les fonctions fuchsiennes.
37. 23 juillet 1883. Sur certaines solutions particulières du problème des trois corps.
38. 29 octobre 1883. Sur la reproduction des formes.
39. 5 et 26 novembre 1883. Sur l'intégration algébrique des équations linéaires.
40. 3 décembre 1883 (en commun avec M. Picard). Sur un théorème de Riemann, relatif aux fonctions de n variables indépendantes, admettant $2n$ systèmes de périodes.
41. 17 décembre 1883. Sur les équations algébriques.
42. 24 décembre 1883. Sur les séries trigonométriques.
43. 4 février 1884. Sur les courbes définies par les équations différentielles.
44. 11 février 1884. Sur les substitutions linéaires.
45. 25 février 1884. Sur les groupes hyperfuchsiens.
46. 31 mars 1884. Sur une équation différentielle.
47. 15 juillet 1884. Sur un théorème de M. Fuchs.
48. 3 novembre 1884. Sur les nombres complexes.
49. 17 novembre 1884. Sur la réduction des intégrales abéliennes.
50. 8 décembre 1884. Sur une généralisation des fractions continues.
51. 29 décembre 1884. Sur les intégrales de différentielles totales de première espèce.
52. 5 janvier 1885. Sur une généralisation du théorème d'Abel.
53. 9 février 1885. Sur l'équilibre d'une masse fluide animée d'un mouvement de rotation.
54. 16 mars 1885. Sur les fonctions abéliennes.
55. 20 avril et 27 juillet 1885. Sur l'équilibre d'une masse fluide animée d'un mouvement de rotation.

56. 9 et 16 novembre 1885. Sur les intégrales irrégulières des équations linéaires.
57. 7 décembre 1885. Sur les séries trigonométriques.
58. 4 janvier 1886. Sur la transformation des fonctions fuchsiennes et la réduction des intégrales abéliennes.
59. 25 janvier 1886. Sur les résidus des intégrales doubles.
60. 29 mars 1886. Sur les fonctions fuchsiennes et les formes quadratiques ternaires indéfinies.
61. 19 avril 1886. Sur la réduction des intégrales abéliennes.
62. 26 avril 1886. Sur l'équilibre d'une masse fluide en rotation. (Réponse à M. Mathiessen.)

Thèse inaugurale.

(Paris, Gauthier-Villars; 1879.)

63. Sur les propriétés des fonctions définies par des équations aux différences partielles.

Acta Mathematica.

(Stockholm, Centralryckeriet.)

64. Sur les groupes fuchsiens (t. I, fasc. 1, p. 1 à 62; 1882).
65. Sur les fonctions fuchsiennes (t. I, fasc. 3, p. 193 à 294; 1883).
66. Sur les fonctions de deux variables (t. II, fasc. 1, p. 97 à 113; 1883).
67. Sur les groupes kleinéens (t. III, fasc. 1, p. 49 à 92; 1883).
68. Sur les groupes des équations linéaires (t. IV, fasc. 3, p. 201 à 311; 1884).
69. Sur les fonctions zétafuchsiennes (t. V, fasc. 3, p. 209 à 278; 1884).
70. Sur un théorème de M. Fuchs (t. VII, fasc. 1, p. 1 à 32; 1885).
71. Sur l'équilibre d'une masse fluide animée d'un mouvement de rotation (t. VII, fasc. 3 et 4, p. 259 à 380; 1885).
72. Sur les intégrales irrégulières des équations linéaires (t. VIII, fasc. 1, p. 295 à 344; 1886).

Journal de Mathématiques pures et appliquées.

(Paris, Gauthier-Villars.)

73. Sur les courbes définies par les équations différentielles. Première Partie (3e série, t. VII, p. 375 à 422; novembre et décembre 1881).
74. — Deuxième Partie (3e série, t. VIII, p. 251 à 296; août 1882).

Figure 7. The first three pages (excluding front matter) of Henri Poincaré's *Notice sur les travaux scientifiques* (Paris: Gauthier-Villars, 1886), compiled by him in 1886, to support his candidacy for the French Academy of Sciences.

come to a new view about those 'stray papers here and there'. The habits of authors such as Charles Darwin, who published new findings in grand books, was now 'out of place and even dangerous'. Rather, 'the writings of Huxley furnish an example of the more common mode of publication adopted by men of science. Nearly all his important contributions to science were published in periodicals; and to judge of Huxley's worth as an investigator, one must go to his "collected papers."'[119]

Histories of modern science in Europe and the United States have long lived in the shadow of the *Catalogue of Scientific Papers* and its representation of the bounds of scientific identity and authorship. For those looking to found the academic study of the historical sociology of science, the idea that the spread of scientific papers might serve as a proxy for the development of science was hard to resist. The group that formed around Robert K. Merton in the 1960s studied the social structure of science through key concepts such as prestige, reward and consensus. The scientific literature seemed to be where all of these came together, and the *Catalogue* was among the best empirical resources for its study. The historian Derek de Solla Price, a pioneer of quantitative methods in history of science, speculated that this methodological discovery might finally lead to a 'science of science'.[120] While many sociologists of science later became wary of this programme, the new tools that they (along with information entrepreneurs such as Eugene Garfield) used and developed were incorporated into institutions and genres of everyday scientific life, from the curriculum vitae to citation indexes.

For the past two decades, historians have challenged the representation of scientific identity and progress instantiated by the *Catalogue* in other ways. Scholars have worked to dismantle the boundaries of authorship and identity that enterprises such as the *Catalogue* helped to put in place. Many who now write about science in the nineteenth-century periodical press, for example, have dedicated themselves precisely to investigating science as it appeared in those genres and formats that the *Catalogue* ignored, including quarterlies, religious monthlies, cheap periodicals and newspapers.[121] Others have attempted to gain historical access to sites of scientific discussion.[122] Our understanding of the social diversity of the groups who actively

119 Michael Foster, 'A conspectus of science', *Quarterly Review* (1903) 197, pp. 139–160, 147. On the relationship between the *Catalogue of Scientific Papers* and the later International Catalogue of Scientific Literature project see Alex Csiszar, 'Broken pieces of fact', PhD dissertation, Harvard University, 2010, pp. 350–425.

120 Derek de Solla Price, *Little Science, Big Science*, New York: Columbia University Press, 1963, p. 1. Merton's programme was based at Columbia University (where he ran a yearly graduate seminar on the sociology of science starting in 1965). Other key groups included Price's base at Yale University, and the group, largely based in Europe, responsible for Reidel's Sociology of the Sciences Yearbook.

121 See, for example, the SciPer project: G. Cantor *et al.* (eds.), *Science in the Nineteenth-Century Periodical: Reading the Magazine of Nature*, Cambridge: Cambridge University Press, 2004; G. Cantor and S. Shuttleworth (eds.), *Science Serialized: Representations of the Sciences in Nineteenth-Century Periodicals*, Cambridge, MA: MIT Press, 2004.

122 Anne Secord, 'Science in the pub: artisan botanists in early nineteenth-century Lancashire', *History of Science* (1994) 32, pp. 269–315; and James Secord, 'How scientific conversation became shop talk', in Aileen Fyfe and Bernard Lightman (eds.), *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, Chicago: The University of Chicago Press, 2007, pp. 23–59.

participated in the life of nineteenth-century science has been expanded immeasurably by this work.

The aim here has been somewhat different. By attending to the ambiguities, sleights of hand and elisions in the construction of these monuments to science, I hope we can begin to better understand the ways in which received boundaries between experts and non-experts – and the values and standards that come with them – were erected in the first place.[123] Today, as new forms of knowledge expression emerge, some now predict the end of the dominant role that the scientific paper has long played in defining a scientific career. At the same time, many of these projections also propose new means of quantifying the value and impact of these new 'knowledge products', taking the quantification of scientific identity to new extremes.[124] At this moment when the most vocal calls to make science more open and democratic have become enmeshed with new platforms for gathering and communicating research, it is crucial that we attend to the ways in which information technologies built to extend access to knowledge can also become technologies of valuation and exclusion.[125]

Appendix: explanation of calculations and sources of numerical information cited in this essay

The information about the contents of the *Catalogue* in this essay was produced as part of an ongoing project. What follows is a short summary intended to help contextualize the numerical data that appear in this essay. All data rely solely on the first series of the *Catalogue*, published in six volumes between 1867 and 1872. Volume 6 also includes a list of additional entries and corrections, as well as a short list of anonymous entries. (This list is made up primarily of entries for which the editors could not assign an author, but it also includes some entries to which they did assign an author, so that the entry is actually a duplicate.) The database was produced by manually corrected text generated by optical character recognition run on digital images of these six volumes. The images used were digitized as part of the Biodiversity Heritage Library; each volume was checked thoroughly to ensure that it was a complete and uncorrupt copy. Errors in the original *Catalogue* were corrected where it was obvious that they were the result of minor clerical or typographical mistakes.

Entries in the *Catalogue* regularly include references to more than one periodical, usually because a paper has appeared in multiple periodicals (often in distinct versions as excerpts, summaries or translations). For the purposes of counting individual authors' publications, each such entry is counted once, regardless of the number of

123 For a more general statement of this distinction see Steven Shapin, 'Discipline and bounding: the history and sociology of science as seen through the externalism–internalism debate', *History of Science* (1992) 30, pp. 333–369; and Shapin, 'Science and the public', in R.C. Olby, G.N. Cantor, J.R.R. Christie and M.J.S. Hodge (eds.), *A Companion to the History of Modern Science*, London: Routledge, 1990, pp. 990–1007.

124 Jason Priem, 'Scholarship: beyond the paper', *Nature* (28 March 2013) 495, pp. 437–440; and Heather Piwowar, 'Value all research products', *Nature* (10 January 2013) 493, p. 159.

125 For more on the broader context for this argument see Kelty, op. cit. (8), on constitutive closure and open-science movements.

versions listed. For counts related to periodicals, however, each periodical reference within an entry is counted individually. Conversely, references to papers occasionally include non-consecutive pagination or references to multiple volumes of the same periodical, usually because the indexer interpreted (rightly or wrongly) a series of papers as forming the parts of one longer paper. These references are only counted once for the purposes of both periodical and author counts.

When the *Catalogue* lists a paper as having more than one author, it usually (but not always) includes an entry under each author's name. I count these entries only once. Counts of authors' publications incorporate their co-authored papers, but only when those are listed following an author's single-authored papers. Occasionally more than one entry in the *Catalogue* refers to the same paper because of a cataloguing error. The two most frequent causes of this are names that appear twice because of alternative variants of a name (e.g. Crivelli, G. Balsamo versus Balsamo-Crivelli, Giuseppe), and co-authored papers that were entered inadvertently under an author's name as both a co-authored paper and a single-authored paper. When detected, these duplicates have been eliminated.

After these corrections, the total number of entries in the first series of the *Catalogue* is 178,118. Counting each periodical reference in these entries separately gives 218,463 references. Table 1 lists the twenty most-cited periodicals, and Table 2 lists the twenty

Table 1. *The twenty most-cited periodicals in the first series of the* Catalogue.

Periodical name	Entries	Periodical name	Entries
Comptes rendus hebdomadaires des seances de l'Académie des sciences, 1835–1863	9,610	*Reports of the British Association for the Advancement of Science* (London, 1833–1864)	2,823
Annales de chimie (et de physique) (Paris, 1789–1863)	5,904	*Annals of Natural History, or Magazine of Zoology, Botany, and Geology* (London, 1838–1863)	2,721
Annalen der Physik und Chemie (Leipzig, 1824–1863)	5,858	*Notizen aus dem Gebiete der Natur- und Heilkunde* (Erfurt, 1822–1849)	2,676
Philosophical Magazine (London, 1798–1863)	5,521	*Journal für Chemie und Physik* (Nuremberg, 1811–1833)	2,429
Journal für praktische Chemie (Leipzig, 1834–1863)	5,152	*Annalen der Physik* (Halle and Leipzig, 1799–1824)	2,183
Annalen der Chemie und Pharmacie (Leipzig and Heidelberg, 1832–1863)	4,980	*Edinburgh New Philosophical Journal* (Edinburgh, 1826–1864)	2,038
Journal de pharmacie et des sciences accessoires (Paris, 1815–1863)	4,872	*Proceedings of the Zoological Society of London* (London, 1830–1863)	1,994
Astronomische Nachrichten (Altona, 1823–1863)	4,074	*Annales de la Société entomologique de France* (Paris, 1832–1863)	1,853
American Journal of Science and Arts (New Haven, 1818–1863)	3,480	*Bulletin de la Société géologique de France* (Paris, 1830–1864)	1,798
Annales des sciences naturelles (Paris, 1824–1863)	3,142	*Sitzungsberichte der Mathematisch-naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften* (Vienna, 1848–1863)	1,789

https://doi.org/10.1017/S0007087417000012 Published online by Cambridge University Press

Table 2. *The twenty regions in which papers were published most frequently.*

Region	Entries	Region	Entries
Germany	64,739	Belgium	2,673
France	54,823	Sweden	2,577
England	40,660	Ireland	1,548
Italy	11,782	Denmark	1,198
USA	8,760	British India	1,184
Austro-Hungary	8,244	Dutch East Indies	758
Switzerland	5,749	Canada	446
Scotland	5,495	Spain	331
Russia	3,124	Norway	270
Netherlands	2,835	Australia	225

Table 3. *The twenty most frequently cited authors in Series 1.*

Author	Entries	Author	Entries
John Edward Gray	499	Joseph Liouville	312
Augustin Louis Cauchy	481	Arthur Cayley	312
Louis Nicolas Vauquelin	377	Sir David Brewster	310
Johann August Grunert	345	Wilhelm Haidinger	288
Félix Edouard Guérin-Méneville	332	Heinrich Rose	284
Hippolyte Lucas	328	Jöns Jacob Berzelius	281
Justus von Liebig	328	Friedrich Wöhler	280
Christian Friedrich Schönbein	323	John Obadiah Westwood	275
Jean Baptiste Biot	320	Christian Gottfried Ehrenberg	268
Richard Owen	314	Carlo Matteucci	256

regions in which papers were published most frequently. Some 5,398 of the entries (3.0 per cent) have multiple authors.

There are 1,387 periodicals referred to in the *Catalogue*'s listing of papers. (This is a slightly smaller number than the number of entries in the various lists of periodical – ninety-four of those turn out never to have been cited at all.) Approximately 29,928 authors are cited in the *Catalogue*, of which 14,450 have at least two publications. I have followed the cataloguers' decisions in identifying papers written by the same author except when I have noticed obvious clerical errors. Table 3 gives the twenty authors with the largest number of publications, including co-authored pieces.

This information is not intended to be a statistical accounting of productivity in nineteenth-century science. It is included only to provide context for the numbers quoted briefly in the body of this essay and to provide a snapshot of the corpus assembled by the Royal Society's cataloguers. Indeed, a central argument of this essay is that historians should be extremely cautious in interpreting these numbers as revealing very much about nineteenth-century scientific publishing.