

Journals, learned societies and money: the *Philosophical Transactions*, c.1750-1900

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Abstract

This paper investigates the finances of the Royal Society and its *Philosophical Transactions*, showing that in the late eighteenth and nineteenth centuries, journal publishing was a drain on funds, rather than a source of income. Even without any expectation of profit, the costs of producing the *Transactions* nevertheless had to be covered, and the way this was done reflected the changing financial situation of the Society. An examination of the Royal Society's financial accounts and minute books reveals the tensions between the Society's desire to promote the widespread communication of natural knowledge, and the ever-increasing cost of doing so, particularly by the late nineteenth century.

Keywords: Royal Society, publishing, journal profits, learned societies, finances, science journals

Introduction

In June 1895, the physicist J. W. Strutt, Lord Rayleigh, wrote a memorandum to the Treasury in which he noted that 'the scientific journals in this country... are carried on with great difficulty and in some cases by private enterprise, and at a loss.'¹ His remark echoed that made by the printer Richard Taylor almost sixty years earlier:

Scientific journals in this country are supported with very great difficulty... I have witnessed in my own recollection a failure of all the scientific journals almost that have been set on foot... They have all of them failed from an inability to cover their expense.²

In fact, by the 1890s, as Rayleigh knew, there were some commercially viable scientific journals, Taylor's own *Philosophical Magazine* and Macmillan's *Nature* among them.³ But these journals mixed brief research communications with news and reviews. Rayleigh was concerned with the transactions, proceedings and memoirs of learned societies, whose principal

contents were research papers.⁴ According to Rayleigh, scientific journals were unprofitable because ‘the expenses are so great’, with the complex type-setting required for tables and algebra easily offsetting the advantage gained by paying authors ‘nothing for their contributions’. Income from advertisements was ‘uncertain and insignificant’, and, unless news and debate was included, the number of potential purchasers was ‘so small’. Rayleigh claimed this was why publications dedicated to full-length research papers were usually produced by learned societies. But, he said, such publishing programmes now ‘exceeded their spending powers’.⁵

Rayleigh’s concerns arose from his experiences as one of the secretaries of the Royal Society, a role which made him well aware of the costs of publishing the *Philosophical Transactions*. Although the *Transactions* had been founded by Henry Oldenburg in 1665, it was only in 1752 that the Royal Society had formally taken over the management.⁶ Noah Moxham shows elsewhere in this special issue that less changed in 1752 than might have been expected.⁷ However, there were three important changes. First, issuing the *Transactions* became a statutory part of the Society’s activity. Second, a standing ‘Committee of Papers’ was charged to select papers for publication through a collective decision-making process that, it was hoped, would protect the Society’s reputation.⁸ And third, the financial aspects of publishing the *Transactions* became the Society’s business. The new statutes acknowledged that ‘great Charge and Expence’ would be incurred, and it must be ‘defrayed out of the Stock or Fund of the Society’.⁹

Rayleigh was writing shortly after the Society’s treasurer had conducted a review of the recent finances of the *Transactions*. As had happened at every other such review (see *Table 1*), it was found that production costs outstripped sales income. The Society’s officers did not (apparently) have the longer perspective that we can re-create (see *Figure 1*),¹⁰ but they were well aware that publishing was not a profitable enterprise. They also knew that its cost to the Society had become vastly greater in the late nineteenth than it had been in the late eighteenth century. As *Table 2* shows, the cost was greater in real terms, and as a proportion of the Society’s annual income, and also if expressed *per capita* to allow for the size of the fellowship.

However, the publication finances were not expected to balance: they were considered part of the general finances of the Society. Indeed, a surplus/deficit figure for the publications did not

become part of the annual accounts until the twentieth century. From 1752 on, the Society's officers valued the *Transactions* for its non-financial benefits: it enhanced reputation, functioned as a membership perquisite, and could be used as a gift in return for information, publications for the library, or services rendered. In the 1890s, the treasurer was not worried that costs outstripped sales income, but by the extent to which they did.

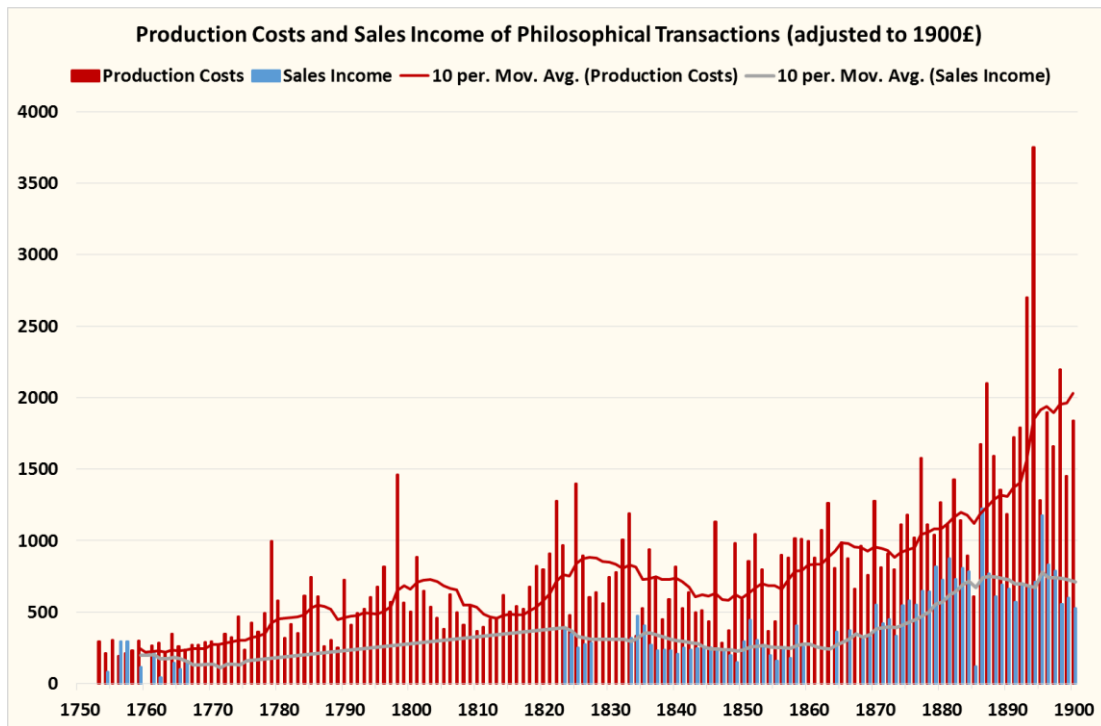
Table 1 Estimates of Philosophical Transactions finances, made by/for Royal Society council

Period reviewed	Average annual deficit	Date of review
1754-1765	£113	Jan. 1765 ¹¹
1835-1845	£527	14 Jan. 1847 ¹²
1841-1845	£505	18 Jun. 1846 ¹³
1847-51	£894	19 Feb. 1852 ¹⁴
1886-1892	£1,665	26 Apr. 1894 ¹⁵

Table 2 Philosophical Transactions finances, as above, adjusted to allow for inflation, size of fellowship and growth of Society income

Period reviewed	Average annual deficit (inflation-adjusted, 1900£)	Adjusted deficit per FRS (1900£)	Deficit as % of RS annual income
1754-1765	£160	0.3	9%
1835-1845	£440	0.6	17%
1841-1845	£458	0.6	13%
1847-1851	£857	1.2	31%
1886-1892	£1,701	3.3	24%

Figure 1 Production Costs and Sales Income for *Philosophical Transactions* 1752-1900
(adjusted for inflation, to 1900£)



An analysis of the Royal Society and its *Philosophical Transactions* offers a way into the historical relationship between learned societies, their journals, and money.¹⁶ Our knowledge of the historical finances of journal publication owes much to the work of W.H. Brock on nineteenth-century commercial journals.¹⁷ Certain publishing societies have been well-studied, particularly those religious and educational organisations which issued cheap tracts, Bibles and instructive-and-amusing magazines.¹⁸ But societies devoted to scholarly publishing – whether the learned scientific societies, or those editing and printing historical documents – have been less studied.¹⁹ How closely could – or should – learned societies engage with the commercial book trade? If a society ran its publishing programme for the sake of an ideological or philanthropic mission, how were the costs to be funded?²⁰ The officers of a non-profit-making society could not afford to ignore finances. The costs of publishing could have implications for a society’s overall financial health and thus, potentially, for its activities, as the Royal Society’s support for Francis Willughby’s very expensive posthumous *De historia piscium* (1686) demonstrates.²¹ In the nineteenth century, we must also ask how this calculation was affected by the growing professional significance of journal publication for men of science.

This paper will start by situating the *Philosophical Transactions* within the broader picture of Royal Society finances, before considering in turn the production and circulation of the *Transactions*. We will see how the Society's concerns about printing shifted from quality to cost; but its approach to distribution remained focused on free circulation rather than sales.

The Finances of the Royal Society, 1750-1900

The Royal Society's finances have yet to attract much attention from historians, although both Roy MacLeod and Marie Boas Hall have discussed its emergence as a grant-making body in the nineteenth century.²² The treasurer was one of the statutory officers of the Society at its foundation, and had ultimate responsibility for the funds, with assistance from the clerk (later, assistant secretary). The Society frequently managed to appoint fellows with substantial financial experience to act as treasurer. For instance, James West (treasurer 1736-68) held several political appointments in the 1740s and 1750s, including a period as joint secretary to the Treasury, and John William Lubbock (treasurer 1830-35) was himself a banker. For the last three decades of the nineteenth century, the Society's treasurers had links directly with the print trades: William Spottiswoode (treasurer 1871-78) had rebuilt the fortunes of printing firm Eyre & Spottiswoode; while John Evans (treasurer 1878-98) was a partner in the Norwich paper-making firm of John Dickinson & Co.

A 'finance committee' had been convened occasionally from at least the 1830s, and became a full standing committee by the end of the century.²³ The finance committee discussed matters that we might now term strategic: membership fees, the choice of printer, and the appropriate manner of treating the named funds (i.e. those donated for a specific purpose). In the late 1840s, the finance committee was actively developing an investment strategy and standard accounting procedures, and asked wine merchant J.P. Gassiot to create a set of model ledgers for the Society in 1849.²⁴

The Society's annual totals for income and expenditure were highly dependent upon special projects, often externally-funded, which ranged from transits of Venus to the cataloguing of the Society's library and the massive bibliographical enterprise that was the *Catalogue of Scientific Papers* (1867-1925).²⁵ The following discussion of finances focuses upon those categories that can be tracked over the long-term, namely income from membership,

Figure 2 Trends in Royal Society income, 1765-1900 (adjusted for inflation, to 1900£)

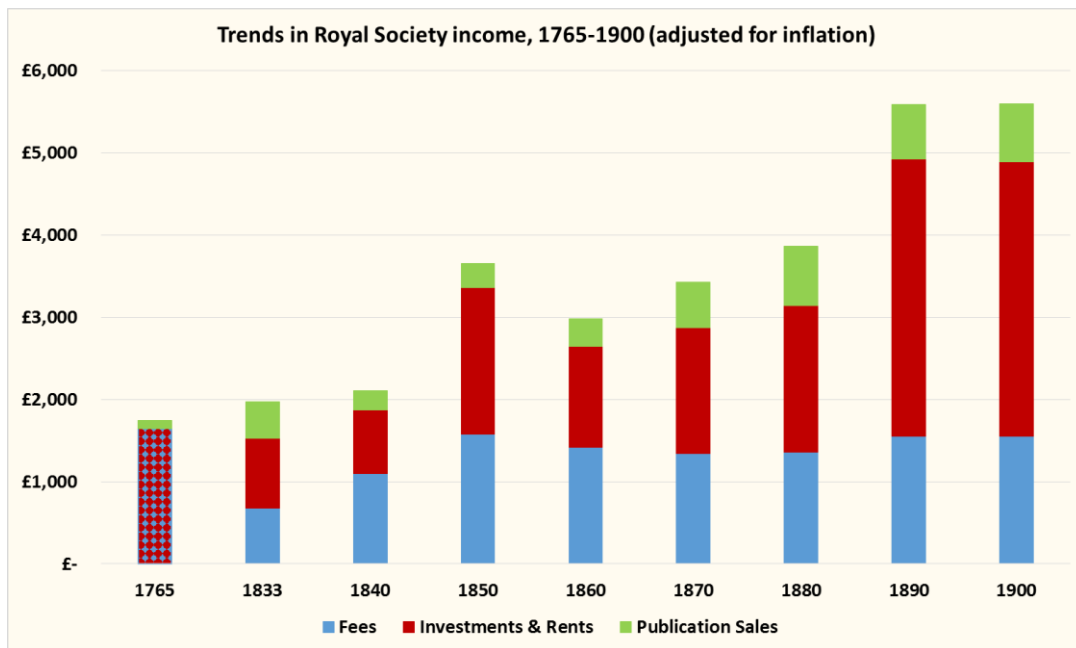


Figure 3 Trends in Royal Society Expenditure, 1765-1900 (adjusted for inflation, to 1900£)

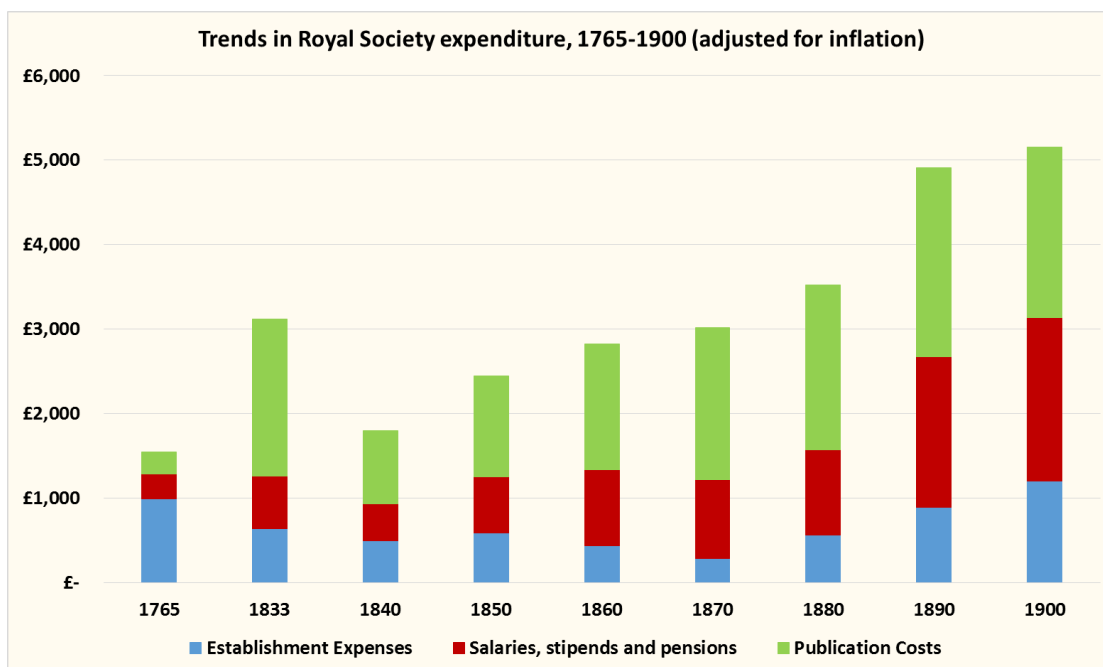
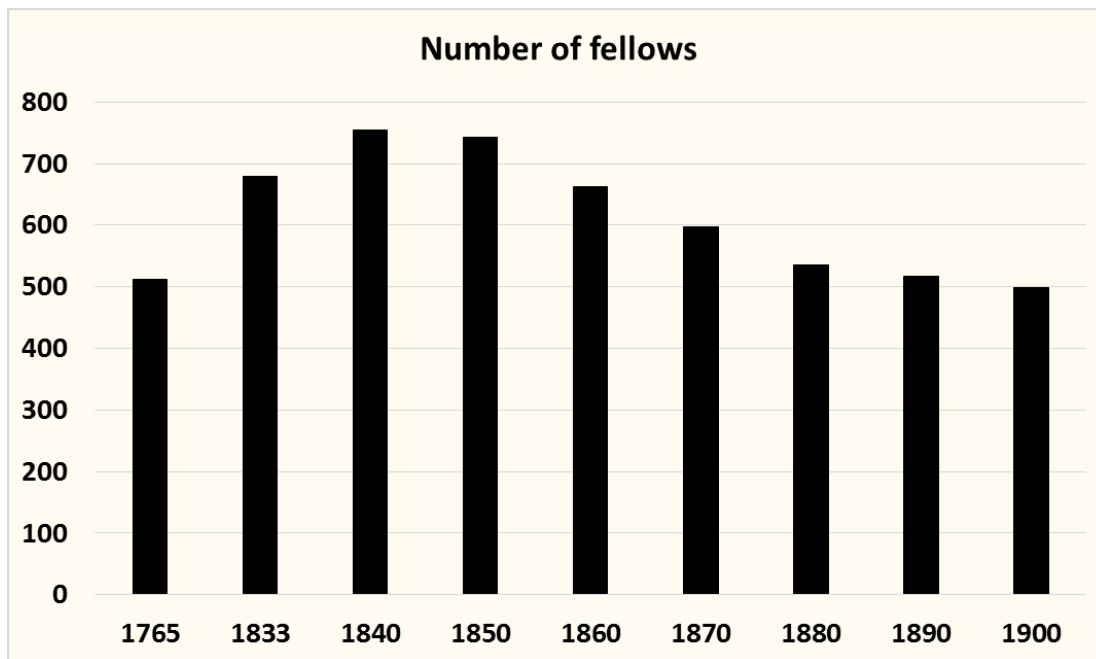


Figure 4 Size of the Royal Society fellowship, 1765-1900



investments and publications; and expenditure on premises, staff and publications. These have been extracted from the Council Minutes and, from 1833, the printed annual accounts, and are summarised in *Figures 2 and 3*.²⁶ Between 1750 and 1900, both income and the expenditure in these categories had more than tripled in real terms. The size of the fellowship, on the other hand, was around 500 at the start and end of the period, but rose as high as 750 in the mid-nineteenth century (*Figure 4*).

In the eighteenth century, the main uncertainty in membership income had been the number of fellows in arrears, some of whom had to be pursued by lawyers.²⁷ By the nineteenth century, the process for receiving subscriptions and ejecting defaulters had become effective, and fee income depended upon the size and composition of the membership. Income from membership rose as the fellowship grew over the first half of the nineteenth century. Admitting new fellows was more financially significant than retaining existing fellows, because new fellows paid a £10 admission fee. The regular subscriptions had historically been 1s. a week, but this was raised to £4 *per annum* in 1819.²⁸ In 1846-47, as part of a campaign to limit membership to those with scientific attainments, reforms were proposed that would result in no more than fifteen new fellows being admitted per year; the financial implications were carefully scrutinised. The challenge lay in estimating the proportion of new fellows who would choose

to ‘compound’ their annual fees by making a one-off payment of £60,²⁹ how many would be eligible for a reduced fee (£3) in recognition of their published research, and what the death rate would be among the existing fellowship.³⁰ The reforms were indeed passed in 1847, and the size of the fellowship slowly reduced (see *Figure 4*). In the 1878, Joseph Hooker, as president, solicited donations from William Armstrong FRS, James Young FRS and Joseph Whitworth, among others, to create an endowed Fee Reduction Fund, whose income would offset the effect of the growing proportion of fellows paying the reduced rate.³¹

Given that the Society was sufficiently sympathetic to the modest circumstances of its late nineteenth-century fellows to create the Fee Reduction Fund, it is clear why there was no attempt to increase membership income by raising the fees further. It was fortunate, therefore, that over the nineteenth century, the Society’s investment income grew substantially. It came to dwarf both other income sources, providing 60% of the Society’s (then-increased) income by the 1890s. The 1846-47 financial review, chaired by Leonard Horner (son of a successful linen merchant), had recommended that half of any future annual surpluses should be invested in funds, to build up the portfolio and thus enhance the income from dividends.³² The growth of the Society’s investment income suggests that successive treasurers did a good job of implementing this policy. The Society’s funds also benefited from occasional donations and bequests, and although many were intended for specific purposes, some were added to the general reserves of the Society.³³

Turning now to expenditure (*Figure 3*), publication costs were a significant component of the increase. They included both the growing cost of *Transactions* (to be discussed in the next section) and a wider range of publication activity, with the launch of the monthly abstracts (later known as the *Proceedings of the Royal Society*) and a variety of occasional reports and catalogues.³⁴ Staffing costs grew partly because the honoraria paid to officers were occasionally increased, but mostly because of the Society’s expanding support staff. In the 1890s, the long-standing post of assistant secretary had been augmented by an assistant librarian, a clerk, and an office assistant and his junior; there was still a porter to look after the premises, but the daily charwoman had been replaced by the porter’s wife acting as housekeeper, with a third family member minding the furnace.³⁵ The third recurring category of expenditure was the ‘establishment expenses’, which, in 1833, included taxes and rates, fire insurance, postage and shipping, carpet-beating, window-cleaning, coal, soap, candles and ‘two

moveable book stands'.³⁶ This type of expenditure had been declining during the Society's time in Somerset House (1780-1857), and even during its brief period in the north wing of Burlington House; but the 1873 move into the newly-built east wing of Burlington House clearly changed the nature of the Society's commitments.³⁷ As the Finance Committee remarked in 1877, 'at the present day', it was becoming more costly to maintain 'an adequate staff and establishment'.³⁸

Both the treasurer's annual statement to Council, in the eighteenth century, and the printed annual accounts until the 1870s, routinely treated the funds carried forward at the start of the year into the figure for total receipts, suggesting that the Society cared more about having enough cash in hand, than in evaluating the income/expenditure in that particular twelve-month period. A year of high expenditure had often been preceded by one which had left a substantial carry-forward, but if the Treasurer's cash box proved insufficient, annuities could be sold, or wealthy fellows solicited for donations. For instance, in 1765, the treasurer sold £400 of '3 per Cents Bank Annuities' to cover the repairs and redecoration of the Society's Crane Court premises.³⁹ It is possible to recreate the annual surplus/deficit figures, and they reveal that until the early nineteenth century, the end-of-year balance was generally between plus or minus £400 (and usually less), but by the later nineteenth century, it could be anywhere between plus or minus £1,500 (and occasionally more). The Society's special projects were certainly a significant source of that increased variability, both because of their cost and because of the donations and grants received to fund them. Of the Society's regular financial activities, the key uncertainty came from the cost of publishing the *Philosophical Transactions*.

The Royal Society was not the only voluntary society engaged in publishing during the eighteenth and nineteenth centuries, and the tract and bible societies demonstrated that a society structure was no bar to an efficient publishing enterprise.⁴⁰ Like these evangelical societies, the Royal Society was run by an elected committee assisted by paid staff, and its publications were not issued for profit but for a mission (the circulation of scholarship, or of gospel truth). However, with its small, elite membership, the Royal Society could not emulate the extensive fund-raising activities of an organisation like the Religious Tract Society, which had over 4,000 members in its local branches. Nor were the Royal Society's officers willing to emulate the Religious Tract Society's close engagement in the book trade. The Tract Society employed an editorial staff to oversee the production of books and magazines that could be sold to the

Christian middle-classes of Britain to make money that could be ploughed back into tract publishing and distribution. The Royal Society's publishing programme was limited to those publications which directly supported scientific research and its circulation. It had no paid editorial staff, relying upon its secretarial staff (honorary and paid), and the fellows who served on editorial committees or acted as referees. And those publications absorbed funds, rather than generating them. The Tract Society celebrated (in its printed annual reports) both the sales of its books and magazines, and the consequent circulation of its tracts. The Royal Society, in contrast, printed the list of institutions all over the world to which it sent the *Transactions*, but never mentioned sales figures in public. I have argued elsewhere that, although it had the structure of a voluntary society, the Tract Society was in fact a well-run publishing house, closely integrated with the commercial book trade.⁴¹ That was not true of the Royal Society in either the eighteenth or nineteenth centuries.

Producing the *Philosophical Transactions*

The 1752 decision to take on the management of the *Philosophical Transactions* did not mean that the fellows of the Royal Society intended to acquire a printing press and learn to use it. They would employ members of London's flourishing print trades, as the secretary-editors had always done.⁴² From the 1750s to the 1780s, the Society's key contact in the print trade was the bookseller: he was occasionally consulted by Council, and until 1775, it was his name (only) that appeared on the imprint of the *Transactions*. But in the period 1750 to 1900 overall, the names of printers appear far more frequently in the Council minutes, partly because of the way bills were recorded, but also because the printers' skill, and his costs, were, from time to time, matters of significant concern. From 1752, the Society's secretary was responsible for negotiating with the printer, choosing suitable paper and type, and agreeing the cost estimates. There are no records of how the *Transactions* came to be printed by Samuel Richardson (of *Clarissa* fame), in the 1750s, or after his death in 1761, by William Bowyer, who was a well-regarded fine printer.⁴³ Bowyer died in 1771, and was succeeded by his partner John Nichols, who had the dubious honour of being the first printer to leave a substantial trace in the archive.⁴⁴

During Nichols's tenure, the Council started to pay more attention to the printing of the *Transactions*. In late 1779, there had been a remark about the need to ensure a good quality of paper; and in 1781, Council mandated a change in type face, since the previous face was 'thought too small'.⁴⁵ And then, in 1787, Charles Blagden, one of the secretaries, 'made a

complaint of great negligence & irregularity on the part of Mr Nichols the Printer,' and Nichols was ordered to 'make compensation'.⁴⁶ Two years later, Blagden had further complaints, and a committee of investigation was appointed. As well as remarking on the 'great irregularity' of mislaying corrected proofs,⁴⁷ the committee informed Nichols that his ink was 'foul and of a bad colour', and that his printing was so 'ill executed' that 'foreigners' believed the *Transactions* to be 'worse printed' than those 'of most of the other learned Societies of Europe'. Nichols 'promised to use his utmost endeavours' to prevent future complaints.⁴⁸ But in December 1791, even though Banks privately reassured Nichols that 'no cause of dissatisfaction at that time existed', Council decided nonetheless to move the *Transactions* to William Bulmer. Banks told Nichols that Council wished the *Transactions* to appear in a new typeface 'which no one but Mr. Bulmer can execute', though the Council minute itself merely notes the 'avowed superiority' of his printing. Bulmer, like Bowyer, was noted as a scholarly and learned printer.⁴⁹ The episode illustrates how greatly the physical appearance, as well as the intellectual content, of the *Transactions* mattered to its promoters.

William Nicol (no relation) became the printer of the *Transactions* in the 1820s, having entered into a partnership with the elderly Bulmer just before his retirement in 1821. In January 1828, however, Nicol, too, faced an investigative committee, chaired by the president Davies Gilbert, and was informed that his printing had been found 'greatly inferior' to that of other printers with 'analogous matter'.⁵⁰ Although he was invited to participate in a competitive tendering process, Nicol chose to resign.⁵¹ The committee sought estimates and samples of printing from five printers.⁵² It then appointed Richard Taylor, who had substantial experience printing scientific papers, both in his own *Philosophical Magazine* and in the transactions of several learned societies.⁵³

Gilbert and his investigative committee were clearly aware of the challenges of typesetting matter for the *Transactions*, for they sent samples of meteorological tables and algebra, as well as prose text, and requested samples of printing, with an estimated cost for typesetting and printing 1000 copies, paper not included. They also asked: 'What number of sheets could you furnish per week?' and 'What number of sheets could you allow to be set up at one and the same time?'⁵⁴ Such questions indicate some awareness of the practicalities of running a printing business, and of the specific requirements of the *Transactions*. And the final decision to appoint Taylor, whose estimate was not the cheapest, reiterates the determination to have the

Transactions printed ‘in the manner most creditable to the Society’.⁵⁵ Taylor’s track-record of high-quality printing and accurate typesetting by an experienced staff was crucial.

When Horner and his finance committee undertook their extensive review of the Society’s finances 1846-47, they believed that print costs were under control. In December 1846, they had instigated a re-tendering process which had persuaded the Society’s paper suppliers and printer to lower their prices.⁵⁶ And they believed, with reason (included in *Table 1*), that the cost of the *Transactions* was falling.⁵⁷ But just five years later, Edward Sabine would show that their confidence had been mistaken.

Sabine would eventually occupy every senior position in the Royal Society, but in 1852, he was serving as treasurer. He reported to the Earl of Rosse, the president, that publishing costs were ‘much beyond what is usual’ and were now ‘more than the funds of the Society will admit’. The mid- and later nineteenth century was a time of falling costs in the print trade at large, due to the uptake of technological innovations such as machine-made paper and steam-powered printing machines.⁵⁸ The fact that Sabine was the first in a long line of treasurers to worry seriously about the rising costs of the *Transactions* suggests that the Royal Society did not feel the benefit of these innovations. This is partly to do with the nature of the printing required by the Society; but Sabine astutely noted that the root of the problem lay not in the printer’s workshop, but with the Society’s authors and its editorial process.⁵⁹

He analysed the number of papers submitted and published over the last two years, noted that the number of papers published had risen, and concluded: ‘The remedy is obvious; -- the selection of papers for the *Transactions* should have reference to the pecuniary means at the disposal of the Council, as well as to the merits of the several communications.’⁶⁰ Quite how he envisioned the Committee of Papers integrating a financial review with the evaluation of intellectual merit made by referees remained unclear, and was made no clearer in 1860, when T.H. Huxley (then a relatively new member of Council) got a similar resolution passed.⁶¹ As *Table 3* shows, the quantity of research printed in the *Transactions* did rise through the later nineteenth century, particularly in the last two decades; and the rise was actually even more substantial than *Table 3* shows, because typographical changes (in the 1790s and 1830s) meant pages held more text later in the period. All this meant more paper, more work of typesetting and printing, and thus, more expense. And this growth in the printed bulk of *Transactions* was

occurring even though a high proportion of the papers submitted to the Royal Society after the 1850s was being recorded only in abridged form in *Proceedings*.⁶²

*Table 3 The changing size of Philosophical Transactions, 1750-1900*⁶³

Decade	Pages per year	Articles per year
1750s	496	70
1760s	370	47
1770s	605	41
1780s	485	34
1790s	475	25
1800s	462	22
1810s	422	27
1820s	461	30
1830s	521	27
1840s	395	20
1850s	697	29
1860s	785	28
1870s	780	28
1880s	981	26
1890s	1449	29

It is striking that the Society's editorial processes did not prevent the growth of the *Transactions*. Unlike commercial journals or magazines, the *Transactions* had no standard page length per issue, and thus, no standard price. Commercial publishers targeted their periodicals to particular markets, and chose a format and price to suit. A set cover price was thus a key element of the marketing strategy, to encourage regular subscriptions; but it entailed a strict adherence to page limits. The *Transactions* did not have a page limit, because the ambition was for the Committee of Papers to be able 'to publish all the papers they wish to be contained in the volume of the year'.⁶⁴ The size of the *Transactions* was to reflect the quantity of worthy research presented each year, however much that happened to be. And thus the Society's ambition deprived it of the simplest way of controlling costs.

In 1876, during William Spottiswoode's treasurership, the Society tried again to reduce 'the expense attendant on printing of the Society's publications', and moved to Harrison & Sons, who were specialist printers without their own publishing division.⁶⁵ But without editorial

action, it made little difference in the long term. Thus, in April 1894, the treasurer John Evans reported that 1893 had been a terribly expensive year, and warned that it was ‘impossible to meet such expenditure out of current revenue.’ Whereas Sabine had been concerned about spending around £1,500 per year, the increased investment income meant Evans was willing to spend £1,800 a year. What worried him was that the papers already accepted for 1894 were estimated to cost £2,600, while another 10 papers (‘probably costing £300’) were still to be considered by the Committee of Papers.⁶⁶

Like Sabine, Evans called for a stricter editorial policy; and he drew attention less to the number of papers accepted, and more to their length and illustrations. Comparing the 1893 figures with the average from the previous six years, he showed that in the period since the splitting of *Transactions* into two series, the number of pages printed had doubled. Given that the total number of articles published had barely increased (*Table 3*), this reveals a significant increase in the average length of articles published in *Transactions*. Evans also pointed out that the number of plates of illustrations had gone up by a half.⁶⁷ For almost a century, from the 1770s until the 1860s, many of the engravings (and, from the 1830s, lithographs) for the *Transactions* had been created in the workshop of the Basire family, spanning three generations all called James Basire.⁶⁸ The 1846-47 financial review had felt unable to run a tender process for engraving, because ‘so much difficulty attends the giving of estimates for works of that description’, and had simply recommended having a pool of trusted engravers, and seeking ‘the most advantageous offer’ for each illustration.⁶⁹ Engravings and lithographs were hand-crafted works of art rather than products of industrial mechanism, and as such, were expected to be expensive. The only way to reduce their cost was to use fewer of them; but the increased length of papers clearly tempted authors to include more images.

Evans wanted to control both length and illustrations, and he recommended that, in future, ‘no paper be printed in the Phil Trans at greater length than 40 pages 4to., or with illustrations that will cost more than £35, without special authority’.⁷⁰ Council passed his resolution, and this appears to have been the first time that any formal efforts were made to constrain authors and to lay down format rules for editors and referees to enforce.⁷¹ As well as placing a burden on authors, Evans suggested that referees should comment explicitly on the illustrations and their ‘necessity’. And he also suggested referees should consider whether papers submitted by authors who were not fellows ‘might not be more advantageously communicated to some other

Society’, thus hopefully shifting the burden of publication elsewhere.⁷² In contrast to their eighteenth-century predecessors, men of science in the 1890s had plenty of options for publishing, and Evans was suggesting that the Royal Society could afford to be more selective. In December 1894, Council drafted a standard letter to referees setting out five questions along the lines proposed by Evans, and specifying that a paper suitable for the *Transactions* should ‘seem to mark a distinct step in the advancement of Natural Knowledge’.⁷³

Circulating the *Philosophical Transactions*

The 1752 statutes stated that under the new arrangements, ‘the Sole use and benefit’ of the *Transactions* would be for ‘the Society, and the Fellows thereof.’⁷⁴ As events soon demonstrated, the ‘use and benefit’ was understood to be non-financial; as well as reputation, it included the free distribution of the *Transactions* to fellows, and its use as a gift. The free circulation clearly affected public sales, as the booksellers Davis & Reymers pointed out, in 1766, that demand was ‘very slow’, because of ‘three hundred philosophical readers [i.e. fellows of the Society] being supplied with the work, gratis’.⁷⁵ Thus, in the 1890s, when John Evans calculated the cost of the *Transactions* to the Society, he took for granted that the sales income should be seen as reducing the total liability; but he also assumed that sales were naturally and inevitably low. The complete absence of any suggestion of a more aggressive marketing strategy to boost sales indicates how alien this was to the Royal Society’s benevolent approach to circulation.

When the members of Council in 1752 considered how the Society would cover ‘the said extraordinary Expence’ of the *Transactions*, they felt it was ‘but reasonable’ that, in future, new fellows ‘should contribute in some measure’; and they raised the admission fee of 2 guineas to 5 guineas.⁷⁶ Levying a one-off charge on future fellows to cover the recurring costs of a benefit to all fellows was hardly a serious measure to cover the production costs, but it created a link between fees and the *Transactions*. The perception of a causal link led the free copy to be seen as an absolute entitlement of fellows. Thus, in 1798, Dr John Wilkinson insisted that the missing volume he sought was ‘my Property & cannot be withholden from me, but by an act of rigorous Injustice; which, I trust, in Honor, the Council will not condescend to commit.’⁷⁷ (Council invoked the statutory five-year limit on claims, and refused him.)

In the late eighteenth century, the print run of the *Transactions* was divided roughly equally between the free copies for the fellows, and those for public sale: in the 1760s and 1770s, the Society usually took about 400 copies, leaving about 350 copies for sales through the trade.⁷⁸ During the Napoleonic war, the run varied, rising as high as 1,000 copies between 1791 and 1808, but then being reduced once more.⁷⁹ The print run was again increased to 1,000 in 1828, when Taylor took over the printing, and remained there until the end of the century.⁸⁰ Yet, although the rise might be due to the growing fellowship, the failure to reduce the print run as the fellowship shrank indicates, not a growing public sale, but the extent to which the *Transactions* was being used in gift exchange.

The Council's use of the *Transactions* as a gift predated 1752, but became easier and more extensive once the Society had first-call on all the copies printed. For a brief period in the 1680s, the Society had a regular arrangement to purchase about 60 copies of each issue for its own use, but otherwise had to purchase them *ad hoc* from the bookseller-printer.⁸¹ Thus, in 1750, when the Society wished to reciprocate a gift from the *Académie royale des sciences* of a complete set of its *Mémoires*, the secretaries tried to purchase a complete set of the *Transactions*. This proved sufficiently difficult that (almost three years later), the Earl of Macclesfield (the new president) donated his own personal set.⁸² One consequence of the takeover was that the Society had easier access to copies of subsequent volumes, starting with a retrospective volume covering 1750 and 1751. Thus, both the Jesuit missionaries in China, in 1753, and the Royal College of Physicians, in 1757, received gifts of the volumes from the time 'the Society took the publication of them into their own hands'.⁸³ Some gifts were reciprocal, acknowledging observations or publications received; but others were efforts to enhance the Society's prestige, such as with the regular donations to the British Museum, and the universities of Oxford and Cambridge instituted in the 1760s, as well as the long-standing gift to the King.⁸⁴

By the 1840s, the Society was giving 20 or 30 copies each year as gifts to individuals.⁸⁵ In addition, it sent another 60 or so copies to learned societies, observatories and academies, mostly in Britain and Europe, in return for copies of their own publications.⁸⁶ During the nineteenth century, such exchanges became an important way for learned societies to build their library holdings at minimal expense. In June 1875, the requests considered (and granted) by the Royal Society included the Royal Society of Edinburgh and the American Philosophical

Society seeking volumes of *Proceedings* and *Transactions* to fill gaps in their library holdings, and the Asiatic Society of Japan (Yokohama) and the public museum in Buenos Aires offering their publications in exchange for *Proceedings*.⁸⁷ As this shows, the Royal Society's network now extended well beyond Britain and Europe. By the end of the century, the number of institutions on the Society's exchange list passed 460, and included institutions in the British dominions and colonies, the United States, and South America.⁸⁸ This largesse allowed the Society to build an unrivalled collection of scientific journals from all over the world, despite a relatively modest explicit library expenditure.⁸⁹

There was also a further way in which the Society supported the free circulation of the *Transactions*: through the provision of 'separate copies' of individual papers (i.e. offprints). From at least the 1770s, authors were allowed free copies of their papers, to circulate through their personal networks. Since they were usually printed off as soon as the paper had been approved, they might be available some weeks or months ahead of the volume to which they formally belonged, and could create confusion about the date of 'publication'. In 1802, for instance, authors were urged to 'use their endeavour' to ensure separate copies were treated as private communications 'till one Month after the publication' of the *Transactions*.⁹⁰ Moreover, as Alex Csiszar has shown, the circulation of separate copies could lead to citations that were almost impossible to track down.⁹¹ In the 1770s, the Council limited the author to 100 copies of each paper; by the 1870s, authors received 50 copies as standard (with the option of 50 more on request, and more on payment).⁹²

The extensive free circulation of the *Transactions* benefited the very same scholars and institutions who might otherwise be purchasers. As well as fellows and their correspondents, virtually all of the universities and university colleges were on the free list by the end of the nineteenth century.⁹³ This explains why there was almost no discussion, after the 1760s, about the efficiency or effectiveness of arrangements for the public sale of the *Transactions*. The Society had to work with paper merchants, binders and printers to get the *Transactions* produced, but the growing free circulation meant that it was an increasingly moot point whether the Society needed booksellers or wholesalers.

Nonetheless, in 1752, Charles Davis, the Society's bookseller, had been consulted by Council on the proposed takeover of the *Transactions*, and continued to act as its distributor under the

new management.⁹⁴ As with its early printers, the Society's booksellers tended to retain its business from one generation to another. Davis was replaced, after his death in 1755, by his nephew Lockyer Davis, then in a partnership with Charles Reymers.⁹⁵ The booksellers were allowed a commission (ranging from 15% to 40%) for managing the sales of the *Transactions* on behalf of the Society.⁹⁶ But in summer 1766, Davis & Reymers proposed a re-evaluation of the terms of business, offering to take full responsibility for arranging the printing and paying the bills, though they promised to take guidance from the Society 'as to price, and all other matters', presumably editorial, 'as heretofore'. Such an arrangement, they argued, would enable the Council members to 'exempt themselves of all trouble, expence, & risque'. The Society did not accept the offer, even though it would certainly have saved time and trouble, and probably money.⁹⁷

One consequence of keeping the risk of publishing was that the Society kept the ownership of the entire print run, and, therefore, had to face the problem of managing the stock, including any copies not claimed by fellows. In principle, such remainders could be used in gift exchange, or to make up sets later. But crates of apparently unwanted publications represented money wasted on paper and printing, and a storage problem (and cost). This was what had prompted Davis & Reymers' offer: in 1765, they had reported that they were storing over 2,600 volumes on behalf of the Society, some dating back over a decade. For instance, they had 55 copies from 1751-52, and 250 copies of one of the parts for 1761-62.⁹⁸ Davis & Reymers agreed to purchase this back stock for 500 guineas, despite claiming it might take thirteen years to sell.⁹⁹

Davis remained the Society's bookseller (with various partners) until his death in 1791, when his partner Peter Elmsley took over. On Elmsley's retirement, in 1802, with no junior partner available, the president, Joseph Banks, opted for George Nicol, 'bookseller in ordinary' to the king.¹⁰⁰ Nicol had connections to the Society's printer, Bulmer; and his son, William, would become printer of the *Transactions* in the 1820s. Unsold stock was a perennial problem: in 1824, for instance, G. & W. Nicol were asked to offer all the remaining pre-1810 volumes for sale at a 50% discount.¹⁰¹ In 1829, after both George Nicol's retirement and his son's forced resignation as printer, Council stopped employing a separate bookseller.¹⁰² For the rest of the century, copies could be bought either from the Society's premises or from the printer.¹⁰³ In 1902, the secretaries were once again debating what to do with the 'large stock of surplus copies of the Society's publications that had accumulated'.¹⁰⁴

Given that most of the print run was reserved for the use of the Society (for fellows, or for gifts), only a few hundred copies of the *Transactions* were usually available for sale to casual purchasers or to those institutions (such as gentlemen's clubs and professional libraries) which did not receive free copies. The only surviving set of sales figures so far discovered was a document apparently prepared for the 1846-47 financial review which gives the sales each year, from 1835 to 1844, ranging between 130 to 160 copies.¹⁰⁵ For earlier and later sales, we can attempt to extrapolate from sales income, but there are too many unknown variables for these figures to be anything other than suggestive: in the 1750s and 1760s, sales were unlikely to have been more than 280 copies;¹⁰⁶ and in the 1860s, they were probably somewhere between 80 to 200 copies.¹⁰⁷ While these sales seem low, they do in fact represent the sale of a sizable proportion of the portion of the print run not reserved by the Society for fellows and gifts.

These sales figures, which suggest that most of the copies not reserved for the Society were being sold, suggest that the accumulating back stock was a consequence not particularly of the low sales (which were expected) but of the incomplete claiming of fellows copies. An audit in the mid-1840s, revealed that only about half of fellows claimed their copies within two years after publication, rising to two-thirds within the five-year limit. This was why the Society had, on average, 200 copies of each volume left.¹⁰⁸ The strength of the perceived link between membership fees and a free copy of the *Transactions* presumably explains why the Council did not feel able to reduce the print run by 200 copies (until 1898).

In his 1895 memorandum to the Treasury, Lord Rayleigh's analysis of the financial position of learned society journals assumed that the market of possible purchasers had shrunk. He attributed this to wider social changes in the audience for scientific journals, rather than, say, to the practice of distributing free copies. He noted the disappearance of a class of wealthy individuals, 'of great importance in former times', who had 'bought scientific publications in order to "add them to their library", whether they read them or not'.¹⁰⁹ In the late nineteenth century, *Philosophical Transactions* usually cost at least £3 a year, and sometimes over £5.¹¹⁰ While Rayleigh himself could have afforded this, he recognised that the new generations of scientific researchers typically came from less affluent backgrounds and worked in modestly-paid jobs.

Rayleigh also noted, that, even though ‘the total number of persons engaged or interested in science... is increasing’, the specialisation of scientific research meant that ‘the number of persons reading any particular paper or set of papers is small’.¹¹¹ This trend to specialisation was why the Society had, in 1887, decided to split the *Transactions* into two series, since few physicists were likely to read the biological papers, and vice versa.¹¹² But even after the split, each series retained a relatively unusual breadth of coverage compared to, say, *Chemical News*.¹¹³

One possible solution to both issues was the sale of ‘separate copies’, enabling researchers to purchase only those papers they wanted to read. In 1875, the Society decided that ‘separate copies’ would be sold through the trade (as well as provided to authors), and contracted with Nicholas Trübner, who already acted as agent for dozens of government departments and learned societies.¹¹⁴ The Royal Society’s experiment was not a great success: Trübner reported in 1883 that no more than ten copies would be needed of future papers.¹¹⁵ Nonetheless, separate copies continued to be available for sale, at prices ranging from a couple of shillings, to a massive 12s. for Charles Sherrington’s 120-page paper on spinal nerves (1893).¹¹⁶ The appointment of Trübner appears to be the Society’s first interaction with a retail or wholesale bookseller since 1829; but it is notable that the Society did not ask Trübner to handle the volumes of *Transactions*. In its volume format, the *Transactions* was arguably more suited for libraries than for individual researchers – and many of the libraries, of course, were getting it for free.

Balancing Costs and Mission

From the 1850s onwards, the Society’s treasurers had drawn attention to the difficulties of funding such a substantial publication for (primarily) free circulation. An evangelical society with a large membership could circulate millions of short tracts, but a scientific society with a small, restricted, and not fabulously wealthy, membership could not rely on membership income to fund even a thousand copies of the expensive product that was *Philosophical Transactions*.¹¹⁷ How, then, were the costs to be supported? In 1894, Evans, as treasurer, arranged for the sale of stock to cover the losses in the short-term, and proposed a limitation on page length and illustrations as a longer-term measure. As adopted by Council, however, the limitation was open to special pleading, and this prevented it being as effective as Evans

would have liked.¹¹⁸ The *Transactions* continued to have a highly variable volume length well into the twentieth century.¹¹⁹

The Society's strategy was to seek alternative sources of income. The previous two decades had been a fruitful period for Society fund-raising, as the *Record of the Royal Society* reveals. Donations were usually for special purposes – such as the £2,000 donated in 1892 by Ludwig Mond FRS 'to assist in carrying on the *Catalogue of Scientific Papers*'¹²⁰ – but the Society's officers could be creative about finding ways to persuade donors to fund core activities, as the Fee Reduction Fund (1878) demonstrated. The publication of research might be a similarly attractive cause for donations.

There had been a short-lived Publication Fund from 1878, endowed (again) by James Young, but, rather than approaching private donors, the president, William Thomson, Lord Kelvin, authorised Rayleigh to write to the government.¹²¹ This was what occasioned his 1895 memorandum to the Treasury. The Society already administered the government grant for scientific research, and Rayleigh argued that a publication grant would enable better circulation of the results of research, which would in turn increase the likelihood of practical applications. Rayleigh acknowledged that 'the public giving the money' should know 'exactly "what it gets for its money"', and argued that the publication of completed research was a context in which 'the exact use of every penny can be clearly ascertained', in contrast to funding research, which was necessarily speculative.¹²² Rayleigh assured the government that, 'it need hardly be said that the Royal Society ... would do its very best to ensure that aid should be given only to that which was worthy of aid'. The Society thus presented itself as the appropriate body for adjudicating such claims of value and worth, willing 'to take all possible pains to ensure that the money shall be spent in a manner most advantageous to science'.¹²³ It had, of course, a track-record in this role, both in its evaluation of applications for the government grant, and the editorial evaluation processes (namely, refereeing) that it had developed at the *Transactions*. Despite emphasising the Royal Society's special role, the Society's officers recognised the strategic value of asking, not for oneself, but on behalf of others. Rayleigh proposed therefore, 'not merely to assist their own publications', but also to aid the publication of 'scientific matters' in 'other channels', as 'demanded by the interests of science'.¹²⁴

In 1894, Rayleigh's co-secretary, Michael Foster, had unsuccessfully sought an increase in the government research grant.¹²⁵ However, Rayleigh's 1895 letter to the Treasury was written as Lord Rosebery's liberal government fell. Within a fortnight, Rayleigh's brother-in-law, Arthur Balfour, was again First Lord of the Treasury, and the Royal Society had a promise of £1,000 a year as a grant-in-aid of publications. Over the next three years, just over half the funds were granted to other learned societies, but the rest subsidised Royal Society publications.¹²⁶ The government continued to support the publication of scientific research by learned societies into the twentieth century, even increasing the grant to £2,500 in the 1920s.¹²⁷ Rayleigh's success would be no long-term solution, but in the medium-term, it enabled the Society to avoid a root-and-branch rethinking of its publishing activities.¹²⁸

By the end of the nineteenth century, the Royal Society's secretaries were receiving far more submissions of publishable research than their predecessors in the 1750s could have imagined. The wealthy gentlemen fellows of 1752 had been perfectly willing to bear the cost of a publication which enhanced the reputation and honour of the Society, and their successors wanted to continue doing so. But the professionalization of science made this difficult, not just because of the increased research activity and the new career significance of publishing, but because demographic changes to the scientific community meant that money was more of an issue than it had once been. The Society was fortunate indeed that the treasurers and finance committee members of the post-1847 period did so well at developing its investments. One can only speculate what the Society might have done with those funds had they not been so effectively absorbed by the publishing programme.

Treasurers of the Royal Society – from Sabine to Evans – had recognised that the rising costs were a consequence of the Society's editorial policy. Each paper was assessed entirely on its own merits, rather than considered as competing with others for a defined (and limited) amount of space in the journal. Indeed, since 1752, the Society had developed increasingly complex editorial processes for doing this, using committees and (since 1832) referees as a way of combining individual expertise with collective, institutional responsibility.¹²⁹ One of the inadvertent consequences was a greater distance between editorial and commercial decisions. Throughout the period, the assistant secretary dealt with the printer, and the treasurer kept an eye on finances, but neither was closely involved with the editorial processes. This contrasts with the running both of early nineteenth-century commercial journals, such as those of

Nicholson, Tilloch and Taylor (all of whom had backgrounds in the print trade);¹³⁰ and with the way the *Philosophical Transactions* had originally been run by Oldenburg, in close contact with his bookseller-printers.

Rayleigh's memorandum had depicted the business of late nineteenth-century scientific journal publishing as beset by the inevitably expensive complex printing requirements, and an equally inevitably tiny market. There was truth in this, but Rayleigh overplayed (for valid strategic reasons) the inevitability. At least in the case of the Royal Society itself, the unbearably high costs were a consequence of an editorial process which aimed to publish all excellent papers, while the lack of paying purchasers resulted from the extensive free distribution to fellows, their correspondents and academic institutions. Thus, we fundamentally misunderstand the Royal Society's publishing activities if we look at them from the perspective of modern learned societies which often gain significant income from their publishing activities. Some earlier publishing societies might have relished their engagement with the commercial book trade, but the Royal Society in the eighteenth and nineteenth centuries is better described as a patron of scientific knowledge than as its retailer.

¹ Royal Society archives [hereafter RS], Council Minutes (Printed) [hereafter CMP] vol. 7, 20 Jun. 1895.

² *Report of the Select Committee on Postage (1837-38)*, 314-329, at 315.

³ W.H. Brock, 'The development of commercial science journals in Victorian Britain' In: A.J. Meadows, editor. *The Development of Science Publishing in Europe* (Amsterdam: Elsevier, 1980). p. 95-122; W.H. Brock and A.J. Meadows, *The lamp of learning: Taylor & Francis and the development of science publishing* (London: Taylor & Francis, 1998); M. Baldwin, 'The shifting ground of Nature: Establishing an organ of scientific communication in Britain, 1869-1900', *History of Science* 50, 125-54 (2012); M. Baldwin, *Making Nature: the history of a scientific journal* (Chicago: University of Chicago Press, 2015).

⁴ Taylor would not have referred to learned society periodicals as 'journals', see J.R. Topham, 'Anthologizing the Book of Nature: the circulation of knowledge and the origins of the scientific journal in late Georgian Britain' In: B. Lightman and G. McOuat, editors. *The Circulation of Knowledge between Britain, India, and China* (Boston: Brill, 2013). p. 119-52.

⁵ RS CMP/7, 20 Jun. 1895.

⁶ On Oldenburg, see A. Johns, *The Nature of the Book: print and knowledge in the making* (Chicago: University of Chicago Press, 1998); A. Johns, 'Miscellaneous Methods: Authors, Societies and Journals in Early Modern England', *British Journal for the History of Science* 33:(2), 159-86 (2000); M.B. Hall, *Henry Oldenburg: shaping the Royal Society* (Oxford: Oxford University Press, 2002).

⁷ N. Moxham, 'For the sole use and benefit of this Society': developing an institutional model of scientific periodical publishing in England', *Notes & Records of the Royal Society* (2015). .

⁸ [Add reference to the Introduction to this special issue?]

⁹ RS Council Minutes (Originals) [hereafter RS CMO], vol. 4, 19 Mar. 1751/2.

¹⁰ The data underlying this graph are far from perfect. Figures have been extracted from the Council minutes until formal accounts were presented, from 1833 onwards. In the earlier period, some figures are missing, and it is sometimes difficult to attribute bills or receipts to specific volumes of the journal with certainty. Cost data is much more complete than sales data. Moreover, for most of the post-1833 period, the sales income from *Proceedings* is inextricably combined with that from *Transactions*; and thus the deficit shown here for the *Transactions* is an underestimate. Adjustment for inflation, using 1900 as a baseline, was made using the real price comparator (RPI) at 'Measuring Worth', www.measuringworth.com [accessed 7 May 2015].

¹¹ RS Domestic Manuscripts [hereafter RS DM] vol. 1/105 (n.d.) records total expenditure over this 11-year period as £2209, and payments from booksellers as £965. This may be the document requested by Council in January 1765, CMO/5, 14 Feb. 1765.

¹² 'The last ten years', Report of the Finance Committee, presented to Council 14 Jan. 1847, RS CMP/2.

¹³ 'The last five years', in Report of the Charter Committee, presented to Council 18 Jun. 1846, RS CMP/1.

¹⁴ Sabine (Treasurer) to Rosse (President), 17 Jan. 1852, recorded in RS CMP/2, 19 Feb. 1852.

¹⁵ Evans (Treasurer) to Kelvin (President), 23 Apr. 1894, recorded in RS CMP/7, 26 Apr. 1894. This figure includes the costs/income of *Proceedings* as well as *Transactions*; production costs were provided separately, but not income.

¹⁶ On the merits of 'following the money', see C. Andersen, J. Bek-Thomsen, P.C. Kjærgaard, 'The Money Trail: A New Historiography for Networks, Patronage, and Scientific Careers', *Isis* 103:(2), 310-5 (2012). .

¹⁷ W.H. Brock, *op. cit.* (note 3); W.H. Brock, 'Brewster as Scientific Journalist' In: A. Morison-Low and J.R.R. Christie, editors. *'Martyr of Science': Sir David Brewster, 1781-1863; proceedings of a bicentennial symposium* (Edinburgh: Royal Scottish Museum, 1984). p. 37-44; W.H. Brock, 'Medicine and the Victorian scientific press' In: W.F. Bynum, S. Lock, and R. Porter, editors. *Medical journals and medical knowledge: historical essays* (London: Routledge, 1992). p. 70-89; W.H. Brock and A.J. Meadows, *op. cit.* (note 3); W.H. Brock, *William Crookes (1832-1919) and the Commercialization of Science* (Aldershot: Ashgate, 2008). On the early nineteenth century, see also J.R. Topham, 'The Mirror of Literature, Amusement and Instruction and cheap miscellanies in early-nineteenth-century Britain' In: G. Cantor, G. Dawson, G. Gooday, R. Noakes, S. Shuttleworth and J.R. Topham, editors. *Science in the Nineteenth-Century Periodical* (Cambridge: Cambridge University Press, 2004). p. 37-66; J.R. Topham, 'John Limbird, Thomas Byerley, and the production of cheap periodicals in the 1820s', *Book History* 8 (2005).

¹⁸ On evangelical publishing societies, see L. Howsam, *Cheap Bibles: nineteenth-century publishing and the British and Foreign Bible Society* (Cambridge: Cambridge University Press, 1991); D.P. Nord, *Faith in Reading: religious publishing and the birth of mass media in America* (New York: Oxford University Press, 2004); A. Fyfe, *Science and Salvation: evangelicals and popular science publishing in Victorian Britain* (Chicago: University of Chicago Press, 2004). On the Society for the Diffusion of Useful Knowledge, see V. Gray, *Charles Knight: educator, publisher, writer* (Aldershot: Ashgate, 2006); R. Kinraide, *The Society for the Diffusion of Useful Knowledge and the Democratization of Learning in Early Nineteenth-Century Britain* [Ph.D.]: University of Wisconsin-Madison; 2006.

¹⁹ The standard histories of learned societies routinely include a section or chapter on the publications, but rarely discuss the actual commercial or editorial business involved. On the

problems of printing historical documents, see C. Johnson, 'The Camden Society, 1838-1938', *Transactions of the Royal Historical Society* 22:(23-38) (1940).

²⁰ University presses faced similar tensions between finances and scholarship, as can be seen in D. McKitterick, *Scholarship and Commerce, 1698-1872* (Cambridge: Cambridge University Press, 1998) and S. Eliot, editor. *The History of Oxford University Press, Volume II: 1780 to 1896*. (Oxford: Oxford University Press, 2013).

²¹ S. Kusakawa, 'The Historia Piscium (1686)', *Notes & Records of the Royal Society* 54:(2), 179-97 (2000).

²² R.M. MacLeod, 'The Royal Society and the Government Grant: Notes on the Administration of Scientific Research, 1849-1914', *Historical Journal* 14:(2), 323-58 (1971); M.B. Hall, *All Scientists Now: The Royal Society in the Nineteenth Century* (Cambridge: Cambridge University Press, 2002), Chs. 4-6.

²³ *The Record of the Royal Society of London*, 3rd ed (London: The Royal Society, 1912), p. 270. The earliest surviving minutes appear to be from 1834.

²⁴ Finance Committee, 8 May 1849, RS Committee Minute Books [hereafter RS CMB] RS CMB/86/A. On Gassiot's later philanthropy to the Society, see *Record, op. cit.* (note 23), pp.188 ff.

²⁵ *Record, op. cit.* (note 23), pp. 275-278; H. Gay, 'A Questionable Project: Herbert McLeod and the Making of the Fourth series of the Royal Society Catalogue of Scientific Papers, 1901-25', *Annals of Science* 70, 149-74 (2013).

²⁶ Expenditure can be reconstructed nearly completely, because bills were always presented to Council for approval, and thus recorded in the Council Minutes. Income was recorded in less detail; and for the eighteenth century, often all that survives is the figure for total annual receipts given in the treasurer's anniversary day (30 November) report to Council. From 1833, accounts with standard headings, including some breakdown of income sources, were printed in the *Proceedings* (from 1897, in the *Year-Book of the Royal Society*).

²⁷ For instance, RS CMO/3, 3 Feb. 1729 and 9 May 1730.

²⁸ The fees were set in the statutes; the historical statutes are discussed in *Record, op. cit.* (note 23), Ch. 3.

²⁹ Both the admission fees and the ‘compounding’ fees were treated as ordinary income, despite repeated entreaties from finance committees that some portion of the compounded fees be invested. Finance Committee, RS CMB/42/10 f.58-60, Jan-Feb 1834.

³⁰ RS CMP/2, 14 Jan. 1847. The finance committee discussions are in RS CMB/86/A, 12 Dec. 1846 to 11 Jan. 1847. None of the ‘business astronomers’ discussed by Will Ashworth, some of whom had actuarial skills, were involved (Baily had died in 1844); W.J. Ashworth, 'The Calculating Eye: Baily, Herschel, Babbage and the Business of Astronomy', *The British Journal for the History of Science* 27:(4), 409-41 (1994).

³¹ From 1878, the Society drew from the Fee Reduction Fund to replace the ‘missing’ £1. However, as the proportion of deserving fellows grew (84% by 1908), the fund went into deficit. See *Record, op. cit.* (note 23), pp.178-9.

³² Appendix I, Report of the Finance Committee, recorded in Council Minutes 14 Jan. 1847, RS CMP/2.

³³ *Record, op. cit.* (note 23), Ch. 5.

³⁴ The enormous and expensive *Catalogue of Scientific Papers*, however, was accounted separately.

³⁵ Salaries were paid in November every year, and the Council Minutes record names, roles and payments. For 1890s, see, for instance, 1 Nov. 1894, RS CMP/7.

³⁶ *Proceedings* 3 (1830-37), 241 (1833 annual accounts).

³⁷ On the Society’s premises, see *Record, op. cit.* (note 23), p.29.

³⁸ Finance Committee report, recorded in Council Minutes 17 May 1877, RS CMP/4.

³⁹ RS CMO/5, 14 Feb. 1765.

⁴⁰ Howsam, *op. cit.* (note 18); Fyfe, *op. cit.* (note 18).

⁴¹ A. Fyfe, 'Societies as publishers: the Religious Tract Society in the mid-nineteenth century', *Publishing History* 58, 5-42 (2005).

⁴² Except when the *Transactions* was printed in Oxford during the plague years, see Robert Moray to Henry Oldenburg, 10 and 11 October 1665, in A.R. Hall, M.B. Hall, editors, *The Correspondence of Henry Oldenburg* (Madison: University of Wisconsin Press, 1965-1986), v.2 p. 560, 563. See also D.A. Kronick, 'Notes on the Printing History of the Early "Philosophical Transactions"', *Libraries & Culture* 25:(2), 243-68 (1990).

⁴³ Printers' names did not appear on the printed issue, but bills for payment, explicitly 'for printing the Transactions' appear in the Council Minutes. Richardson printed the *Transactions* from at least 10 May 1753 until 15 May 1760 (he died 1761), RS CMO/4. William Bowyer was first recorded as printer of *Transactions* on 18 Nov. 1762, RS CMO/4. Richardson and Bowyer are both in the *Oxford Dictionary of National Biography*.

⁴⁴ The ODNB entry on Nichols (in 'Nichols family') gives an overview of the literature on this well-known book trade figure.

⁴⁵ RS CMO/7, 16 Dec. 1779 and 1 Feb. 1781.

⁴⁶ RS CMO/7, 25 Jan. 1787. Pages, and some title pages, had been omitted.

⁴⁷ RS CMO/7, 25 Jun. 1789.

⁴⁸ RS CMO/7, 9 Jul. 1789.

⁴⁹ Banks to Nichols, 28 Dec. 1791, in N. Chambers, *The Scientific Correspondence of Sir Joseph Banks, 1765-1820* (London: Pickering & Chatto, 2007), IV, p.94; compare with RS CMO/8, 22 Dec. 1791. On Bulmer, see P. Isaac, *William Bulmer: the fine printer in context, 1757-1830* (London: Bain & Williams, 1993).

⁵⁰ Committee for Printing Philosophical Transactions, 25 Jan. 1828, RS CMB/1/24/1.

⁵¹ Committee for Printing Philosophical Transactions, 28 Jan. 1828, RS CMB/1/24/1.

⁵² The printers involved were William Clowes, Richard Taylor, Priestley & Weal, James Moyes and R Watts. RS DM/1/95 Memorandum of printing estimates; RS DM/1/94 Memorandum of Watts' printing estimates.

⁵³ RS CMO/10, 14 Feb. 1828 (decision to appoint Taylor). On Taylor, see W.H. Brock and A.J. Meadows, *op. cit.* (note 3).

⁵⁴ 'Memorandum of questions to printers', n.d. (late Jan. 1828), RS DM/1/96 (an abbreviated version is at RS DM/1/91).

⁵⁵ 'Circular to the printers', n.d. (late Jan. 1828), RS DM/1/85.

⁵⁶ For the 1846 retendering (in which Taylor was successful), see RS CMB/86/A, 12, 14 and 17 Dec. 1846; RS CMP/2, 17 Dec. 1846.

⁵⁷ Appendix I, Finance Committee report to Council, RS CMP/2, 14 Jan. 1847. The committee compared the costs in 1835-40 with those in 1841-46; and since the 1840s costs were lower, it concluded that costs were falling. The early 1840s volumes were indeed shorter than their predecessors.

⁵⁸ For an overview of the technology, see M. Twyman, *Printing 1770-1970: an illustrated history of its development and uses in England* (London: British Library, 1998), and A. Fyfe, *Steam-Powered Knowledge: William Chambers and the business of publishing, 1820-1860* (Chicago: University of Chicago Press, 2012), Ch. 1. For the economics, see A. Weedon, *Victorian Publishing: the economics of book production for a mass market, 1836-1916* (Aldershot: Ashgate, 2003).

⁵⁹ Sabine to Rosse, recorded in RS CMP/2, 19 Feb. 1852.

⁶⁰ Sabine to Rosse, recorded in RS CMP/2, 19 Feb. 1852. This seems to have been the only time in the nineteenth century when the submission and acceptance rate was analysed. Sabine regarded a 60% acceptance rate as typical.

⁶¹ RS CMP/3, 23 Feb. 1860.

⁶² From the 1850s, the Society's secretary kept a 'Register of Papers' (MS/421), which recorded all papers submitted, and their progress (or not) through the process of being read, refereed, and approved for printing.

⁶³ Calculated from data supplied by the Royal Society publishing division. The page counts are for text, not images; and the definition of an 'article' is sometimes inconsistent in the earlier period.

⁶⁴ Finance Committee report to Council, RS CMP/2, 14 Jan. 1847.

⁶⁵ Harrison & Sons were appointed on 7 Jun. 1877, RS CMP/4. Scant details of the tender process survive in the minutes of the Library Committee for 1876-77, RS CMB/47/3, supplemented by RS CMP/4, 26 Oct. 1876. See also 30 Nov. 1876. Among the unsuccessful were Taylor & Francis, and Eyre & Spottiswoode.

⁶⁶ Evans to Kelvin, 23 Apr. 1894, recorded in RS CMP/7, 26 Apr. 1894.

⁶⁷ Evans to Kelvin, 23 Apr. 1894, recorded in RS CMP/7, 26 Apr. 1894.

⁶⁸ The Basire family are in ODNB. The third James Basire died in May 1869. He had been paid £75 for engraving and lithography on 15 Apr. 1869, RS CMP/3.

⁶⁹ RS CMB/86/A, 12 Dec. 1846.

⁷⁰ Evans reported, 26 Apr. 1894, RS CMP/7.

⁷¹ Council approved, 6 Dec. 1894, RS CMP/7.

⁷² RS CMP/7, 26 Apr. 1894. This was to be done before the paper had been accepted for reading before the Society.

⁷³ RS CMP/7, 6 Dec. 1894.

⁷⁴ RS CMO/4, 19 Mar. 1751/2.

⁷⁵ RS DM/1/112.

⁷⁶ RS CMO/4 19 Mar. 1751/2.

⁷⁷ RS Miscellaneous Manuscripts [hereafter MM] MM/3 f.65, 30 Nov. 1798. Wilkinson wanted the 1791 volume, having been abroad at the time. The Council insisted that, even so, he had plenty of time to claim within the 5 year deadline, RS CMO/8, 20 Dec. 1798.

⁷⁸ RS CMO/5, 15 Jul. 1767 (375 copies for bookseller, 375 for Society); RS CMO/6, 9 Jul. 1772 (400 copies for Society); RS CMO/7, 11 Mar. 1779 (350 copies for bookseller).

⁷⁹ The print run was 750 copies in 1766: RS DM/1/101 (10 Jul. 1766), and RS DM/1/112 (18 Jul. 1766). 850 copies in 1787: RS CMO/7, 20 Dec. 1787, p.289. 1000 copies when Bulmer took over: RS CMO/8, 22 Dec. 1791. 750 copies in 1808, RS CMO/8, 11 Feb. 1808.

⁸⁰ 1000 copies when Taylor took over: RS CMO/10, 28 Feb. 1828. Reduced to 800 in 1898, RS CMP/7, 20 Jan. 1898.

⁸¹ This arrangement lasted from 1682-1687. RS Account Books [hereafter AB] AB/1/1/2 (1682); and T. Birch, *The history of the Royal Society of London for improving of natural knowledge, from its first rise. In which ... papers ... hitherto not ... published, are inserted in their proper order, as a supplement to the Philosophical Transactions by Thomas Birch* (London: A. Millar, 1756-57), IV, pp. 170-1.

⁸² RS CMO/4, 4 Jul. 1750 and 18 Jan. 1753.

⁸³ RS CMO/4, 17 Nov. 1753, and 17 Nov. 1757 ('into their own hands').

⁸⁴ RS CMO/4, 25 Jun. 1761 (BM, and the universities) and 12 Dec. 1765 (the King). On earlier gifts to the king, see A. Johns, *Nature of the Book*, *op. cit.* (note 7), 493.

⁸⁵ Undated circulation figures [before 12 Feb. 1846], RS CMB/86/A.

⁸⁶ Finance Committee, RS CMB/86/A, c.1846.

⁸⁷ RS CMB/47/3, 1 Jun. 1875.

⁸⁸ From 1897, the list of institutions was printed in the *Year-Book of the Royal Society*.

⁸⁹ The 1847 financial review set aside £250 a year for library purchases and a further £150 for binding, RS CMB/86/A, 4 Jan. 1847. The annual accounts show that the library expenditure

was actually below £300 a year until the end of the century. The Society's library holdings enabled it to take the lead on the *Catalogue of Scientific Papers*.

⁹⁰ RS CMO/8, 15 Jul. 1802.

⁹¹ A. Csiszar, 'Seriality and the Search for Order: Scientific Print and Its Problems during the Late Nineteenth Century', *History of Science* 48, 399-434 (2010).

⁹² RS CMP/5, 21 Mar. 1878.

⁹³ Exceptions (from the 1908 *Year-Book*) include Durham, St Andrews, Maynooth and Edinburgh (several copies went to Edinburgh but not to the university).

⁹⁴ RS CMO/4, 27 Mar. 1751/2. In 1752, as well as a cut of sales, Davis also received a 20% commission for collating the printed sheets and stitching them into wrappers prior to delivery to the Society or sale. By 1772, but probably by the late 1760s, this had become part of the printer's role, see RS CMO/6, 9 Jul. 1772.

⁹⁵ RS CMO/4, 11 Dec 1755 notes the appointment of Davis & Reymers as 'Printers to this Society' (even though they appear not to have been doing the printing).

⁹⁶ On discounts, see RS CMO/4, 27 Mar. 1751/2 (proposal for 25%), RS CMO/5, 15 Jul. 1767 (40%), RS CMO/7, 24 Feb. 1780 (15%). On the eighteenth-century book trade, see J. Feather, *A History of British Publishing* (London: Routledge, 1988); J. Raven, *The Business of Books: Booksellers and the English Book Trade 1450-1850* (New Haven: Yale, 2007).

⁹⁷ The relevant documents are RS DM/1/101 (10 Jul. 1766), which include an outline proposal from Davis; and RS DM/1/112 (18 Jul. 1766), which is a more detailed proposal. Davis & Reymers proposed to offer the Society either 300 copies at a negotiated price per issue, or at a set price of 4s.6d. regardless of length. The latter arrangement would have seen the Society paying £67.10s. for its copies; Council minutes in the early 1760s suggest that the Society was usually out of pocket on the *Transactions* by at least £120 per volume.

⁹⁸ Davis & Reymers account, 24 Nov. 1765, RS DM/1/102.

⁹⁹ RS DM/1/112. Davis & Reymers did buy the stock; the payment is recorded in RS AB/1/1/11.

¹⁰⁰ RS CMO/8, 4 Feb. 1802.

¹⁰¹ Fellows could have them for a third of the retail price, RS CMO/10, 5 Jun. 1824. There was a further disposal effort (down to 20 copies) in 1828, RS CMO/10, 24 Apr. 1828.

¹⁰² G. Nicol retired in 1825 and died in 1828. His son continued the bookselling business as G. & W. Nicol, but he lost the printing contract in February 1828. Council decided to have no bookseller on 14 May 1829, RS CMO/11. No reason was stated.

¹⁰³ For Taylor handling sales, see, for instance, entries for 1835 in the Taylor 'Income and Expense Account, 1835-55' [held in the Taylor & Francis archive, St Bride's Printing Library]. The *English Catalogue of Books 1863-72* (London: Sampson & Low, 1873), 435 lists Taylor & Francis as the distributor. In the 1890s, *English Catalogue of Books 1893* (London: Sampson & Low, 1894), 134 gives 'Burlington House', rather than Harrison & Sons the printer; but the Society's ledgers do record sales income received from Harrison.

¹⁰⁴ RS CMP/8, 11 Jul. 1902.

¹⁰⁵ Undated circulation figures [before 12 Feb. 1846], RS CMB/86/A.

¹⁰⁶ 'Overview of Royal Society income from the *Transactions* to 1765' [covering 1752 to 1765], undated document, RS DM/1/105. The Society received £965 from the 8 volumes published in these years. The average retail price was just over 10s., and the bookseller's commission might have been 15%.

¹⁰⁷ The sales income from publications is given in the annual accounts (printed in *Proceedings* each November). Income from *Proceedings* is amalgamated with that for *Transactions*; and it includes sales of all volumes during that year (not just the volume published in that year), which makes it non-trivial to divide by the known retail price of that year's volume. The trade discount at the time is unknown.

¹⁰⁸ Undated circulation figures [before 12 Feb. 1846], RS CMB/86/A. The figures cover the years 1835 to 1844, so presumably date from 1845 or early 1846.

¹⁰⁹ RS CMP/7, 26 June 1895 (Rayleigh to Treasury). Although, on the late survival of country-house physics, see S. Schaffer, 'Physics Laboratories and the Victorian Country House' In: C. Smith, J. Agar, editors. *Making Space for Science: Territorial Themes in the Shaping of Knowledge* (Basingstoke: Macmillan, 1998). p. 149–80.

¹¹⁰ For instance, the parts of *Philosophical Transactions* for 1870 cost £3.8s. in total; and £3.15s. in 1871 (from S. Low, editor. *The English Catalogue of Books*. (London: Sampson Low, 1863-1914), vol. 2, p.435.

¹¹¹ RS CMP7, 26 June 1895 (Rayleigh to Treasury)

¹¹² The split was proposed on 18 March 1886, and finally approved on 2 Feb. 1887, RS CMP/6. The split was followed by a reorganisation of the institutional distribution lists, see Report of Library Committee, recorded in RS CMP/6, 21 Jun. 1888. Like individuals, many institutions wanted a particular series of the *Transactions*, but not both; and this may have enabled the print run to be reduced without significantly diminishing the number of beneficiaries, see RS CMP/7, 20 Jan. 1898.

¹¹³ On *Chemical News*, see W.H. Brock, 'The making of an editor: The case of William Crookes' In: L. Henson, G. Cantor, S. Shuttleworth, editors. *Culture and Science in the Nineteenth-Century Media* (Aldershot: Ashgate, 2004). p. 189-98.

¹¹⁴ Trübner was allowed a 10% discount, RS CMP/4, 17 Jun. 1875. On Trübner (later part of Kegan Paul), see L. Howsam, *Kegan Paul, a Victorian Imprint: publishers, books and cultural history* (Toronto: University of Toronto Press and Kegan Paul International, 1999).

¹¹⁵ RS CMP/5, 24 May 1883. The Library Committee had originally proposed making 50 copies available for sale, RS CMP/4, 18 Mar. 1875.

¹¹⁶ *English Catalogue of Books* (London: Sampson Low, 1893), p.103. In 1894, the separate copy business was transferred to Dulau, see RS CMP/7, 25 Oct. 1894.

¹¹⁷ The Camden Society had a similar problem: all seemed well when it had a thousand members, and a print run of just over a thousand; but things went much less well when membership fell to just a few thousand. See Johnson, *op. cit.* (note 19), especially pp. 35-37.

¹¹⁸ RS CMP/7, 1 Nov. 1894.

¹¹⁹ This was still true in the 1970s, see RS AB/2/20/3 Publications Account to 28 February 1977.

¹²⁰ *Record, op. cit.* (note 23), p.197.

¹²¹ The Publication Fund was created in June 1878, see RS CMP/5, 27 Jun. 1878. It does not feature in *Record, op. cit.* (note 23).

¹²² RS CMP/7, 20 Jun. 1895.

¹²³ RS CMP/7, 20 Jun. 1895.

¹²⁴ RS CMP/7, 20 Jun. 1895.

¹²⁵ R.M. MacLeod, 'The Royal Society and the Government Grant: Notes on the Administration of Scientific Reserach, 1849-1914', *Historical Journal* 14:(2), 323-58 (1971), p. 351.

¹²⁶ RS CMP, 16 Feb 1899.

¹²⁷ In 1930, just over £1,500 was granted to other societies, and £1000 supported the Royal Society's publications. See the financial statement in *Year-Book of the Royal Society* (London, 1930), p. 185.

¹²⁸ The twentieth-century story of the Royal Society's publishing finances will be the subject of a future paper.

¹²⁹ The development of refereeing after 1832 is currently being investigated by both Alex Csiszar and Julie McDougall-Waters. I am grateful to them for letting me read their unpublished research, including A. Csiszar, *The Rise of the Scientific Journal in Nineteenth-Century France and Britain* (forthcoming). See also Baldwin's paper in this special issue, M. Baldwin, 'Credibility, peer review, and Nature, 1945-1990', *Notes & Records of the Royal Society* (2015).

¹³⁰ On Nicholson, see I. Watts, 'We Want No Authors': William Nicholson and the Contested Role of the Scientific Journal in Britain, 1797-1813', *British Journal for the History of Science* 47:(3), 397-419 (2014).