

FROM PHILANTHROPY TO BUSINESS: THE ECONOMICS OF ROYAL
SOCIETY JOURNAL PUBLISHING IN THE TWENTIETH CENTURY

by

AILEEN FYFE*

*School of History, University of St Andrews, St Katharine's Lodge, The Scores,
St Andrews KY16 9BA, UK*

Scientific journal publishing has become a lucrative enterprise, for commercial firms and (some) society publishers alike; but it was not always thus. The Royal Society is the publisher of the world's longest-running scientific journal, and for most of the history of the *Philosophical Transactions*, its publication was a severe drain on the Society's finances. This paper uses the rich archives of the Royal Society to investigate the economic transformation of journal publishing over the course of the twentieth century. It began the century as a scholarly mission activity heavily subsidized by the Society, but ended it as a valuable income stream. Never-before-seen data reveal three phases: the end of the philanthropic model of circulation; the transition to a sales-based commercial model amidst the post-war boom in subscriber numbers; and the challenges facing that new business model once subscriber numbers went into decline in the late twentieth century. The paper does not directly address the open access movement of the twenty-first century, but is essential reading to understand the financial background.

Keywords: Royal Society; twentieth century; scientific journals; academic publishing; profits; circulation of knowledge

Over the course of the twentieth century, the publishing of original scientific research papers has become a successful commercial enterprise.¹ From an activity that was once the preserve of learned societies and academies, it has come to be dominated by a handful of international media corporations. Globally, over half of academic research articles are now issued by just five publishers.² In certain fields or disciplines, learned and professional society publishers have remained important, but even there the circulation of knowledge has shifted from a

*akf@st-andrews.ac.uk

¹ The focus here is on the publication of scientific *research* journals. Commercial publishers were certainly involved in the publication of other sorts of scientific periodicals and magazines long before the 1950s.

² On the dominance of the big commercial players in the late twentieth century, but also the ongoing importance of a few big society publishers in the sciences, see V. Larivière, S. Haustein and P. Mongeon, 'The oligopoly of academic publishers in the digital era', *PLoS One* **10**(6), e0127502 (2015). For an overview, see M. Mabe and A. Watkinson, 'Journals (STM and humanities)', in *The Cambridge history of the book in Britain. Volume 7: the twentieth century and beyond* (ed. Andrew Nash, Claire Squires and Ian Willison), pp. 484–498 (Cambridge University Press, 2019).

subsidized part of the scholarly mission to a valuable source of income: in 2015, publishing revenues accounted for 26% of the income of UK learned society publishers.³ In other words, scientific journal publishing has come to be big business.

The current and future financial sustainability of learned society publishing is of much concern in current debates about the transition to open access,⁴ but the historical literature on society publishing is short on quantitative detail. Our knowledge of the history of scientific journal publishing tends to be based upon the printed products themselves, or, if we are lucky, on surviving editorial correspondence or paperwork. Details of the finances have rarely survived. The archives of the Royal Society, however, contain not just editorial paperwork but a consistent series of high-level income and expenditure data from the 1830s onwards and, for certain periods, more detailed data on costs and subscriptions for the *Philosophical Transactions* (1665; split into series A and B in 1887) and the *Proceedings of the Royal Society* (1831; split into series A and B in 1905).⁵ The financial histories of these journals can therefore be told from both quantitative and qualitative perspectives, and offer us a rare insight into the twentieth-century transformation of journal publishing from a philanthropic, mission-driven activity to a commercial business opportunity.

My focus on the Royal Society is dictated by the availability of those archives. I do not intend to suggest that the Royal Society's publishing activities can be taken as 'typical' of journal publishers in general. As a society publisher, the Royal Society's publishing division operates in a different way from commercial publishing companies or corporations. It belongs to a parent organization that is a mission-led, registered charity and non-profit making. It also has a distinctive governance structure. The Royal Society is governed by a 'council' of trustees, whose members are elected by and from the fellowship of the Society. The senior officers of the Society are the president, the treasurer and two secretaries: they are also elected by and from the fellowship for a limited fixed term (in the twentieth century, this has usually been 5–10 years). None of these people are employees of the Society, and (unless retired) perform their roles for the Society in addition to their (usually academic) jobs. These voluntary officers are assisted by a number of employees: at the start of the twentieth century, the Society had fewer than a dozen staff, but by the end of the century there were over a hundred staff.⁶ The most senior staff member was originally known as the 'Assistant Secretary', and more recently as the 'Executive Secretary'; these people have often served for longer than the officers or council members. Over the course of the century, the professional staff have acquired greater autonomy and responsibility for running the Society's affairs, including the publication of its journals, but all the staff report ultimately to the Council and must work within the mission set by the Council and officers.

3 On UK learned society finances in 2015, see R. Johnson and M. Fosci, 'On shifting sands: assessing the financial sustainability of UK learned societies', *Learned Publ.* 28(4), 274–282 (2015); cf. C. Baldwin, *What do societies do with their publishing surpluses? ALPSP and Blackwell Survey 2004* (Association of Learned & Professional Society Publishers, Watford, 2004).

4 A. Wise and L. Estelle, 'How society publishers can accelerate their transition to open access and align with Plan S', *Learned Publ.* 33(1), 14–27 (2020). See also the work of the Open Access Scholarly Publishers Association, <https://oaspa.org/>, and the 'Transitioning society publications to OA' project, <https://tspoa.org/>.

5 On the histories of the Royal Society journals, see A. Fyfe, J. McDougall-Waters and N. Moxham, '350 years of scientific periodicals', *Notes Rec. R. Soc. Lond.* 69(3), 227–239 (2015), and A. Fyfe, N. Moxham, J. McDougall-Waters and C. M. Røstvik, *A history of scientific journals: publishing at the Royal Society, 1665–2015* (UCL Press, London, October 2022).

6 For staff numbers, see Royal Society [hereafter RS] *Year Book* (1921), p. 2, and RS Trustees' Report (2005–2006), p. 23.

The Royal Society is also unusual, among both its corporate and society peers, for its wide disciplinary remit: its *Transactions* and *Proceedings* are ‘specialized’ only in so far as *Transactions A* and *Proceedings A* focus on the physical and mathematical sciences, while *Transactions B* and *Proceedings B* focus on the biological sciences. The Royal Society also has a uniquely long history of journal publishing, and this brings both experience and conservatism. That said, the Royal Society does usefully represent the experience of a small to medium-sized publisher: it issues fewer journals than the big corporate firms, but is bigger than the many society publishers with just one journal.⁷

One approach to the history of the commercialization of scientific journal publishing would take the perspective of the firms that prospered by targeting an international, English-language market of institutional subscribers in the 1950s, 1960s and 1970s. Such a narrative might start with such companies as Butterworth Scientific, Pergamon Press and Academic Press, and then discuss the responses from older publishing firms (including Basil Blackwell, Taylor & Francis and Cambridge University Press in the UK; Elsevier in the Netherlands; Springer in Germany; and Wiley in the USA), as they too saw the potential in publishing scientific research journals for an international market. At present, this history remains scattered among the house histories of separate firms and the memoirs of participants.⁸

However, learned societies had been publishing scientific research journals long before Robert Maxwell and Pergamon came on the scene. Telling the story from their perspective allows us to recognize the challenges that society publishers already faced to their sustainability in the early twentieth century. It helps us to understand why the activities of the entrepreneurial new publishers in the post-war period could be seen as a threat to long-established scholarly practices, while simultaneously offering a much-needed solution to long-standing financial difficulties. The story does, however, leave us wondering about the future path for society publishing, now that the politico-economic conditions underpinning the era of easy journal profits no longer pertain.

The first section of this paper introduces the available quantitative data on the finances of Royal Society journal publishing over the long twentieth century. The data files are available in the supplementary material online. Anyone who wishes to re-analyse the data is strongly recommended to read appendix S1 in the supplementary files online for a fuller discussion, including gaps in the historical record, the methods used to normalize the data and the repeated changes in accounting practice over the course of the century.

The remaining sections of this paper are structured around three chronological phases that might be characterized as the Royal Society shifting from seeing journal publishing as a ‘philanthropic’ (or subsidized) activity, to one that was expected to be ‘self-supporting’ and eventually to ‘income generating’. From the perspective of academic

7 The surveys carried out by the Association for Learned and Professional Society Publishers since 2003 classify respondents by the number of journal titles published: 10 or under is ‘small’, while 100 or more is ‘large’. By these criteria, the Royal Society was ‘small’ in the twentieth century but is now ‘medium’. In 2013, over 70% of respondents to the survey were ‘small’ publishers, and almost a third of them published just one journal. See S. Inger and T. Gardner, *Scholarly journals publishing practice: academic journal publishers’ policies and practices in online publishing. Fourth survey* (Association of Learned & Professional Society Publishers, Watford, 2013), appendix 2.

8 For instance, B. Cox, ‘The Pergamon phenomenon 1951–1991: Robert Maxwell and scientific publishing’, *Learned Publ.* 15, 273–278 (2002); R. N. Miranda, ‘Robert Maxwell: forty-four years as publisher’, in *A century of science publishing: a collection of essays* (ed. E. H. Fredriksson), pp. 77–89 (IOS Press, Amsterdam, 2001); E. H. Fredriksson, ‘The Dutch publishing scene: Elsevier and North-Holland’, in *ibid.*, pp. 61–76; H. K. Jones, *Butterworths: history of a publishing house* (Butterworth & Co., London, 1980); H. Goetze, *Springer Verlag: history of a scientific publishing house, part II 1945–1992* (Springer, Berlin and Heidelberg, 1996).

journal publishing at large, these three phases might equally be labelled as ‘before’, ‘during’ and ‘after’ the emergence of a viable commercial model for research journal publishing.

Phase 1 runs up to the Second World War and represents the tail-end of the Royal Society’s long history of philanthropic, non-commercial, subsidized journal publication.⁹ This model of publishing was, however, already struggling under the expansion of research activity in the late nineteenth century, and a key question for Phase 1 is how the philanthropic model survived despite those pressures.

Phase 2 covers the period from the war until the early 1970s, and represents the Royal Society’s transition to a financially self-supporting model. The actual year in which Royal Society publishing broke even for the first time is 1954. This is consistent both with the general narrative of twentieth-century journal publishing that places innovation and expansion in the post-war years and with the Royal Society’s own internal narrative that identifies key organizational changes in the 1950s. However, the data reveal the 1950s transition as less dramatic than we might expect, resulting from changes that had begun in the 1920s and 1930s. Thanks to a boom in institutional subscribers—particularly in the USA—the 1950s and 1960s would prove to be the most profitable decades of the twentieth century for the Royal Society, even though the stated objective was simply to break even.

Phase 3 addresses what happened next, amidst the oil crisis and high inflation in the 1970s and the budget cuts for scientific research and higher education in the 1980s. The Royal Society’s treasurers now wanted the publishing team to actively generate income, but subscription numbers kept falling. Fortunately, technological innovations in printing and typesetting in the late 1970s and 1980s meant that, for the first time in this story, production costs fell. As a society publisher, the Royal Society was insulated from the wave of acquisitions and mergers that swept the commercial publishing industry in this period (including Pergamon’s sale to Elsevier in 1991), but its unique historic status also excluded it from the mergers of societies that took place within certain disciplines (including physics and chemistry). This meant that the Royal Society had to adapt to the new technologies—and to the later digital revolution—without the economies of scale available to bigger publishers.

Historians of science have discussed the relationship between scientific research and business in terms of patents, industrial research and commercialization;¹⁰ and they have discussed scientific journal publishing from the perspectives of scholarly communication, reputation building and peer review (as well as communication and popularization more generally), though more usually for periods before the twentieth century.¹¹ We have

9 A. Fyfe, ‘Journals, learned societies and money: *Philosophical Transactions*, ca 1750–1900’, *Notes Rec. R. Soc. Lond.* **69**(3), 277–299 (2015); A. Fyfe, ‘The Royal Society and the noncommercial circulation of knowledge’, in *Reassembling scholarly communications: histories, infrastructures, and global politics of open access* (ed. Martin Paul Eve and Jonathan Gray), pp. 147–60 (MIT Press, Cambridge MA, 2020).

10 S. M. Horrocks, ‘The Royal Society, its fellows and industrial R&D in the mid-twentieth century’, *Notes Rec. R. Soc. Lond.* **64**, S31–S41 (2010); J. Mercelis, G. Galvez-Behar and A. Guagnini, ‘Commercializing science: nineteenth- and twentieth-century academic scientists as consultants, patentees, and entrepreneurs’, *Hist. Technol.* **33**, 4–22 (2017); A. Guagnini, ‘Ivory towers? The commercial activity of British professors of engineering and physics, 1880–1914’, *Hist. Technol.* **33**, 70–108 (2017); B. Dick and M. Jones, ‘The commercialization of molecular biology: Walter Gilbert and the Biogen startup’, *Hist. Technol.* **33**, 126–151 (2017).

11 A. J. Meadows, ‘The growth of journal literature: a historical perspective’, in *The web of knowledge: a festschrift in honor of Eugene Garfield* (ed. B. Cronin and H. B. Atkins), pp. 87–107 (Information Today, Inc., Medford, NJ, 2000); W. H. Brock, ‘The development of commercial science journals in Victorian Britain’, in *The development of science publishing in Europe* (ed. A. J. Meadows), pp. 95–122 (Elsevier, Amsterdam, 1980); A. Csizsar, *The scientific journal: authorship and the politics of knowledge in*

bibliometric studies of the growth of journals, and of published research, in the twentieth century,¹² but we know very little about how the publication of that research became so lucrative—for publishers, rather than for researchers—in the twentieth century. Given the current debates about the future of academic publishing, it is a question that matters. This paper provides part of the answer.

THE FINANCES OF PUBLISHING, 1880–2010

Publishing the *Transactions* and the *Proceedings* had been the Royal Society's single largest category of expenditure since the 1750s, but it did not become a significant source of income until the second half of the twentieth century. This means that the financial health of the Society at large has been highly dependent on the state of the publication finances. We start, therefore, by considering the wider context of the Royal Society's income and expenditure in the twentieth century.¹³ The financial values in figure 1*a* and *b* (and all following figures) have been adjusted for inflation to allow more meaningful historical comparison, and this means that the trends may differ from those perceived by the Society's officers at the time.

The Society's main sources of income had historically been membership fees and its investment portfolio. During the twentieth century, investment income remained substantial, but figure 1*a* shows the increasing importance of three additional sources of income in the second half of the century: one of those was publication sales; the others were grant administration¹⁴ and, at the very end of the century, trading income from conferences, catering and events. The Society's growing involvement in grant-making, international scientific diplomacy, schools education and policy work after 1960 meant that its own meetings and publications were no longer its only activities—but also meant that it needed a bigger and more expensive staff, as is clear from figure 1*b*.¹⁵

The most consistent available data on publishing finances come from the annual accounts compiled by the Society's treasurers from at least the 1830s. Figure 2*a* shows the publishing income and expenditure (inflation-adjusted) from these accounts. (Appendix S1 explains three discontinuities in accounting practice during the twentieth century that affect these figures.) Publication income and expenditure both depend on the quantity of matter being printed and sold: publishing more articles involves more editorial work, more paper and more

the nineteenth century (University of Chicago Press, 2018); M. Baldwin, *Making 'Nature': the history of a scientific journal* (University of Chicago Press, 2015); M. Baldwin, 'Scientific autonomy, public accountability, and the rise of "peer review" in the Cold War United States', *Isis* **109**, 538–558 (2018); A. Fyfe, F. Squazzoni, D. Torny and P. Dondio, 'Managing the growth of peer review at the Royal Society journals, 1865–1965', *Sci. Technol. Hum. Val.* **45**, 405–429 (2020).

12 The pioneer of using of journals to measure the growth of science was Derek da Solla Price, see D. J. d. S. Price, *Little science, big science* (Columbia University Press, Cambridge MA, 1963), at pp. 8–12. More recent analyses include L. Bornmann and R. Mutz, 'Growth rates of modern science: a bibliometric analysis based on the number of publications and cited references', *J. Ass. Info. Sci. Technol.* **66**, 2215–2222 (2015); Larivière *et al.*, *op. cit.* (note 2); D. Fanelli and V. Larivière, 'Researchers' individual publication rate has not increased in a century', *PLoS One* **11**(3), e0149504 (2016), <https://doi.org/10.1371/journal.pone.0149504>.

13 These figures do not consider income or expenditure from 'restricted funds', i.e. funds donated or entrusted to the Society for a specific purpose and that cannot be diverted to other purposes.

14 From the 1930s, the Society began to claim a small percentage of the income from the 'restricted' funds it managed as an 'administration charge', a move that was crucial in enabling the Society's staff to expand to match its responsibilities.

15 Peter Collins, *The Royal Society and the promotion of science since 1960* (Cambridge University Press, 2015); J. Hughes, 'Mugwumps? The Royal Society and the governance of post-war British science', in *Scientific governance in Britain, 1914–1979* (ed. Don Leggett and Charlotte Sleight), pp. 81–99 (Manchester University Press, 2016).

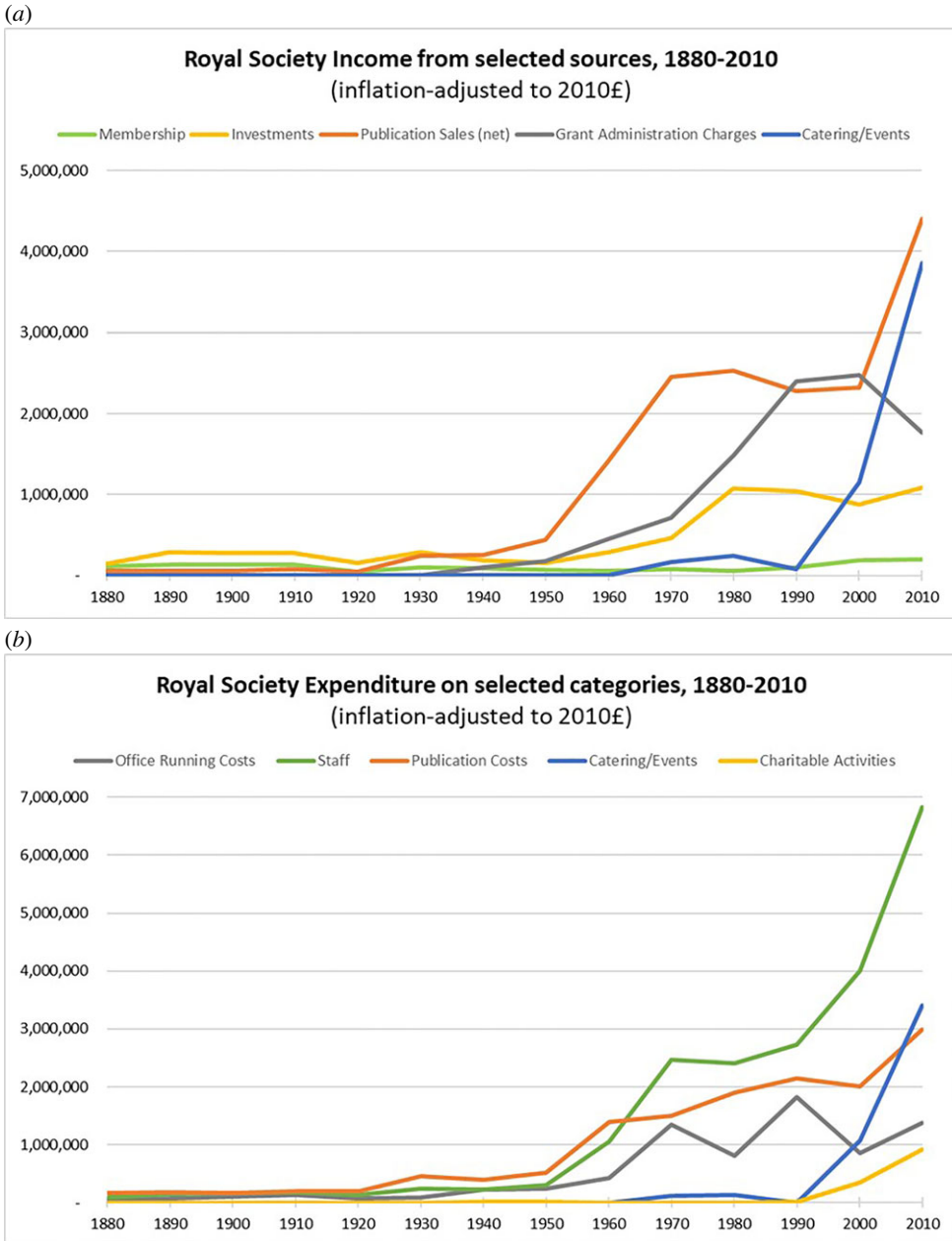


Figure 1. Publishing as part of Royal Society income (a) and expenditure (b). (Online version in colour.)

labour from the typesetters and printers, but customers can be charged more for more content. Figure 2b shows the growth in the amount of content published in the Royal Society's journals over the century; the number of articles and number of pages published both grew. There are clear similarities between the trends in figure 2a and b.

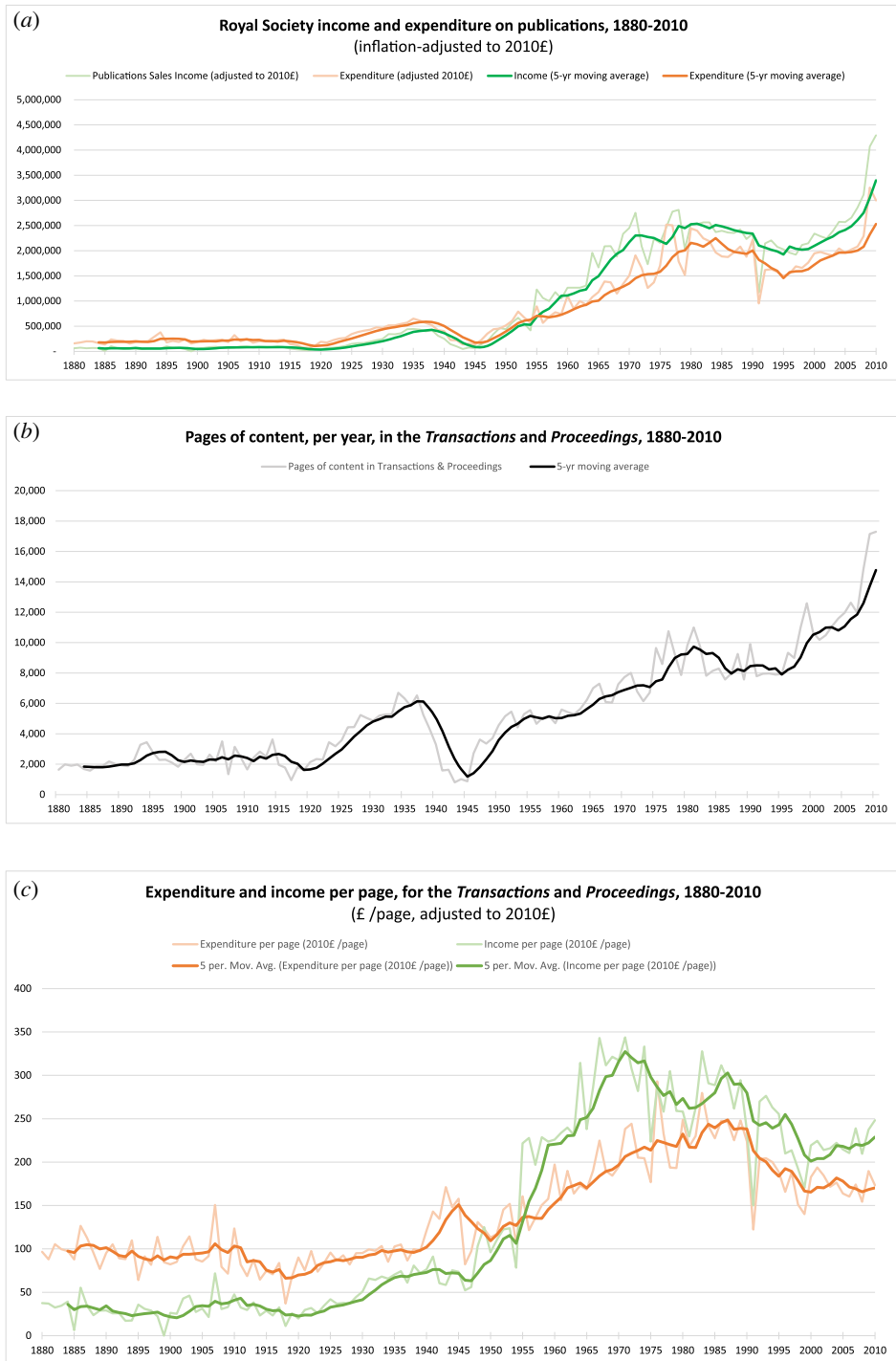


Figure 2. The Royal Society's publication finances, 1880–2010: (a) publications income and expenditure (inflation-adjusted); (b) pages of content published per year; (c) expenditure and income (inflation-adjusted) per page of content published. (Online version in colour.)

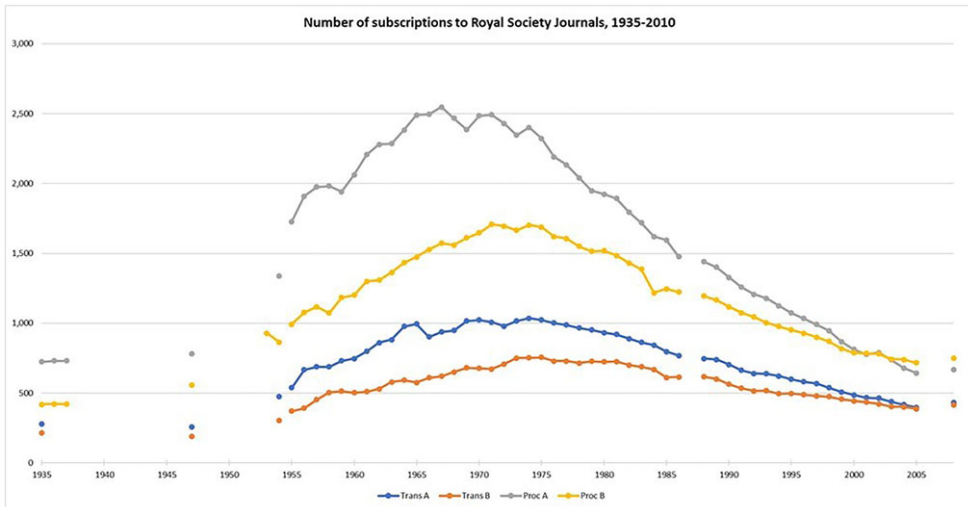


Figure 3. Commercial circulation of the *Proceedings* and *Transactions*, 1935–2010. (Online version in colour.)

It is possible to normalize the income and expenditure data by calculating ‘cost per page’ and ‘income per page’ (figure 2c). Print run data is almost entirely lacking for the twentieth century, so these costs must be understood as ‘per page of editorial content’, not ‘per physical page printed’. Figure 2c makes clear that the increases in the Society’s costs of publishing from the 1920s onwards were not simply due to the growth of scientific research and the need to publish more and more articles. In both figure 2a and c we can see the mid century financial transformation of Royal Society publishing: in the first half of the twentieth century costs outstripped sales income, but in 1954 the lines cross and since then income has regularly outstripped costs.

Figure 3 presents the best available data on the paid-for circulation of the Society’s journals, as distinct from the many copies distributed gratis to fellows and learned institutions. It shows the scale of the post-war boom in subscriber numbers for all four journals, peaking in the early 1970s, and explains why the Society’s journals generated more income per page in the two decades post-war. Anecdotal experiences of publishing professionals active at this time suggest that the phenomenon of booming post-war subscriptions was not unique to the Royal Society, but characterized the new approach to scientific journal publishing.¹⁶

Figure 3 also shows how short-lived that boom proved to be, for the Royal Society at least. The decline in subscriber numbers since about 1975 explains why the Society’s income per page dropped back again. Yet, even though subscriber numbers had fallen back to 1950s levels, the publishing account in the 1990s did continue to show a surplus—and to do so despite the costs of an expanded publishing team. To understand how this was possible, we need to look at costs as well as income.

The only sub-categories of costs that are consistently available across the full chronological period are ‘production’ (paper, typesetting, printing, illustrations, covers), ‘distribution’

¹⁶ For example, Cox, *op. cit.* (note 8), at p. 275.

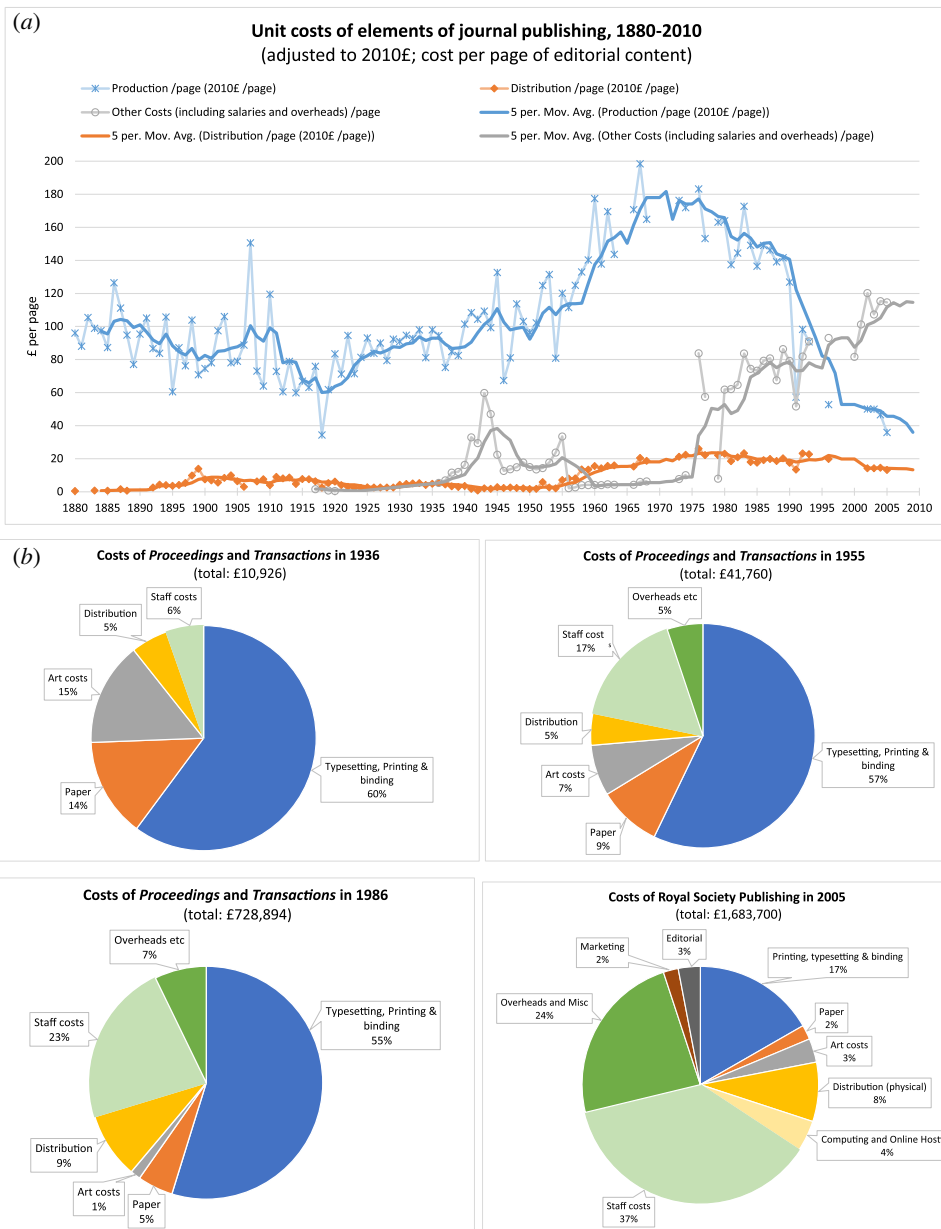


Figure 4. Costs of Royal Society journal publishing: (a) elements of publishing costs, 1880–2010, as cost per page of editorial content; (b) snapshots of production costs from 1936, 1955, 1986 and 2005. (Online version in colour.)

(postage, packing) and ‘other’ (everything else, including salaries, office costs, overheads). These are shown in figure 4a, adjusted for inflation, and shown as unit costs per page of editorial content (see appendix S1 for caveats). ‘Production’ costs were by far the most significant element of publishing expenditure for almost the whole of the twentieth century. The increase in both production and distribution costs from the 1950s on can be linked to

the presumed increase in the print run implied by the subscriber numbers in figure 3. The fall in production costs in the late twentieth century—gradually in the 1970s, dramatically in the 1990s—is striking. The ‘other’ costs depend heavily on the way that staff and overhead costs were treated in the treasurer’s annual accounts: they were excluded from the publishing account prior to 1936 and between 1955 and 1980, with very visible effects on figure 4a. The trends are consistent with the wider history of substantial technological changes in the nature of printing in the late twentieth century, and the increasing professionalization of the editorial and publishing staff of society publishers.

There are occasional moments in the archives when more detailed cost breakdowns exist, and figure 4b uses these moments to present a set of suggestive snapshots. Traditionally, the major costs of printing had been typesetting and printing (usually provided by the same supplier), paper and artwork.¹⁷ The Royal Society snapshots suggest that typesetting and printing remained the cause of more than 50% of journal publishing costs throughout the twentieth century. The costs of paper and artwork, on the other hand, became far less significant: they had accounted for 30% of costs in the 1930s, but only 6% by the 1980s. The Royal Society had continued to use rag-based paper long after cheaper wood-pulp paper was available, but it finally made the transition in the 1970s.¹⁸ The practice of engraving images onto copper plates had already been replaced by wood engraving and lithography by the early twentieth century, but by the 1980s the ability to capture images photographically, and print them using offset lithography, had generated significant cost-savings for all publishers.¹⁹

Our 1986 snapshot comes from a time when the Society was just beginning to adopt computerized systems for typesetting and art generation. By the 1990s authors would be submitting electronic files, and the idea of electronic journals (on CD-ROM or online) was being discussed. Production cost breakdowns do exist for the mid 1990s, but it was such a time of change at Royal Society publishing—in terms of both technologies and staffing—that it is difficult to choose a ‘representative’ year. I have therefore presented the 2005 snapshot: this was just before open access became an issue, but the Society already had a website (1996), was offering subscribers electronic access to its journals (1997) and had launched its first born-electronic journal (2003).²⁰

IT costs had acquired a separate budget line by 2005, but the key changes since the 1980s are the ballooning of staff and overhead costs, and the fact that typesetting and printing costs had shrunk for the first time. The Society had no paid staff specifically for its publishing activities at the start of the century, but had about 20 staff in its publishing division at the end of the century.²¹ Salaries, office costs and overheads had already grown to 30% of all costs by 1986, and the recruitment of additional staff, including senior managers, took that

17 Alexis Weedon, *Victorian publishing: the economics of book production for a mass market, 1836–1916* (Ashgate, Aldershot, 2003).

18 J. S. Rowlinson and N. H. Robinson, *The record of the Royal Society: supplement to the fourth edition, for the years 1940–1989* (The Royal Society, London, 1992), at p. 108.

19 P. Luna, ‘Technology’, in *History of Oxford University Press: volume IV* (ed. Keith Robbins), ch. 7 (Oxford University Press, 2017); S. Bromage and H. Williams, ‘Materials, technologies and the printing industry’, in Nash *et al.*, *op. cit.* (note 2), at pp. 41–60.

20 The impact of new technologies on Royal Society publishing is much more fully discussed in chapters 15 and 16 of A. Fyfe *et al.*, *op. cit.* (note 5).

21 The Society appointed its first ‘publications clerk’ in 1932; that role was later designated ‘assistant editor’ and was supported by (women) secretaries and (male) editorial assistants. The 1990s publishing staff were listed in *RS Year Book* (1991), p. 367.

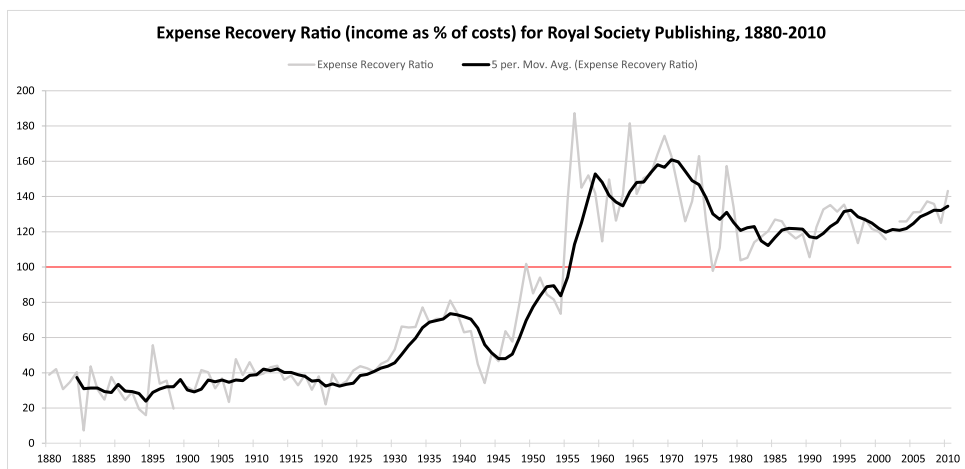


Figure 5. Expense recovery rate for Royal Society publishing, 1880–2010. (Online version in colour.)

category to over 60% by 2005. On the other hand, the adoption of computer software for a variety of editorial and production tasks, and the assertive use of competitive tendering for services (especially for printing and typesetting, though these were not yet overseas) had substantially reduced typesetting and printing costs. The falling costs per editorial page from the mid 1980s on (seen in figure 2c) were a result of these changes in technology and strategy.

Figure 5 provides a different perspective on the income/expenditure data by examining the ‘expense recovery rate’, a measure that expresses income received as a fraction of costs.²² In this visualization, breaking even (recovering 100% of costs) is not a singular dramatic moment in 1954, but part of a much longer-term trend extending back (if we ignore the interruptions of the Second World War) to the 1920s and forward to the 1960s. Whereas figure 2a and c suggested a ‘before’ and ‘after’ story, figure 5 recasts the narrative into three acts: a relatively stable phase in the first decades of the twentieth century, in which publishing income only ever covered 30–40% of its costs; then a phase in which sales improved substantially, enabling more and more of the costs to be covered, ultimately reaching an astonishing 160%; followed by a phase in which the decline in subscriptions hit the financial performance, but Royal Society publishing found a new stability with a recovery rate of about 120% of costs. The remainder of this paper looks more closely at the ways that Royal Society journal publishing was financed in each of these phases.

PHASE 1: THE PHILANTHROPIC MODEL OF CIRCULATION IN THE EARLY TWENTIETH CENTURY

Why the philanthropic system never made money

The fact that the Royal Society’s income from sales covered barely a third of its publishing costs in the early twentieth century should not be understood as a commercial failure.

22 On ‘Expense Recovery Rate’, rather than ‘Gross Profit Margin’, see appendix S1.

	<i>Proceedings</i> A	<i>Proceedings</i> B	<i>Transactions</i> A	<i>Transactions</i> B
Print Run	1400	1060	900	750
Sales	725	420	c280	215
Non-commercial Distribution				
... to Fellows	320	270	125	100
... to Institutions	200	200 to 210	120	130
Total Non-commercial	520	c475	245	230

Figure 6. Print run, sales and distribution of Royal Society periodicals, ca 1935.

Rather, it reflects the Society's commitment to a different model for the circulation of knowledge. Prior to the 1920s, its guiding principle was scholarly philanthropy. Many of the copies of its *Transactions* and *Proceedings* were distributed gratis. They went to fellows of the Society and to learned institutions across Britain, Europe and the world. Relatively few copies of the Society's journals were sold and, when they were, prices were purposefully set low.²³ It was taken for granted that publishing and circulating detailed accounts of original scientific research—as against news, controversy or rational recreation—was an activity that required subsidy.²⁴

Back in the nineteenth century, the Society's journals had larger philanthropic circulations than paid-for sales. By the 1930s, rare surviving circulation data (figure 6) suggest that the balance was shifting towards sales (especially for *Proceedings A*), but the non-commercial circulation remained substantial. This meant that every year the Society was paying for the production of hundreds of copies of its journals that were never expected to yield any income. These copies had other functions: they were a perquisite for fellows of the Society, and they could be used as a gift or an exchange token in the wider scholarly world.²⁵ Philanthropic circulation to learned institutions both demonstrated the Society's largesse and status, and was a practical way of ensuring that published papers were available in major research libraries. There is no evidence of the Society attempting to quantify the financial cost of this commitment until after the Second World War.

In the first decades of the twentieth century there had been even more philanthropic—and less commercial—circulation than we find in the 1930s. In 1908, for instance, there had been over 460 institutions receiving gratis copies of some or all of the journals.²⁶ In the intervening

23 Fyfe, 'Journals, learned societies and money', *op. cit.* (note 9); Fyfe, 'Non-commercial circulation of knowledge', *op. cit.* (note 9).

24 The periodicals that historians have called 'commercial science journals' in the nineteenth century may have had commercial ambitions, but they struggled to cover their costs. See W. H. Brock, *op. cit.* (note 11) and W. H. Brock and A. J. Meadows, *The lamp of learning: Taylor & Francis and the development of science publishing* (Taylor & Francis, London, 1998). Periodicals with news, views and entertainment proved more attractive to paying customers than those carrying nothing but densely detailed original research papers. For instance, Baldwin, *Making 'Nature'*, *op. cit.* (note 11), chs 1 and 2; and G. Dawson, B. Lightman, S. Shuttleworth and J. R. Topham (eds), *Science periodicals in nineteenth-century Britain: constructing scientific communities* (University of Chicago Press, 2020), esp. ch. 4.

25 W. O. Hagstrom, 'Gift giving as an organizing principle in science', in *Science in context: readings in the sociology of science* (ed. Barry Barnes and David Edge), pp. 21–34 (Open University Press, Milton Keynes, 1982); J. Beckman, 'Editors, librarians, and publication exchange: the Royal Swedish Academy of Sciences, 1813–1903', *Centaurus* 62, 98–110 (2020); A. Fyfe, 'Noncommercial circulation', *op. cit.* (note 9).

26 They were listed in *RS Year Book* (1908), pp. 125–142.

years, efforts to restore the Society's post-war finances had imposed two sets of cuts: to the number of recipient institutions, and to the number of journal titles they were entitled to receive. The Society's largesse was thus restricted to *research* institutions (e.g. university libraries and academies of science, not public libraries), and, in the case of universities, to those in the British academic world (rather than Europe or the USA).²⁷ The libraries of research institutions continued to be important nodes through which published research could be made available to individual scholars, but the decision to treat US universities as customers, rather than recipients of patronage, prefigures the later shift in the Society's mode of engagement with all libraries.

When learned institutions had been regarded as gift recipients, it is little wonder that the potential market of paying purchasers for scientific journals was believed to be (as Lord Rayleigh had put it in 1895) 'so small' that 'the scientific journals in this country ... are carried on with great difficulty'.²⁸ The market appeared to be limited to those individual scientists who did not have convenient access to an institutional library, and who were not (yet) sufficiently well-established in their careers to have been elected to the fellowship of the Royal Society. This assumption informed the Society's pricing strategy: as Ernest Rutherford explained in his 1930 address as president, the Society's desire to make its journals 'accessible to the widest range of scientific workers' meant that it was a matter of pride that they should be priced 'low', both in comparison with 'other scientific publications' and 'in relation to the increased cost of production'.²⁹

This strategy for price-setting meant that even the copies sold through the commercial book trade were not required to cover their own costs, let alone those of the gratis copies. Retail prices were calculated for each journal issue on the basis of an estimated cost per sheet, multiplied by the number of printed sheets it contained, but the estimated cost per sheet was based just on print, paper and a proportion of the illustration costs.³⁰ Much of the editorial work was done by unpaid volunteers (referees, committee members), but the salaries of the support staff, as well as office costs and the bulk of the illustration costs, were silently subsidized by the Society. In the case of the *Proceedings*, the uneconomic pricing was exacerbated by the 1905 decision to set the advance subscription rate at a discount on the price of the individual issues.³¹ As a consequence, most copies of *Proceedings A* and *B* sold in the 1910s and 1920s were sold for less than an already-underestimated 'cost price'.

It should now be clear why the Society recovered so few of its publishing expenses in the late nineteenth and early twentieth centuries. Under this model, the challenge facing the Society's treasurers was to find ways of funding the two-thirds of the publishing costs that were not covered by sales income, a task made continually more daunting by the constant increase in the sterling values involved, due to the increased quantity of material being published each year (see figure 2*b*) and, in the 1920s, inflation. Treasurers had been

27 The 1921 cuts were recommended by the Emergency Finance Committee, RS Council Minutes Printed [hereafter RS CMP] vol. 11, 8 July 1920; and a reduced list was printed in *RS Year Book* (1923). For the 1932 cuts, see Library Committee minutes, RS Committee Minute Books [hereafter CMB] CMB/47/5, 15 March 1932 (the list was no longer printed in the *Year Book*).

28 Rayleigh to the Treasury, in RS CMP/07, 20 June 1895. Rayleigh was seeking government support for scientific publishing, see Fyfe, 'Journals, learned societies and money', *op. cit.* (note 9).

29 [E. Rutherford], 'Address of the President, 1930', *Proc. R. Soc. Lond. A* **130**, 248–249 (1931).

30 In 1905 the calculation of the notional cost was laid out in the Council minutes, see RS CMP/09, 7 December 1905.

31 *Ibid.* There was no advance subscription to *Transactions* until the 1950s.

worrying about the expansion in published content since the 1890s, but it became an increasing problem in the twentieth century.³²

The importance of publishing to the financial well-being of the Society as a whole was made glaringly obvious in summer 1920, when an Emergency Finance Committee was convened. The treasurer was predicting that the Society would end the year with less than £8000 of income to cover an expenditure of over £14 000 (around £6000 of those costs was attributable to publishing).³³ The core problem was the ‘increase in the cost of printing and in salaries and wages, whilst the income of the Society remained stationary’.³⁴ The specific context was soaring post-war inflation, but the basic problem—that costs kept increasing, while income was relatively static—could have described the Society’s finances at any point in the late nineteenth or early twentieth century.

Keeping the philanthropic model going

Given that the Society had so little spare income available to cover unexpected expenses, finding sufficient money to subsidize the publication of the *Proceedings* and *Transactions* was a regular problem for treasurers in the late nineteenth and early twentieth centuries. The Society’s success in sustaining its publications on the philanthropic model until the mid twentieth century, despite increasing publications costs, is, in retrospect, remarkable. It did not do so by finding ways to cut costs, but by securing additional income from external grants, donations and sales.

Occasional suggestions, usually from treasurers, that the Society should be more selective about the papers it published were routinely ignored by the referees and committees that made the editorial decisions.³⁵ The only significant cost-cutting measures were cuts to the free distribution to institutions in 1921 and 1932, but, while this did reduce post and packing charges, the number of copies of the *Transactions* languishing in the warehouse in 1936 (see figure 6) suggests that the Society had not taken the opportunity to reduce the print run. Requests for fellows to be more selective about claiming their free copies generated only trivial savings, as did efforts to reduce the number of free offprints available to authors.³⁶

The assistant secretary and the treasurer tended to present the rising costs of paper, printing and images as an external inevitability over which the Society had little or no control. This is not entirely true: there were various changes that the Society could have made, but they would have involved compromising what was seen as the high production values of the journals. For instance, the Society could have reduced the number of illustrations allowed, used cheaper paper for printing or redesigned the page layout to cram more lines of text onto each page, but, even in the context of the ‘emergency’ in 1920, the fellows charged with making

32 On the growing output of science, see L. Bornmann and R. Mutz, *op. cit.* (note 12).

33 Report of the Emergency Finance Committee, RS CMP/11, 8 July 1920.

34 RS CMP/11, 17 June 1920 (quoted in CMB/86/1/2, minutes of the Finance Committee). As things transpired, the annual accounts (for the year ending November 1920) would show total expenditure of £13 600, of which publications amounted for £6130, see *RS Year Book* (1921), pp. 168–169.

35 On editorial process at the Royal Society, see A. Fyfe, ‘Editors, referees and committees: distributing editorial work at the Royal Society journals in the late nineteenth and twentieth centuries’, *Centaurus* 62, 125–140 (2020) and N. Moxham and A. Fyfe, ‘The Royal Society and the prehistory of peer review, 1665–1965’, *Hist. J.* 61, 863–889 (2018). On acceptance rates, see A. Fyfe, F. Squazzoni, D. Torny and P. Dondio, *op. cit.* (note 11), figure 4A and discussion.

36 Fellows copies: RS CMP/9, 30 April 1908; RS CMP/11, 15 July 1920. Offprints: RS CMP/09, 22 February 1906; *RS Year Book* (1941), p. 90.

suggestions to rescue the finances were unwilling to make any ‘drastic change’ that might ‘materially modify’ the ‘scope and character’ of the journals.³⁷

A similar attitude underpinned the work of a committee set up in 1934 to investigate ‘the paper, printing and engraving of the Society’s publications’.³⁸ The immediate context was concern with the quality of service being provided by the Society’s printers, Harrison & Sons, who ‘frankly admitted’ that some of their work ‘has been unsatisfactory’.³⁹ The committee made proposals that would *increase* costs by at least £415 a year. The Council’s willingness to accept these recommendations reinforces the impression that quality control, not cost, was what mattered to the fellows.⁴⁰

Changing printers might have been another way to save money, and the Society did indeed decide to do this in 1936. After a tendering process, the choice of printer narrowed to Harrison or Cambridge University Press (CUP).⁴¹ Both were offering cost-savings on the status quo, and Harrison’s bid was lower. However, several of the senior fellows, including the co-secretary A.V. Hill, were keen to move to Cambridge, convinced that there would be benefits that ‘cannot be expressed numerically’.⁴² No one denied that CUP would deliver a ‘high standard of work’, but Hill noted that it would be ‘perhaps a little easier’ to convince his colleagues ‘if we could be sure at least that a change to Cambridge would not cost us more’.⁴³ With his help, CUP managed to revise their bid so that the Publications Committee could assure Council that the financial difference was ‘negligible’.⁴⁴ They argued that a ‘very great weight’ should be attached ‘to the experience of the Cambridge University Press in scientific printing’, and Council agreed to move the Society’s printing and publishing operations to Cambridge with effect from 1937.⁴⁵

The Royal Society’s ongoing determination to choose high-quality production values over absolute cheapness meant that the financial sustainability of its publications—and of the Society as a whole—depended upon income.⁴⁶ As the discussion of the 1920 ‘emergency’ revealed, the Society did not have substantial cash reserves. The short-term solution was to sell some of the Society’s stocks and shares, but this was hardly ideal since the annual income generated by the investment portfolio was the Society’s largest source of income at the time (see figure 1a). Fortunately, the Society’s portfolio was significantly augmented during the 1920s by the receipt of many new bequests and donations. In most cases, the income from these new funds was restricted to specific purposes defined by the donors, but the bequests from the estates of industrialists Rudolf Messel and Ludwig Mond were fortunate exceptions. In 1923 and 1924, therefore, the treasurer was able to use income

37 Report of the Emergency Finance Committee, RS CMP/11, 8 July 1920.

38 RS CMP/14, 1 March 1934.

39 Report of Publication Committee, in RS CMP/14, 5 July 1934. Harrison & Sons had printed for the Royal Society since 1877.

40 Report of Publication Committee, in RS CMP/14, 5 July 1934.

41 CMB/329, 17 December 1935 (launch of tender); and *passim*, to 6 July 1936. For the history of Harrison & Sons at this point, see section 2 of the document prepared for the firm’s listing as a public company, ca 1947, item 1272/12 in Harrison archive, City of Westminster Archives Centre. For CUP, see David McKitterick, *A history of Cambridge University Press: volume 3, new worlds for learning, 1873–1972* (Cambridge University Press, 2004), ch. 12.

42 Hill to Roberts (CUP), 25 June 1936, CUP archive, Cambridge University Library, PrA/R.578/41.

43 Hill to Cameron (Master of Gonville & Caius, syndic), 17 June 1936, CUP archive, PrA/R.578/39.

44 RS CMB/329, 6 July 1936. The difference was £160 a year on printing.

45 RS CMB/329, 6 July 1936 and CMP/14, 9 July 1936.

46 On the Society’s finances around this time, see H. Lyons, ‘On the finances of the Royal Society for the ten years 30th November 1929 to 30th November 1939’, in *RS Year Book* (1940), pp. 222–227.

from the Messel and Mond funds to cover the deficits on the Society's publications.⁴⁷ Some within the Society, however, felt that these bequests should be put to other uses.⁴⁸

The pressure on the Society's own funds was partially relieved by external support. Since 1895 the Royal Society had been administering an annual £1000 grant-in-aid of scientific publishing from the UK government. Any funds that were not disbursed to other learned societies could be retained by the Royal Society to reduce its own publishing shortfall. In the years before the First World War, the Royal Society benefited by around £700 a year, but in the difficult post-war years the grant was devalued by inflation and under pressure from the many societies seeking help. In 1923 there was only £60 left for the Royal Society.⁴⁹ The Society successfully lobbied for additional funds, and, from 1925, the government grant-in-aid was raised to £2500 a year.⁵⁰ This meant that the Royal Society could once more expect to benefit to the tune of £700 to £900 each year without depriving other learned societies. Even though it was receiving a substantial fraction of the available government funding, that was still less than a tenth of the Society's total publications expenditure.⁵¹ Nor would the value of the grant be increased again until after the Second World War.

A second source of support for publishing came from the chemical industry. The firm of Brunner, Mond & Co. had close personal ties to the Royal Society: Ludwig Mond had been a fellow and a major donor, and his son, Alfred, was one of the company directors. It was presumably due to his influence (and perhaps his awareness of how his father's bequest was being used by the Society) that in 1925 Brunner, Mond offered the Royal Society £500 a year towards the publishing costs of the A-side journals (i.e. the journals that included chemistry).⁵² Brunner, Mond became part of Imperial Chemical Industries in 1927, and ICI increased the annual donation to £1000 a year.⁵³ ICI continued to support Royal Society publishing until the 1950s, but did not increase the grant further.

The treasurers were inconsistent (especially in the pre-1914 period) in the way they identified the grants, donations or internal transfers that supported the publications. For this reason, the figures earlier in this paper focus only on sales income (which is consistently reported). The support from the government and ICI had been valuable in the mid 1920s, but it was fixed in value. In contrast, sales income had the potential to increase, and this is the main reason that the Society's expense recovery rate began to improve in the late 1920s and early 1930s. There was now enough income to cover around 70% of the publishing costs, rather than barely 40%—independent of the government or industrial grants. In the late 1930s, *Proceedings A*—the journal with the best sales—actually broke even in some years. Pre-war, the sales income was not sufficient to support the entire costs of all the Society's journals, but the foundations for the mid century transformation were laid.

There is very little evidence that the Society paid much conscious attention to marketing, or indeed to its sales figures, prior to the Second World War. Although the annual accounts

47 RS CMP/12, 3 May 1923 and 30 October 1924.

48 Rutherford successfully argued that Mond's bequest should be used to fund a new laboratory in Cambridge, see [Rutherford], *op. cit.* (note 29); L. Badash, *Kapitza, Rutherford, and the Kremlin* (Yale University Press, New Haven, 1985).

49 RS *Year Book* (1924), p. 178

50 RS CMP/12, 22 January 1925.

51 For instance, in 1927 the Society kept £800 from the government grant; total publications expenditure that year was almost £9000, see RS *Year Book* (1928), pp. 170 and 178.

52 RS CMP/12, 20 October 1925.

53 RS CMP/13, 27 October 1927.

reported total sales income, the only surviving information on number of units sold appears to be that collated in 1936 for the printing tender (i.e. figure 6). Nor do we have any information on the number (or identity) of customers or subscribers in this early period. That information was kept by the printer, not the Society (and CUP was frustrated by how long it took for Harrison to hand over the list in 1937).⁵⁴ However, given that the Society continued its strategy of low prices (and did not often revise prices for inflation), the increased income per page between 1920 and 1940 (figure 2c) implies an increase in the number of copies sold.

At least some of that growth was surely due to circumstances beyond the control of the Society. In particular, the growth of research universities in the USA meant that there was a new group of institutions with an interest in acquiring scientific journals. They were too new to be part of the Royal Society's existing philanthropic circulation and, as American institutions, they were in any case excluded from the post-1932 remit of the Society's philanthropic circulation. Unlike the libraries of British universities, those of the new American research universities were 'customers' from the start.

That said, some changes made by the Royal Society in the 1920s and 1930s did inadvertently help to increase sales. In 1932 the Library Committee reported to Council that 'a large proportion' of those institutions whose 'free supply' had been discontinued in 1921 had now become paying subscribers.⁵⁵ This appears to be the first time a connection was made between the philanthropic circulation and the potential commercial market for the Society's journals.

The move to CUP also helped. The Press was an experienced publisher as well as a printer, and was better positioned than Harrisons to engage with the expanding North American academic market. During the 1936 negotiations the Royal Society's representatives focused almost entirely on the costs of printing, but the Press's representative was interested in the proposed arrangements for marketing and sales, including the 10% commission the Press would earn. When he asked the Society's secretary for an estimate of the likely sales prospects, the brief answer was: 'I have no idea.'⁵⁶ This inability, and apparent disinclination, to discuss markets for the Society's journals reminds us that, even in the 1930s, commercial sales were still regarded as an after-thought in the Society's approach to journal publishing.

On the eve of the Second World War, therefore, Royal Society publishing was operating on a mixed economy: there was still a substantial philanthropic circulation to fellows and learned institutions; retail prices were still set low with the intention of providing access to individual scientists; and the shortfall between costs and income was covered by a combination of internal funds and external support from the government and ICI. Nonetheless, sales were increasing, and CUP hoped to improve them still further. The idea that the Society's publishing activities might no longer need to be subsidized was far more plausible in the 1930s than it had been 30 years earlier. As Ernest Rutherford had pointed out, not having to subsidize the publications would 'release ... a substantial sum' that they could use to explore other ways of 'promoting some form of scientific research'.⁵⁷

54 CUP [Roberts?] to Hill, 12 April 1937, CUP PrC/R229.

55 RS CMP/13, 21 April 1932.

56 Hill to Roberts, 29 June 1936, CUP PrA/R578/43.

57 [Rutherford], *op. cit.* (note 29), p. 249.

PHASE 2: LEARNING TO BE SELF-SUPPORTING IN THE MID TWENTIETH CENTURY

The improvement in the Royal Society's sales income in the interwar period had been almost accidental, but the post-war period would be a time of conscious, active pursuit of sales. The survival of the increasingly expensive philanthropic model for the circulation of knowledge into the 1930s had depended both on the Royal Society's willingness to subsidize it and the willingness of the government and ICI to help. Neither of those two conditions was necessarily true after the war. The emphasis was now on making publishing self-supporting.

In the Society's internal narrative, 1954 was presented as a dramatic watershed. That was the year in which the Society created its own publishing sales team; and the year in which it cut the remaining gratis distribution to learned institutions. In fact, these changes were too recent to contribute to that year's financial performance—and figure 5 makes clear that breaking even was the result of trends originating in the interwar period—but 1954 does represent a significant shift in mind-set at the Royal Society. Sales, not philanthropy, would become the focus, with the aim of making publishing sustainable without draining the Society's funds or relying on government support.

The immediate stimulus for the change of approach was an apparent crisis in the publishing finances in 1951–1953, coupled with CUP's desire to renegotiate its contract. In the immediate post-war years, there had been many positive signs for the publishing finances: ICI reinstated its annual grant at pre-war levels; the government agreed to increase the value of its grant-in-aid; and Cambridge reported that sales had returned to pre-war levels, and it had great expectations of its new branch office in New York.⁵⁸ In 1951, and again in 1952, the Society received more income from sales of its journals than ever before. And yet, in early November 1953 the Society's executive secretary, David Martin, was warning the Council to expect a deficit of £5000 on publishing in the coming year.⁵⁹

In the *longue durée* perspective of the figures presented earlier, this 'crisis' is barely visible, but there is no doubt that Martin and the officers were severely worried. Ongoing shortages of raw materials and labour were pushing up costs: in 1951 the price the Society paid for paper almost doubled.⁶⁰ The end of the war had also meant a return to more normal research and publication practices, and the number of papers submitted to (and accepted by) the Society was increasing. It had not yet passed the levels of the 1930s, but it was another cause for concern. The Society's officers and staff spent much of 1952 trying to find ways of cutting costs, to little effect.⁶¹ An attempt to redesign the page layout of the journals revealed that the Society's staff were as unwilling as its fellows to make changes that might lead to a 'deterioration in the traditionally high standard of style and legibility' associated with the Royal Society journals.⁶²

The real stimulus to action came later in November 1953, when a letter arrived from CUP. The Press announced that, given the difficult economic climate, it wished to rationalize its arrangements with the learned societies for which it printed and published. The new proposals included an increase in the commission on sales, and would have made the

58 On CUP's new American branch, see McKitterick, *op. cit.* (note 41), ch. 15.

59 'Consideration of estimated deficit on RS publications account', 4 November 1953, uncatalogued but in RS OM3.

60 Officers meeting, 12 July 1951, RS OM2/47(51).

61 Draft of proposed circulate letter to fellows (re cardboard cartons), 25 March 1952, in RS OM3/16(52).

62 Comments by assistant editor J. C. Graddon, 25 March 1952, RS OM/17(52).

Royal Society worse off by about £700 annually. For the Society, this letter ‘put a completely new complexion’ on the existing ‘problem’ of the publishing deficit.⁶³

The point at issue was the arrangements for publishing and selling the journals, not their printing. CUP was still highly respected for its scientific typesetting and printing, and there was no suggestion of trying to find a cheaper provider. The fact that CUP felt the need to defend the ‘good results’ produced by ‘our unspectacular methods’ of marketing suggest that some in the Society must have felt that more could be done.⁶⁴ The Society’s immediate response to CUP’s letter was to ask Martin to make enquiries ‘about the possibility of having an alternative publisher’.⁶⁵

Just four months later, Martin aired the possibility of the Royal Society ‘selling its own publications’.⁶⁶ This would avoid paying sales commission to an outside party, and Martin argued that the cost of employing the sales and marketing staff would be more than offset by their ability to focus on the specific needs of the Society’s journals. Martin’s recommendation led to unusually swift and decisive action, and the new publishing sales team began work in October 1954. It began with just two members of staff (one internal redeployment and one new appointment), both of whom had experience in retail but not in publishing.⁶⁷

At the same time, Martin was analysing the Society’s remaining non-commercial distribution arrangements with learned institutions. His calculations suggested that the value of publications distributed by the Royal Society was at least three times that of the ‘gifts’ received in return by the Society’s library.⁶⁸ He proposed to cut all the ‘gifts’ to universities in Britain and the Commonwealth and to retain only a few, carefully scrutinized, exchange arrangements.⁶⁹ Council agreed ‘with great reluctance’.⁷⁰ Martin presented the cuts as an effort to reduce the amount the Society paid on printing and shipping, but the long-term consequence was that all university libraries—not just those in the USA—now had to purchase the journals (or not). Turning these institutions into potential customers was as important to the Society’s mid century transformation as the appointment of the publishing sales team.

From the mid 1950s onwards the ‘number of subscribers’ became a key performance indicator for the Society, and its *Year Book* began to report subscriber numbers for each journal (as well as listing the total sales income in the accounts).⁷¹ The modest surviving non-commercial circulation (to fellows and a few exchanges) received barely a passing mention. The *Year Book* presented sales (and specifically subscriptions) as the dominant form of circulation.

Subscriber numbers and total sales income kept rising through the late 1950s and 1960s: in 1953 income from sales had been £27 500, in 1955 it was £58 500, and by 1967 it would be

63 Officers minutes, 30 November 1953, RS OM2/62(53).

64 CUP to RS, 16 December 1953, in RS OM3/2(54).

65 *Op. cit.* (note 63).

66 Officers minutes, 4 March 1954, RS OM2/15(54).

67 On John Boreham (1914–1998) and Gladys Dance (1914–2013), see *Comrades of old: Royal Society staff pensioners, biographical sketches, the Royal Society former staff association* (privately circulated, 2015), at pp. 11 and 33–34.

68 ‘Revision of the lists of exchanges and gifts of the Royal Society’s publications’, 2 March 1954, in RS OM3/14(54); ‘Recommended reductions in exchanges and gifts of the Royal Society’s publications’ [undated, spring 1954], in RS OM3/16(54).

69 Council minutes, 1 April 1954, RS CMP/19; and RS *Year Book* (1955), p. 188.

70 RS *Year Book* (1955), p. 188.

71 For instance, RS *Year Book* (1957), p. 202. An advance subscription option for the *Transactions* was finally introduced in 1956.

£133 000.⁷² By the late 1960s the paid-for circulation of the journals was three to four times higher than it had been in the late 1930s (see figure 3). The journals were now covering all their costs and the Society declared its new publishing sales team an unprecedented success.

The increase in subscriber numbers undoubtedly reflected substantial activity by the sales team. They targeted institutions that were former recipients of the Society's philanthropic circulation (mostly in the British dominions and Europe) and they drew upon the insider knowledge of the fellows of the Royal Society to identify other institutions (especially in north America) whose libraries might be persuaded to subscribe. The fellowship helped the sales team target individual heads of department or laboratory directors and suggested scientific conferences that might be good venues for distributing publicity materials to raise awareness, particularly beyond the traditional British academic world. By 1973, if not earlier, the biggest market for Royal Society journals had become the USA, which generated 38% of subscriptions; only 11% of subscribers were based in the UK.⁷³

Figure 7, in the supplementary material online, offers some insight into journal pricing, focused on *Proceedings A*. The lack of early twentieth century price information makes it difficult to evaluate what changed in the 1950s or 1960s; the amount paid per year by a customer certainly rose, but that was partly due to an increase in the quantity of material being published and partly to a shift away from setting prices based on a 'notional cost' to a pricing strategy that aimed to recoup costs. The low subscription rates of the early twentieth century had been intended for an individual junior or mid career scientist, but from the 1950s onwards the subscription rates were intended for institutional research libraries (and by the 1980s individual subscribers had entirely disappeared).⁷⁴

The Society's internal narrative associated the financial success of its journal publishing in the late 1950s and 1960s with the decision to take control of sales and marketing, but in reality the new sales team cannot claim all the credit. It was capitalizing on the economic-academic circumstances of the 1950s and 1960s: British and North American research was well-funded, and that applied to libraries as well as laboratories.⁷⁵ Journal publishers who were willing to look to an international English-speaking market, rather than a national one, and to focus their efforts on institutions, rather than individuals, discovered that it was possible to make journal publishing commercially successful in a way that had been unimaginable 50 years earlier. This was a good time for all scientific journal publishers, not just the Royal Society.

By the late 1950s the Royal Society would be actively promoting the idea of 'self-help' and 'financial independence' as a route to sustainability for learned society journals. The desire to avoid reliance on external support was pragmatic at a time when government officials were seeking to make cuts,⁷⁶ but it also had a political edge. In 1957 Martin advised the Chemical Society that 'indebtedness' to government funds 'might endanger the

⁷² RS annual accounts, *passim*.

⁷³ In 1973, 11% of subscriptions were to the UK, see 'Trends in subscriptions for *Proceedings* and *Philosophical Transactions*', RS OM3/88(80).

⁷⁴ By 1987 there were no individual subscribers, see Annex D to 'The Society's publications', 11 June 1987 in RS C/87(87).

⁷⁵ D. Edgerton, *Warfare state: Britain, 1920–1970* (Cambridge University Press, 2005), ch. 6; J. H. Capshaw and K. A. Rader, 'Big Science: price to the present', *Osiris* 7, 2–25 (1992).

⁷⁶ On the desire for cuts, see Treasury to RS, 8 January 1951, in RS OM/4(51). The grant-in-aid was reduced in 1952 and again in 1957.

independence of the publishing body in deciding what is to be published'.⁷⁷ This argument would resurface in the 1980s.

The aim of 'financial independence' underpinned the Society's collaboration with the Nuffield Foundation from 1955 to 1961, which offered professional advice and small grants to learned society publishers.⁷⁸ The resulting pamphlet, *Self-help for learned journals* (1963), advised societies to pay more attention to realistic (not discounted) pricing, marketing and subscriber numbers. This was the strategy that had enabled the Royal Society to cover all its costs from sales while also declining any share of the parliamentary grant-in-aid and letting the ICI donation lapse.⁷⁹

There are two caveats, however, to this vision of Royal Society journals as entirely self-supporting through sales. First, between 1955 and 1980 the Society was still indirectly supporting its publications by absorbing their salary and office costs in the general operations account. This meant that the publications surpluses in this period seemed greater than they would have been under previous (or subsequent) accounting practices. Counterbalancing that, however, we should remember that 'the publications account' included all the Society's publications, not just the research journals. At the time, *Biographical Memoirs, Notes and Records* and the Society's *Year Book* had virtually no public sales, and their costs were a drain on the publications account. The finances of the *Proceedings* and *Transactions* were even healthier in the 1960s than figure 5 suggests.

PHASE 3: SHRINKING MARKETS AND NEW TECHNOLOGIES IN THE LATE TWENTIETH CENTURY

Royal Society publishing in the late 1950s and 1960s may have aimed to be 'self-supporting', but it did in fact delight the treasurers by generating a surplus; and the publishing finances would continue to generate a surplus in the late twentieth century, despite the consistent and apparently irreversible decline in subscription numbers after 1970. There were certainly moments when the Society's treasurers expressed the wish that publishing might generate *more* income, but there seem to have been no worries that it might fail to cover its costs.⁸⁰ The continuing commercial success of Royal Society publishing in a period of declining subscriber numbers was largely the result of falling production costs (due to technological innovations) with some help from price increases.

The experiences of learning to work with new technologies, and of developing pricing strategies to compensate for the decline in subscriptions, were common to all scientific journals publishers in this period, but Royal Society publishing faced some very specific additional challenges: the attractiveness of its journals in the wider journal landscape, and the perceived function of the publishing division within the Society's wider portfolio of activities.

The post-war period had seen a proliferation of research journals launched by scientific societies and associations, and by publishing companies. In 1960 *Nature* reported that the

77 Martin (for the Royal Society) to the Chemical Society, 15 January 1957, in 'Minutes of Council, January 17, 1957', archive of the Chemical Society (now part of the Royal Society of Chemistry) C.P./4(57), p. 5.

78 A. Fyfe, 'Self-help for learned journals: scientific societies and the commerce of publishing in the 1950s', *Hist. Sci.* **60**, 255–279 (2022).

79 The RS no longer took a share of the government grant after 1955, see RS CMP/28, 3 November 1955. The ICI grant disappeared soon after, certainly by 1957.

80 The healthy prognosis for the publishing finances is also implied by the 1980 decision to charge staff and office costs to the publishing account, thus ending the indirect subsidy.

Science Museum Library was having to subscribe to 700 new journals every year, and by the early twenty-first century it would be estimated that there were over 30 000 peer-reviewed English-language journals.⁸¹ In this context, it was far from clear that the Royal Society's determinedly generalist journals remained attractive to authors: the available data on submissions suggest that the Royal Society did not benefit from the near-exponential growth in scientific research and publishing reported in other sources after 1945.⁸² By the 1970s and 1980s this had become cause for concern, resulting in a major re-branding and re-launch of all four of the Society's research journals in 1990 and a change of submission policy.⁸³ This would prove enormously successful in increasing the flow of submissions from authors, particularly in the thriving biological sciences.⁸⁴ It did nothing to reverse the decline in subscriptions from libraries.

The second issue for Royal Society's publishing team specifically was the changing expectations placed upon it by the Society's officers. The great financial success of the 1960s meant that, by the 1970s, their ability to generate a surplus had come to be taken for granted. The idea that journal publishing should be treated as 'a major source of income' for the Society at large first became explicit in a financial review in 1972.⁸⁵ It became particularly attractive in the late Thatcher years, when the Society's officers sought to reduce their dependence on government funding by fund-raising and a new enthusiasm for conferences, events and catering income (as seen in figure 1).⁸⁶ In the business plans produced for the publishing division at the turn of the millennium the aim of making (more) money was explicitly stated.⁸⁷ The concern with financial performance underpinned the Society's approach to its journals throughout the late twentieth century, including its first steps in electronic journals in the 1990s and its response to 'open access' in the 2000s (although the latter is beyond the scope of this paper).

Income

The Society's publishing sales team was certainly aware of the decline in subscriptions in the 1970s, but the annual report did not admit it publicly until 1984, when it offered the cold comfort that 'many other scientific journals' were having similar experiences.⁸⁸ By 1990 the term 'serials crisis' had been coined to describe the vicious circle in which university

81 D. Richter, 'How many more new journals?', *Nature* **186**, p. 18 (2 April 1960). This was a meeting of the Scientific Publications Council, sponsored by the Ciba Foundation. For near-current journal numbers, see R. Johnson, A. Watkinson and M. Mabe, *The STM report: an overview of scientific and scholarly publishing 1968–2018 celebrating the 50th anniversary of STM*, 5th edn (International Association of Scientific, Technical and Medical Publishers, The Hague, 2018), at p. 5.

82 Compare the wider patterns of growth shown in L. Bornmann and R. Mutz, *op. cit.* (note 12), with the lack of exponential growth in Royal Society submissions after 1945: A. Fyfe, 'Submissions in life sciences vs physical sciences, 1927–1989', in *The history of the scientific journal* [weblog] (13 February 2018), <https://arts.st-andrews.ac.uk/philosophicaltransactions/submissions-in-life-sciences-vs-physical-sciences-1927-1989/>.

83 Since the eighteenth century, authors could only submit to the Royal Society via a fellow of the Society; this changed in 1990. See A. Fyfe, 'Editors, referees', *op. cit.* (note 35).

84 The influx of submissions led to a higher rejection rate, see A. Fyfe, 'More submissions, more rejections: the Royal Society journals since the 1950s', in Fyfe, *op. cit.* (note 82) (18 June 2020), <https://arts.st-andrews.ac.uk/philosophicaltransactions/more-submissions-more-rejections-the-royal-society-journals-since-the-1950s/>, esp. graph 2.

85 'Review of the Society's finances', in Officers minutes for 26 January 1973, RS OM2/16(73).

86 Collins, *op. cit.* (note 15), at pp. 285–286.

87 In 1996 income generation was one of two aims, see Publication Board minutes, 14 October 1996, RS CMB/417. In 2005 increasing the surplus was the first of three aims listed in 'Vision, strategy and business plan', February 2005, in RS PUB/1(05).

88 RS Annual Report (1984), p. 10. For an earlier, internal analysis, see 'Trends in subscriptions for *Proceedings* and *Philosophical Transactions*', RS OM3/88(80).

librarians, whose budgets were at best static if not actually shrinking, struggled to renew subscriptions to journals whose prices kept rising.⁸⁹ The serials crisis is frequently associated with government cuts to research and higher education budgets on both sides of the Atlantic in the 1980s, but figure 3 reveals that the Royal Society's subscriber numbers had begun falling earlier than this.

The Society's own analysis of its subscription trends between 1973 and 1979 revealed an average fall of 11% per journal. The decline was most marked for *Proceedings A*, perhaps because its circulation had grown most impressively in the late 1950s and 1960s. During the 1970s *Proceedings A* lost almost 20% of its subscribers. There were regions where subscriptions were still increasing, including Italy and Japan, but the Society's biggest market had come to be the USA, and that market was shrinking. The contemporary analysis also revealed that the decline was not, at this point, due to university budgets. The subscribers who had opted not to renew were government and industrial institutions.⁹⁰ This meant that, by the mid 1980s, the Society's subscription list had come to consist almost entirely of university libraries and would thus be vulnerable to changes in higher education funding.⁹¹

The Society's publishing income was also affected by the value of the subscriptions to its journals, and this was being eroded by the high inflation of the late 1970s and 1980s. Treasurers reported year-on-year increases in the raw sterling values, but the Society's sales income was declining in real terms through the 1980s and early 1990s (figure 2a). Fluctuations in currency exchange rates (after the collapse of the Bretton Woods agreement) added further uncertainty, especially with almost 90% of the Royal Society's subscribers being overseas.⁹²

In this difficult market, careful pricing was essential. The Society's treasurer had introduced an annual (rather than occasional) price-setting exercise in the mid 1970s. His initial plan was to push up prices in order to generate more income for the Society, but in practice it became a mechanism for keeping up with inflation. The price increases in figure 7 (see supplementary material) are above inflation, but not dramatically so: the sales team was acutely conscious of the 'real danger of losing subscriptions'.⁹³ The absence of explicit discussions in the archival record makes it difficult to assess whether the Society was strategic or (more likely) reactive in its approach to pricing in this period. There is sufficient pricing data from the 1970s and 1980s to say that the price per page of editorial content for *Proceedings A* increased in line with inflation in the late 1970s, but increased ahead of inflation in the 1980s.

The Royal Society staff were aware that these were problems experienced by the wider academic publishing industry, and by the 1990s comparisons to the performance or practices of other publishers (including commercial publishers) were becoming commonplace in Society reports. For instance, in 1995–1996 Royal Society subscriber

89 K. Douglas, 'The serials crisis', *Serials Librarian* 18(1–2), 111–121 (1990); J. M. Panitch and S. Michalak, *The serials crisis: a white paper for the UNC-Chapel Hill Scholarly Communications Convocation* (University of North Carolina, Chapel Hill, 2005).

90 'Trends in subscriptions for *Proceedings* and *Philosophical Transactions*', pp. 2–3, RS OM3/88(80).

91 Annex D, *op. cit.* (note 74). On university funding, see M. Shattock, 'Higher education and the research councils', *Minerva* 27(2/3), 195–222 (1989).

92 RS Annual Report (1981), p. 8. For proportion of UK/overseas sales, see 'Trends in subscriptions for *Proceedings* and *Philosophical Transactions*', RS OM3/88(80).

93 Minutes of the Publications Policy Committee, 30 January 1974, RS CMB/328.

numbers had fallen by a further 4.65%, but rather than compare this to past performance (which would have involved admitting to subscriber numbers similar to those of the late 1950s), the Society preferred to note that this decline ‘almost exactly mirrored the industry forecast for European-based journals’.⁹⁴ Two years later, a price increase of 8% was said to be ‘reasonable’ on the grounds that it was ‘well below that of major commercial publishers in the STM sector. Elsevier was reported to be increasing prices by 15%: John Wiley by 18% ...’.⁹⁵

The Royal Society also began trying to learn from the practices of other publishers. In 1995–1996 it created the new ‘Publishing Board’ to oversee all the Society’s publications, and included external representatives among its members. It also ended its long-term practice of promoting from within its own editorial staff and hired a new team of senior managers with substantial experience from other publishers.⁹⁶ The new management team was well aware that, ‘in common with most academic publishers’, the Society’s business model relied on ‘taking an increasing amount of cash income from a shrinking number of customers’.⁹⁷ ‘Product development’ was a key focus for the Royal Society publishing team at the end of the twentieth century. Some journals had their capacity and/or periodicity increased, and in 2003 the Royal Society would launch its first new journal titles since *Notes and Records* (1938).

In the mid 1990s the new management team began to explore additional income sources, noting that any ‘non-subscription income’ was very ‘welcome’.⁹⁸ The UK government grant and ICI donation were long gone and had, in any case, been intended to help learned society publishing break even, not to make it more profitable. Another option might have been to ask authors (or, rather, their funders) to contribute to publication costs, as some of the major US societies had been doing since the 1960s, but UK societies had not generally done this.⁹⁹ The Royal Society did not impose publishing charges on its authors and their funders (except for extra pages, or for colour printing) until it began offering the option of open access publishing in 2006.

In the 1990s it was the advent of electronic technologies that offered new ways of charging for content or services. CD-ROMs providing additional content or supplementary data files seemed promising at first, but by the mid 1990s the Royal Society’s Publishing Board noted that ‘the whole industry is gearing up’ for online delivery via the internet, planning ‘new services’ that would hopefully ‘become a revenue stream’.¹⁰⁰ Online access to current and historic issues of the journals was originally presented as an additional service for which existing subscribers could be asked to pay extra, but it would transform the mode of circulation, allowing access to be sold or granted to individuals, single institutions, groups of institutions or entire countries at the level of single articles, single titles or bundles of titles. In the 2000s the ‘number of article

94 Minutes of Publications Executive Committee, 23 April 1997, RS PEC/7(97).

95 Minutes of Publications Board, 10 July 1998, RS PUB/18(98).

96 The first appointment was Ruth Glynn, who became the first head of Publishing in 1995. She oversaw the recruitment of John Taylor, Charles Lusty and Phil Hurst in 1996, but left shortly after.

97 *Op. cit.* (note 94).

98 *Op. cit.* (note 95).

99 On US societies using page charges, see T. Scheiding, ‘Paying for knowledge one page at a time: the author fee in physics in twentieth-century America’, *Hist. Stud. Nat. Sci.* **39**, 219–247 (2009) and M. Noel, ‘Building the economic value of a journal in chemistry: the case of the *Journal of the American Chemical Society* (1879–2010)’, *Revue française des sciences de l’information et de la communication*, no. 11 (2017), <https://doi.org/10.4000/rfsic.3281>. For the Royal Society’s belief that page charges would deter authors, see the report of the Publications Policy ad hoc committee, in minutes of Council, RS CMP/24, 12 July 1973.

100 Minutes of Publications Executive Committee, 23 April 1997, RS PEC/7(97).

downloads' and 'number of countries with access' would replace 'number of subscriptions' (as used in figure 3) as the key circulation metrics.

In the early twenty-first century the new management team would succeed in using commercial business practices and new technologies to improve the Society's income from its journals. The focus of this paper, however, is on the twentieth century, and for most of the period 1970 to 2000 falling subscriptions meant that, despite price increases, the Society's income per page of editorial content, once we adjust for inflation, was in decline (figure 2c). The healthy surplus was possible only because costs were—for once—falling faster.

Expenditure

As figure 4a demonstrated, the key trends in expenditure in the late twentieth century were that staff-related costs were rising, but production costs were falling; distribution-related costs were steady. The production costs include paper, typesetting, printing and illustrations, and they were clearly falling before the internet. The patchy data available, including the snapshots in figure 4b, suggest that it was falls in the cost of typesetting and printing, rather than of paper, that were particularly significant. This is consistent with the adoption of new technologies for typesetting and printing, including the use of (non-networked) computers, in the 1970s and 1980s.¹⁰¹

Through the mid twentieth century, CUP had continued to train and employ skilled compositors who could set complex material by hand (such as the mathematical sections of scientific papers) alongside the late Victorian hot-metal typesetting machines. By the 1970s, however, offset lithography was replacing relief printing as the dominant technology. The plates for offset litho printing could be produced from photographs of an image or text, but by the late 1970s computer operators began to use new software and hardware to create photographic film directly from electronic text. By 1984 all of the Royal Society's journals were being 'typeset by computer-assisted composition'.¹⁰²

The computerization of typesetting separated it from the labour of printing, and during the 1980s and early 1990s the labour of typesetting was relocated. In the early 1980s the Royal Society's staff had to re-key the typed manuscripts provided by authors before sending the electronic word-processor files to CUP's typesetters for conversion into the TeX typesetting software that could generate the photographic film to etch the printing plates. By the late 1980s the Society's editorial staff had learned how to use TeX, and had acquired an Imagesetter; they now sent photographic film to Cambridge, rather than disks with word-processor files. Furthermore, although there was apparently 'very little indication from authors of a wish or willingness to provide their typescripts' in electronic form in 1987, things quickly changed.¹⁰³ By 1994 submitting papers on floppy disk had become the norm. Some authors submitted word-processed files, which the Society's staff processed into TeX. Authors in more mathematical disciplines learned how to create their own TeX files. Over 80% of papers were now being typeset by the Society's authors or by its staff, not by CUP.¹⁰⁴

101 For overviews, see Nash *et al.*, *op. cit.* (note 2), part I.

102 RS Annual Report (1981), p. 18; and 'The Society's publications', *op. cit.* (note 74), p. 8.

103 'The Society's publications', *op. cit.* (note 74), p. 9.

104 RS Annual Reports (1992), p. 17 and (1993), p. 19; Publication Management Committee meeting (1 December 1994), RS CMB/367. However, CUP continued to do most of the typesetting for the B-side journals until 1997, when that work was outsourced to Dobbie Typesetting; see Minutes of the Publishing Board, 10 July 1997, PUB/14(97) in RS CMB/417.

The new technologies, particularly for typesetting, are a major reason why the journal production costs fell in the 1970s and 1980s. The more dramatic fall in costs in the 1990s (figure 4a) was an indirect consequence of the same change. Decoupling typesetting from the printing process enabled publishers to think differently about their printing arrangements. The Royal Society no longer needed the specialist typesetting skills of CUP, and in the early 1990s it not only looked for a new printer but broke its three-century tradition of appointing a sole printer for all its journals. It began issuing competitive tenders for specific printing jobs, and building a pool of trusted printers, of whom CUP remained one. Regular competitive tendering proved a more effective way of pushing print costs down than anything the Society had tried previously. For instance, in 1991 the tender for *Transactions B* was won by Alden Press, a family-owned firm in Oxford, whose quotation was apparently £20 000 a year cheaper than CUP's.¹⁰⁵ Competitive tendering would become common practice for many aspects of Royal Society publishing in the later 1990s and 2000s.

The Royal Society's initial approach to the new technologies in the 1970s and 1980s had been to do as much as possible in-house, on a shoe-string budget. Thus, by the late 1980s the editorial team found themselves acting as typesetters and electronic image creators as well as copy editors and production managers. This approach would later be glossed as a 'policy of optimizing in-house skills' that had avoided both 'reliance on outside suppliers for day-to-day management' and investment in 'high capital cost technologies' that might soon be outdated.¹⁰⁶ However, it had increased the burden on the staff and meant that 'it was not possible' for Royal Society journals to be 'at the leading edge of electronic publishing'.¹⁰⁷ That 'leading edge' was occupied by the big firms that had emerged out of the wave of acquisitions and mergers in the publishing industry in the 1980s and early 1990s.¹⁰⁸ Most notably, Elsevier had acquired Pergamon Press, but there were also mergers within the world of society publishing, such as the creation of the Royal Society of Chemistry in 1980. Economies of scale helped publishers use the new technologies to survive the serials crisis.

The Royal Society's move to online publishing in the late 1990s and early 2000s was made possible by a change of approach. The new management team looked at what other journal publishers were doing and increasingly worked with external service providers and purchased commercially produced software packages, rather than doing things in-house. The result was that, whereas Royal Society publishing had begun the 1990s with one major external contractor (i.e. CUP), by the early twenty-first century it would have dozens of external partners and service providers, selected through regular competitive tendering. This changed approach to the provision of services was as important as the new technologies themselves in driving down costs per page in the late twentieth century—and, thus, in enabling Royal Society publishing to generate the surplus its treasurers wanted to see.

¹⁰⁵ RS PMC/32(91), 20 June 1991, and RS PMC/45(91), 10 December 1991. On the history of Alden Press, see Chris Koenig, 'Printing firm hits trouble', *Oxford Times*, 1 December 2008.

¹⁰⁶ Minutes of the Publishing Board, *op. cit.* (note 104).

¹⁰⁷ Minutes of the Publishing Board, 13 March 1996, RS CMB/417 PUB/13(96).

¹⁰⁸ Larivière *et al.*, *op. cit.* (note 2). For an insightful account of changes in the publishing industry, and especially academic publishing (even though focused on books rather than journals), see J. B. Thompson, *Books in the digital age: the transformation of academic and higher education publishing in Britain and the United States* (Polity, Cambridge, 2005), part I.

CONCLUSIONS

Money—specifically, how to get more of it—was prominent in conversations about Royal Society publishing throughout the twentieth century. In the early decades the aim had been to find enough money to keep the philanthropic model of journal publishing operating. There is no doubt, however, that this model was under severe strain in the early twentieth century, and may have reached the physical and financial limits of what was possible on paper. It is nonetheless remarkable that the Royal Society managed to keep it going for so long, which it did by cultivating a mix of income streams, including philanthropy, government grant and industrial support.

The discourse around publishing's relationship to money changed significantly in the middle of the century, as the spectacular growth of subscription income allowed Royal Society publishing to become financially self-supporting and even to generate a surplus. The Society became used to having extra funds to spend on other activities, and by the 1980s and 1990s publishing had come to be regarded as a source of valuable unrestricted income that the Society could use creatively and flexibly. But the publishing division's ability to deliver surpluses had originally been built on the boom in institutional subscriptions in the late 1950s and 1960s. The Society began to seek more income from its publishing activities just as that boom turned to decline in the 1970s, 1980s and 1990s. Generating a surplus under these conditions was more difficult. The new typesetting and printing technologies helped by reducing costs, but it is not surprising that electronic and online publishing methods were initially seen as possible new sources of additional income.

For most of the twentieth century, rising costs seem to have been regarded as an inevitability largely beyond the control of the Society's fellows and staff. There had been hopes since the 1950s, if not earlier, that new printing technologies would bring down costs, but it took until the 1970s and 1980s before this came to pass. The Royal Society publishing team can take no credit for the innovations, but their experiences do remind us of the importance of seeing innovations within the wider system of techniques and technologies used in a particular organization. The development of computerized typesetting reduced the cost of typesetting, but it also enabled the Royal Society to completely rethink its printing arrangements. In the 1990s the discourse around costs changed from reactive to proactive: the Society took a far more active approach to choosing and managing its contractors and service providers. Costs came to be seen as something that could be controlled. A new feature of the late-century discourse was an attention to staff costs. Tasks that had once been invisibly incorporated into the workload of the Society's general administrative staff were now being done by specialist professionals, and, by the turn of the millennium, staff salaries, overheads and relating costs had replaced printing and typesetting as the largest component of journal publishing expenditure at the Royal Society.

The Society's sustainability model in the nineteenth and early twentieth centuries had been grounded in a philanthropic, gentlemanly vision of scholarly sharing. It was non-commercial and, even as sales income became more important to the Society, it remained ambivalent, even distrustful, of commerce. In 1957 David Martin told a London audience that 'the moment commercial gain began to dominate' in publishing then 'the welfare of the scientific community would suffer'.¹⁰⁹ He was worried that the interests of scientific

¹⁰⁹ D. C. Martin, 'The Royal Society's interest in scientific publications and the dissemination of information', *Aslib Proc.* 9(5), 127–141 (1957), at p. 135. See also Fyfe, *op. cit.* (note 78).

researchers would be subordinated to those of the directors and shareholders of publishing companies. Martin and his contemporaries distinguished between commercial publishers and learned society publishers, and argued that only the latter should be trusted to safeguard the interests of the scientific community.¹¹⁰ As the later twentieth century would prove, however, society publishers could learn how to combine their commitment to mission with a more commercial approach to the circulation of knowledge.

The buoyant politico-economic circumstances of the late 1950s and 1960s had made it relatively easy for society publishers to improve the paid-for subscriptions to their journals without dramatically changing the ethos of their publishing divisions. By the 1980s and 1990s, however, in a more difficult economic climate, 'a more commercial approach to the journals' became something to be actively desired.¹¹¹ The Royal Society was having to work harder to keep the publishing surpluses coming. In 1989 the head of Publishing told one of the journal editors that 'We have to be businesslike now: it may go against the grain to be so ungentlemanly and commercial, but publishing is a hard commercial world!'¹¹² In the following years, the Society recruited new senior managers and appointed board members whose experience of the wider academic publishing industry helped to make Royal Society publishing more 'businesslike'.

The financial *longue durée* offered in this paper enables us to tell the story of the Royal Society's transition from subsidizing its journal publishing to seeing publishing as an income stream. This is undoubtedly of historical interest, but of perhaps greater contemporary interest is that this long chronological perspective allows us to see how unusual the late 1950s and 1960s were for scientific journal publishing. The subscription-based model of international journal publishing, that open access campaigners are currently trying to reform, emerged at a very specific point in time when research laboratories and libraries were generously funded. The boom in subscriber numbers was already over for the Royal Society by the mid 1970s, and by the 1990s the 'serials crisis' was widely recognized. The new commercial model has been struggling on in a political, economic and technological context that is very different from that which pertained at its origin, somewhat as the old philanthropic model also did. As we wait to see what shape a sustainable model for online open access journal publishing will take, the Royal Society's history of repeatedly exploring alternative, and multiple, streams of income may be relevant.

DATA ACCESSIBILITY

Supplementary material, including Excel files with data for all the graphs in this paper, is available at <http://doi.org/10.6084/m9.figshare.c.6101550>.¹¹³ Interested readers can find further data, including price, print run and editorial information for specific years from 1665 to 2015, at <https://arts.st-andrews.ac.uk/philosophicaltransactions/>.

110 See A. Fyfe, '1963: the Royal Society publishing code', in *The history of the scientific journal* [weblog], 4 July 2017, <https://arts.st-andrews.ac.uk/philosophicaltransactions/the-royal-society-publishing-code-from-1963/>.

111 'Ad hoc meeting on RS Publications Policy, 25 May 1984', p. 4, in RS C/155(84).

112 Bruce Goatly to Frank Smith (editor of *Transactions A*), 17 January 1989, in Smith's papers, RS CAX/other/06.

113 A. Fyfe, 'From philanthropy to business: the economics of Royal Society journal publishing in the twentieth century', Figshare. (2022), <http://doi.org/10.6084/m9.figshare.c.6101550>.