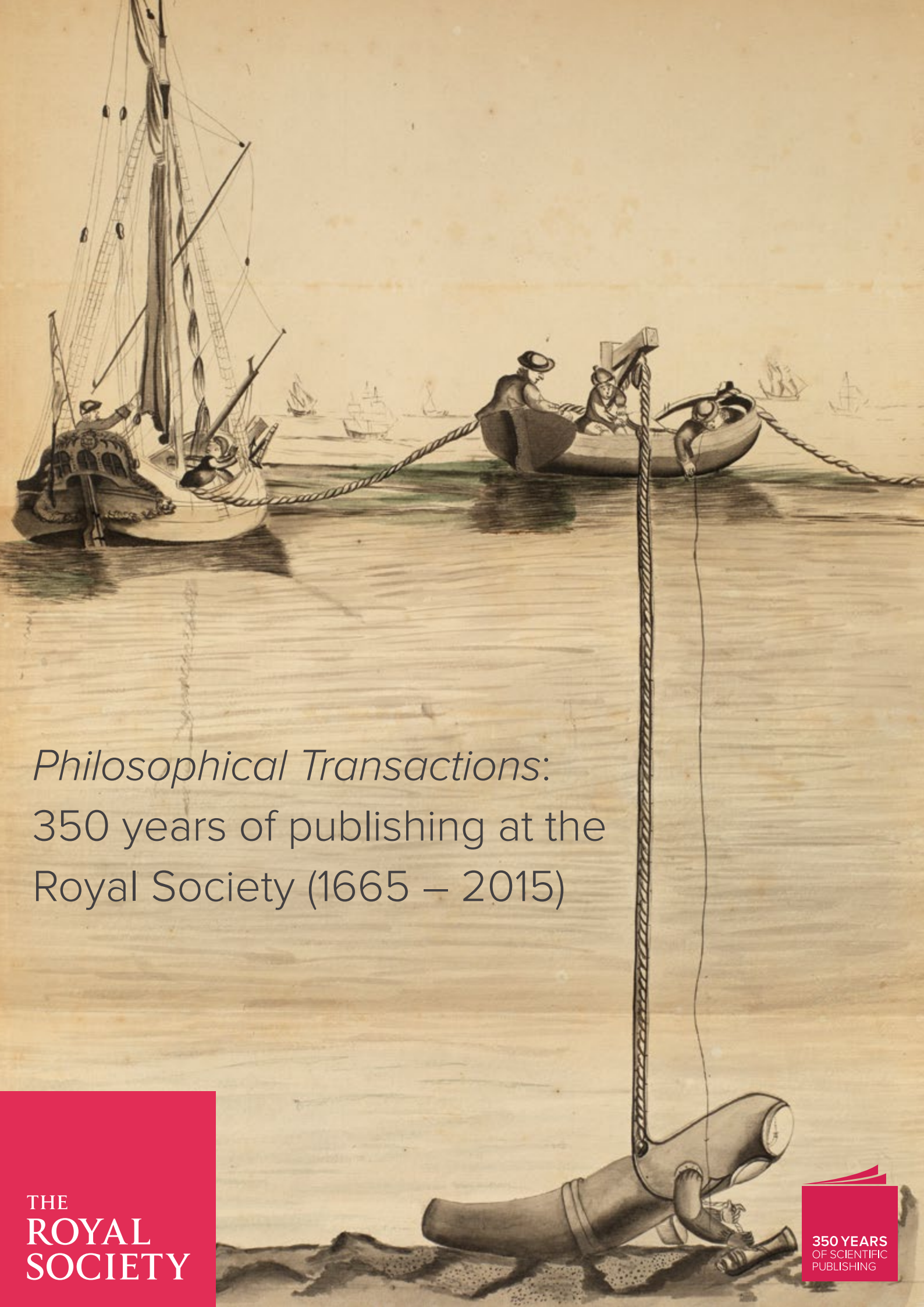

Philosophical Transactions: 350 years of publishing at the Royal Society (1665 – 2015)

THE ROYAL SOCIETY

350 YEARS OF SCIENTIFIC PUBLISHING

Curated by

Julie McDougall-Waters, Noah Moxham and Aileen Fyfe.

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Cover
A drawing of William Barlow's underwater diving apparatus submitted to *Philosophical Transactions* in 1736

Foreword from the president

Among the Royal Society's many and varied contributions to the development of modern science, one of the most lastingly important was quietly announced in an ordinary meeting in February 1665. The first publication of the *Philosophical Transactions*, whose 350th anniversary the Society is celebrating throughout this year, had a range of implications as staggering as many of the world-altering papers that would later appear in its pages – by Robert Boyle, Isaac Newton, Gottfried Leibniz, Christiaan Huygens, Edmond Halley, Benjamin Franklin, Henry Cavendish, William and Caroline Herschel, Humphry Davy, Charles Darwin, Michael Faraday, James Clerk Maxwell, John Tyndall, Alan Turing, Dorothy Hodgkin, and Stephen Hawking, among a galaxy of others.

What began as a labour-saving device, dreamed up by Henry Oldenburg as a means of simplifying the Society's correspondence and perhaps making a little money on the side, initiated an entirely new genre – the scientific journal, a form of print whose flexibility, diversity of content, and speed of transmission immediately captured the imagination of 17th-century natural philosophers and sparked a revolution in the communication of their work.

With the Royal Society's encouragement, *Philosophical Transactions* outlived the founding editor, then the one after and the one after; and in some respects it is the very longevity we celebrate this year that has helped to make its lasting impact. Men (and later women) of science, eager to see their discoveries published rapidly and to secure the credit for their inventions, gradually began to adapt their writing to the requirements of the periodical form. The journal also embodied and projected the *collective* enterprise of science, right from the beginning. Since its inception it has encouraged others to replicate, test and extend the work it contains, and it has been instrumental in the development and establishment of peer review – a system of guaranteeing methodological rigour, good practice and good faith in science that has underpinned its progress.

Philosophical Transactions has carried the Society's face to the world for 350 years. During that time it has been joined in the scientific firmament by 30,000 other periodicals – perhaps the greatest testament to its lasting importance is the spectacular extent to which it is no longer unique. Yet the Royal Society and its publishing division, including *Philosophical Transactions* and its stablemates – the seven other journals published today – continue to be at the forefront of debates about science publishing in an ongoing communication and information revolution.

As we enter the anniversary year, the Royal Society looks forward to an exciting series of events which will use findings from the history of our journal to stimulate and inform discussions of the future of scholarly publishing. The Royal Society values its history, not simply as the mark of a distinguished past but as an abiding challenge to innovate and discover both now and in the future, and is committed to its preservation and promotion – and the events of the next year will give both Fellows and the general public the opportunity to observe it in action.

Paul Nurse

Paul Nurse

President, Royal Society

From Oldenburg to online access

The Society began to feel more urgently the pressure from the proliferation of scientific journals, and to worry about the commercial position of the *Transactions*, and not just its prestige.

Philosophical Transactions, the world's first and longest-running scientific periodical, began life in 1665. Though always associated with the Royal Society of London in the minds of its readers, it was in fact the initiative and personal property of the Society's first Secretary, Henry Oldenburg, who drew on the Society's activities, his own prodigious network of natural-philosophical contacts, and his considerable skills as a linguist to produce the material that became the *Transactions*. The early journal consisted of letter-excerpts, reviews and summaries of recently-published books, and accounts of observations and experiments from European natural philosophers. After Oldenburg's death, *Transactions* passed through the hands of a series of subsequent editors, usually also Secretaries of the Society (some of them, such as Edmond Halley or Hans Sloane, very well-known to the annals of science), and a succession of printers. During this time – up to 1752, when the Royal Society took over financial responsibility for it – the form and content of the journal altered in ways that broadly reflected the priorities of the various editors, and to some extent those of the Society as well.

After the Society's takeover, the contents of the *Transactions* were more closely tied to the contents of the Society's meetings, and the Society (rather than the editor personally) bore the costs of publication. Over the following century, the processes for submission and evaluation were gradually formalised, including more systematic reviewing of papers by the middle of the nineteenth century. Although editorial responsibility had been transferred to a Committee of Papers, the stamps of individual editors did not completely disappear. Despite the emergence of numerous specialist disciplinary journals during the nineteenth century, the *Transactions* remained a determinedly generalist publication until 1887, when it was finally split into two series, 'A' and 'B', for the physical and biological sciences respectively.

Despite a growing desire from scientists to get their work into print as quickly as possible, *Transactions* continued to appear just twice a year. (Authors in a rush could publish shorter articles in the Society's monthly *Proceedings of the Royal Society*, which had, since 1832, been printing abstracts of papers presented to Royal Society but from 1893 began to carry short articles.) *Transactions*, and *Proceedings*, continued to cost the Society money; but from the 1890s, new efforts were made to limit the extent of this drain on Society resources. The Society began to feel more urgently the pressure from the proliferation of scientific journals, and to worry about the commercial position of the *Transactions*, and not just its prestige.

It was only in the middle of the twentieth century that the journal's income became to exceed expenditure, and learned society publishing started to be considered as an income stream rather than a charitable expenditure. The Society's Committee of Papers was finally abolished in 1989, when individual Fellows were given editorial responsibility, supported both by editorial advisory boards, and by the Society's staff of professional publishers and editorial assistants. The journal first went online in 1997, and the entire back issue archive to 1943 has been freely available since 2010.

Left
Heinrich (Henry) Oldenburg, the Society's first Joint Secretary and mastermind behind the *Philosophical Transactions*.

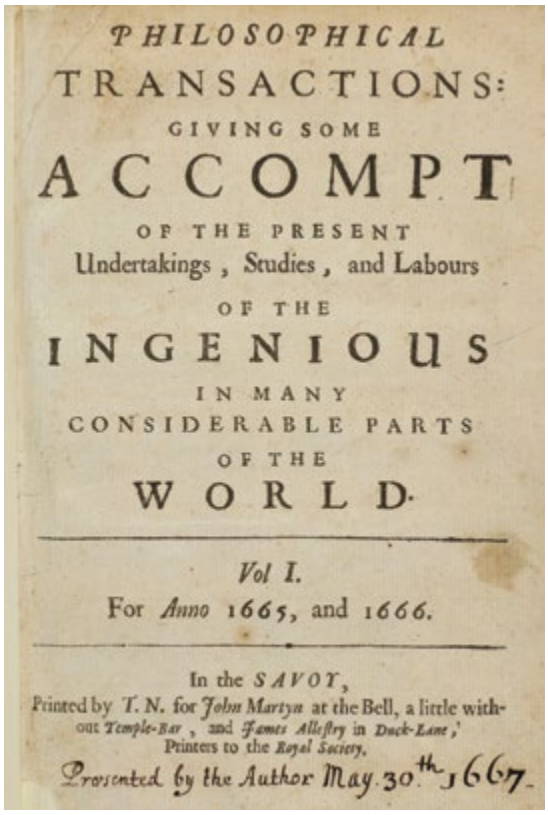
Above
Royal Society Open Science, the Society's newest journal was launched in September 2014.

Philosophical Transactions: Giving some Accompt of the Present Undertakings, Studies and Labours of the Ingenious in Many Considerable Parts of the World (to allow it its full title) began life in 1665 as the personal venture of the Royal Society's industrious first Secretary, Henry Oldenburg.

Beginnings of the *Philosophical Transactions*

Born in Bremen around 1619, Oldenburg was educated in his home town and subsequently, though less formally, at Utrecht and Oxford. He perfected his English – which John Milton complimented as the best he had ever heard from a foreigner – through a series of appointments as tutor to the sons of English noblemen, most recently to Richard Jones, Robert Boyle's nephew, and a couple of diplomatic missions as Bremen's envoy to Oliver Cromwell, England's Lord Protector. By 1660, he was settled in London.

When the inaugural meeting of what was to become the Royal Society was held at Gresham College in late November 1660, many of Oldenburg's philosophical friends and acquaintances were in attendance, and he was proposed as a member the next month. The constitution of the Society wasn't formalised until the grant of its first Charter in 1662, but at that point Oldenburg's vast acquaintance among the intellectuals and natural philosophers of Europe, coupled with his considerable skills as a linguist – he wrote English, Dutch, French, German, Italian and Latin with virtually interchangeable fluency – made him a natural choice for the post of Secretary, with the Society's correspondence as his particular responsibility.


PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOMPT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD.
Vol I.
For Anno 1665, and 1666.
In the SAVOY,
Printed by T. N. for John Martyn at the Bell, a little without Temple-Bar, and James Allestry in Duck-Lane,
Printers to the Royal Society.
Presented by the Author May. 30th. 1667.

By the summer of 1664 Oldenburg was adapting his two previous roles, as a tutor to noble families and as secretary to the Society, into a new money-making scheme. He told Robert Boyle, whom he now assisted as editor and translator of Boyle's chemical works, that he proposed to start a subscription service; a (manuscript) letter of 'weekly intelligence, both of state and literary news,' for which he hoped Boyle would be able to suggest willing subscribers. Shortly thereafter news came of the launch of the *Journal des Sçavans* at Paris, a printed weekly containing reviews of books on theology, history, medicine, and natural philosophy. Oldenburg had been contacted by the authors of the French periodical and invited to supply accounts of new books and other goings-on in the world of English learning; he brought a copy of an early issue into a meeting of the Society, along with what was described as 'a sample' of a similar project, 'but much more philosophical in nature'. This was a draft, or perhaps a proof copy, of the first issue of *Philosophical Transactions*.

Oldenburg acted as both compiler and publisher, though the journal was licensed by the Royal Society, whose Charters included the right to license books for publication on its own authority. The Society's first official printers were John Martyn and James Allestree, and the first issues of the

Left
The first volume of *Philosophical Transactions*, for years 1665 – 1666.

136

The number of issues of the *Transactions* put out by Oldenburg before his death in 1677.

Transactions came out under their imprint. These early issues consisted of adapted bits of Oldenburg's correspondence, accounts of books that had come his way (at first or second hand), and reports of experiments carried out in the Royal Society and elsewhere. The expense of the project was Henry Oldenburg's alone. The retail price of a monthly issue was fixed at one shilling – steep, for a pamphlet of two or three sheets – and the print run was probably quite large. We know it was negotiated at 1000 copies in mid-1665 – Oldenburg was hoping for 1250 – and he took 50 copies himself for distribution to his correspondents. Oldenburg thought he would break even if he sold 300 copies, indicating production costs of £15 per issue. Sales of 500 would thus afford printer and publisher a profit per issue of £5 each: not handsome, but not entirely negligible either.

By the time of Oldenburg's death in 1677 he had put out 136 issues of the *Transactions*, but not without some bumps along the way: publication was interrupted by the plague of 1665, the Great Fire of 1666, and the second Anglo-Dutch war of 1667 (when Oldenburg was briefly imprisoned in the Tower of London when his continuing scientific correspondence with Dutch colleagues led to his arrest on suspicion of passing information to the enemy). A rival publisher, or quite possibly Martyn himself, exploited his incarceration by putting out what purported to be the next number of the journal; Oldenburg denounced the piracy in the next issue he published after his release. Though there was no formal submission process, and much of the language of the journal is Oldenburg's, his correspondents would occasionally ask, directly or indirectly, if their contribution might be printed. Oldenburg sometimes asked for permission to print a letter, but more often he took it for granted that in sending him their communications, scholars were giving him their tacit permission to share them with the Royal Society and beyond. Most of the content appeared in English, either because it originated in English or because Oldenburg had rendered it that way, although many astronomical papers and some mathematical ones remained in Latin. Oldenburg secured contributions from most of Britain and Europe's leading natural philosophers, including Isaac Newton, Robert Boyle, Christopher Wren, and Robert Hooke, as well as the astronomers Johannes Hevelius, Giovanni Domenico Cassini and Adrien Auzout, the Dutch pioneer of microscopy Antoni van Leeuwenhoek, and the mathematicians Christiaan Huygens, Jacob Bernoulli and Gottfried Leibnitz, among numerous others. Oldenburg never succeeded in gaining his living from the *Transactions* – the most it had ever done, he noted in 1668, was to cover the rent on his house in Piccadilly – but it soon became an entrenched part of the European Republic of Letters and, by the time of his death, it had no direct rival, European or English.

Right
In 1667 England was at war with the Dutch Republic. Suspected of passing information to the enemy, Oldenburg was interred in the Tower of London, providing the opportunity for a rival to produce this 'pirate' issue number 27.

A LETTER

Concerning a new way of curing ſundry diſeaſes by Transfuſion of Blood, Written to Monſieur de MONTMOR, *Counſellor to the* French King, *and Maſter of* Requeſts.

By J. DENIS *Profeſſor of* Philoſophy, *and the* Mathematicks.

Munday July 22. 1667.

SIR,

THE project of cauſing the Blood of a healthy animal to paſſe into the veins of one diſeaſed, having been conceived *about ten years agoe*, in the illuſtrious Society of *Virtuoſi* which aſſembles at your houſe; and your goodneſs having received M. *Emmeriz*, & my ſelf, very favorably at ſuch times as we have preſum'd to entertain you either with diſcourſe concerning it, or the ſight of ſome not inconſiderable effects of it: You will not think it ſtrange that I now take the liberty of troubling you with this Letter, and deſign to inform you fully of what purſuances and ſucceſſes we have made in this Operation; wherein you are juſtly intitled to a greater ſhare than any other, conſidering that it was firſt ſpoken of in your *Academy*, & that the Publick is beholding to you for this as well as for many other diſcoveries, for the benefits & advantages it ſhall reap from the ſame.

But that I may give you the reaſons of our procedure & con-

The Royal Society's takeover

Hans Sloane reckoned that in the course of nearly twenty years as the journal's editor he had spent £1500 on producing it – a very substantial sum in a period where a labourer's wage was around £15 a year.

By the mid-eighteenth century, *Transactions* no longer enjoyed a unique position, but had proved itself extremely resilient. Almost 90 years old, it was approaching its 50th volume and 500th issue and passed through the hands of ten different editors – besides Oldenburg, the most notable were Edmond Halley, Hans Sloane, James Jurin and Cromwell Mortimer. In virtually all cases the journal was edited by a serving Secretary of the Society (and occasionally by both Secretaries working in tandem). These tenures weren't always smooth or uninterrupted, and the status and responsibilities of the Secretary were much debated during this period. They seem always (unofficially) to have included editing the *Transactions*, however. The Society had become keenly aware of how much of its early reputation had depended on Oldenburg's journal, and while not apparently willing to assume responsibility for it, was anxious that it shouldn't wither away either.

These editor-secretaries continued to bear the financial burden of publishing the *Transactions*. Though the Society had no right to order these men to spend their own money on putting out the journal, it nevertheless continued to expect them to do so. Hans Sloane reckoned that in the course of nearly twenty years as the journal's editor he had spent £1500 on producing it – a very substantial sum in a period where a labourer's wage was around £15 a year. Sloane could comfortably afford it: he was a fabulously wealthy man by the standards of the age, and most of the other editor-secretaries died in possession of substantial estates or left significant bequests to the Royal Society. In general, the early Royal Society was never short of rich Fellows, able and apparently willing to carry it financially; and when the institution finally took over the *Transactions* in 1752, it wasn't because it was better able to shoulder the expense.

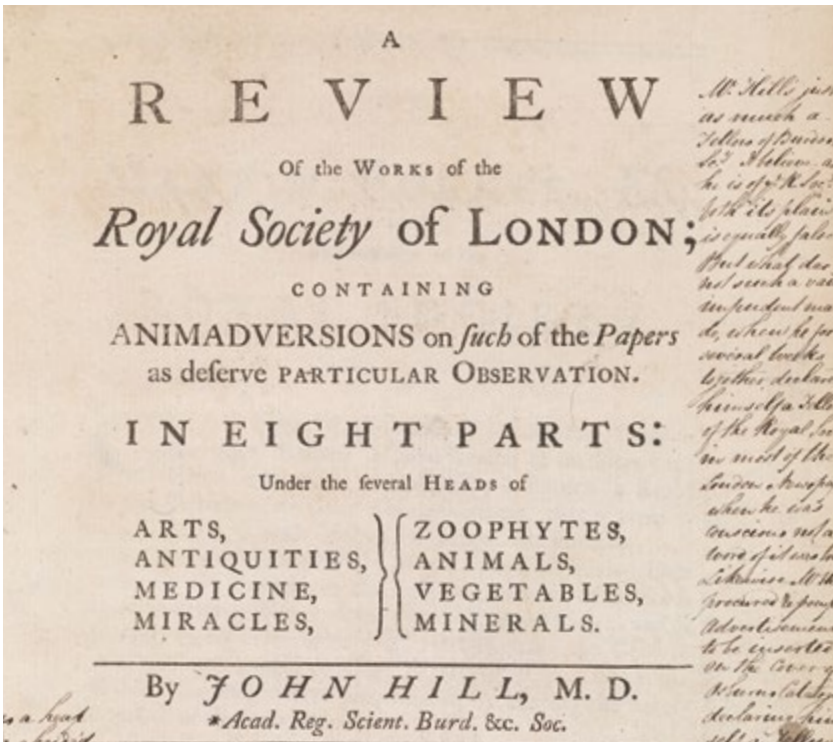
Philosophical Transactions had survived into the mid-eighteenth century, but it was experiencing something of a crisis by around 1751, with the Society as a whole feeling peculiarly vulnerable around this time. Expenditure had regularly begun to exceed income in the late 1730s; the President, Martin Folkes, was too ill to have much to do with the Society any more; the Secretary, Cromwell Mortimer, had fallen two years behind in the publication of the *Transactions*; and the journal itself had come under biting satirical attack by John Hill, an actor, apothecary, and naturalist who had been bitterly disappointed in his hopes of being elected to the Society, and who took his revenge by publishing three works in two years ridiculing the Society and the *Transactions*. The Society was travestied as a noisy, undignified, backbiting, nepotistic vision of bedlam, the unfortunate Folkes as an idle, drooling epicure and a liar in his personal affairs, and the *Transactions* as a catalogue of futility, error, and triviality.

Hill's critique was not entirely fair: as the Society was quick to point out, it wasn't officially responsible for the *Transactions*. Neither, however, could it plausibly disavow the journal completely, and Hill's attacks gained force from the fact that the *Transactions* and the Society were inextricably linked in the minds of most contemporary readers. This wasn't simply a matter of association, but a widespread assumption that the journal came out with the Society's approval and under its supervision. Very soon after the appearance of Hill's satires, a knot of senior Fellows, led by Lord Charles Cavendish and the Earl of Macclesfield, George Parker, moved rapidly to have the journal taken over by the institution. The *Transactions* would henceforth be published "for the sole use and benefit of this Society"; they would be financially supported by the member's subscriptions; and they would be edited by a standing Committee of Papers

Left
Martin Folkes, President of the Society 1741 – 1752, as painted by Hogarth.

Bottom
John Hill's satirical *Review of the Works of the Royal Society* was one of the parodies that catalysed the reforms leading to the Society's takeover of the journal in 1752.

(in practice the Society's governing Council), who would vote in due order on each paper read before the Society – in dignified silence and by secret ballot, to avoid the imputation that any of the Committee's members had been bribed or coerced. Because the Fellows were now effectively paying for the journal's publication, they would each be entitled to a free copy of every issue. The remaining copies – a little over half the initial print run of 750 – would go on general sale through the Society's booksellers.



A

REVIEW

Of the WORKS of the

Royal Society of LONDON;

CONTAINING

ANIMADVERSIONS on *such* of the *Papers* as deserve PARTICULAR OBSERVATION.

IN EIGHT PARTS:

Under the several HEADS of

ARTS, ANTIQUITIES, MEDICINE, MIRACLES, } { ZOOPHYTES, ANIMALS, VEGETABLES, MINERALS.

By JOHN HILL, M. D.

Acad. Reg. Scient. Burd. &c. Soc.

Under Banks the work of the Committee of Papers had continued fairly efficiently, with the President himself in frequent attendance; at the same time, however, it became evident that there were a number of ways in which the President and Secretaries could bypass or subvert the Society's publishing procedures.

The Banks era

After the takeover of the *Transactions* by the Society, management decisions about the journal, including the business of negotiating with printers and booksellers, were still the preserve of one of the Secretaries, but editorial control was exercised through regular meetings of the Committee of Papers.

The transfer of responsibility had the predictable effect of tightening existing links between the journal and Society activity. Any paper read before the Society was automatically considered by the Committee of Papers: from a contributor's point of view, therefore, any communication to the Society was an implicit submission for publication. (An author did have the option of withdrawing his paper from consideration). Once a paper had been considered by the committee it might be accepted for printing, rejected, postponed to a subsequent meeting, or referred to a designated ordinary member of the Society for expert evaluation. This last only happened at the specific request of the Committee, but the reviewing of papers was thus written into the constitution of *Transactions* for the first time, even though seldom used in practice. The Committee mostly based its judgements on the 300 to 500-word abstracts of papers read to the Society that formed the minutes of its weekly meetings, although they could if they desired consult the original paper in full.

The Society's series of 'Archived Papers' for the late eighteenth and early nineteenth centuries – papers rejected for publication or, in certain instances, filed without being read – contain a striking proportion of foreign papers. The Society evidently no longer considered it part of its remit to represent European natural philosophy, perhaps because of the proliferation of learned societies in Europe with published proceedings and transactions of their own. It's equally evident that many of these papers were rejected not on chauvinist grounds but simply because they were a nuisance. Quite a lot of them are proposals for longitude solutions, perpetual motion machines, and squaring the circle. The Royal Society clearly had a sharp enough eye to the reputation of the journal, and the value of its own time, not to bother with them.

Once the decision to print had been taken, the paper appeared in the volume for that year – the practice of publishing monthly or quarterly issues had by this time been discontinued, and had to all intents and purposes ceased well before the Society assumed control. It would feature the author's name, the name of the Fellow who had communicated the paper to the Society, and the date on which it was read. The Society paid for paper, engraving and printing costs. Fellows were expected to sign for their copies in person – and one of the surviving signature-books contains a surprising subscription purporting to be 'His Royal Highness the Damn'd Bloody Devil, by Note from Himself'. The remaining copies were held by a bookseller, who sold them on 25% commission and settled up with the Society at the end of the year.

The Society found the journal to be a money-losing proposition; it cost, on average, upwards of £300 a year to produce, of which they seldom recouped more than £150. Because two-fifths of the copies were distributed for free to the journal's natural market, sales were generally slow, and although back issues sold out gradually it would usually be ten years or more before there were fewer than 100 left of any given print run. The problem was perhaps compounded by the fact that contributors were allowed to take off-prints of their papers for their own use; a Council decision of 1773 limits this to 100 copies (a strikingly high figure, given the likely size of the audience). Prices fluctuated with the size of the volume, from 7 shillings in some cases to £1 or more in others.

The Society found the journal to be a money-losing proposition; it cost, on average, upwards of £300 a year to produce, of which they seldom recouped more than £150.

Opposite
Joseph Banks, naturalist and the Society's longest-serving President (1778 – 1820) was a domineering force.

Part 2d for the year 1801.

11 Lord Hopetoun
12 Mr Moulton, by Mr Peacock
13 Mr Peacock
14 James Rein Esqr. p. Jas. Buckshanks Junr.
15 H. P. Wyndham
16 Baron Maseres Esqr by J. White P. Stevens
17 Charles Hatchett.
18 [illegible]
19 [illegible]
20 Warren Hastings.
21 C W Gray
22 J Rennell
23 Chas. Wilkins
24 Chas. Wilkins for J L Williams Esq.
25 Palmerston
26 John Romney
27 Wm Marsden
28 John Crisp by Wm
29 Library at Gottingen by Geo: Best
30 Geo: Best.
31 Dr Thomas Young
32 Fran. Wollaston
33 Griffin Wilson
34 George Shaw.
35 His Royal Higness the Dam'd bloody Devil
Bynote from himself

Transactions continued steadily under its new dispensation through the turn of the century and into the 1820s. By that time the Society was just emerging from the very long shadow cast by the Presidency of Sir Joseph Banks, whose 42-year tenure had vastly expanded the role of science in the realm of public policy but had not been free of controversy. Presidential influence on the election of Fellows, Officers, and appointments to the Council had been very strongly felt and, on several occasions, publicly resented, and his practical control of Royal Society publishing was no different. Under Banks the work of the Committee of Papers had continued fairly efficiently, with the President himself in frequent attendance; at the same time, however, it became evident that there were a number of ways in which the President and Secretaries could bypass or subvert the Society's publishing procedures. Though papers were rarely subjected to formal review there is more evidence of editorial intervention in this period, with Banks himself or a trusted deputy proposing cuts or emendations to particular contributions entirely on his own authority. Papers could be prevented from ever reaching the Committee by not allowing them to be read in the first place. There was also a strong process of informal evaluation, with papers often passed around the social gatherings that Banks frequented for comment and criticism before they were brought into the Society or considered for publication. Publishing in the *Transactions* still carried a high degree of prestige and Banks himself attributed an attempt to unseat him, relatively early in his Presidency, to the envy of prospective authors whose papers had been rejected from the journal.

Dissatisfaction with this state of affairs was one of the chief motives of the reform movement in the Royal Society in the late 1820s and early 1830s. The reformers felt that the scientific character of the Society had been undermined by the admission of too many gentleman dilettantes under Banks (who were, in turn, all too willing to do Banks's bidding). In proposing a more limited membership, to protect the Society's reputation, they also argued for systematic, expert evaluation of papers for *Transactions* by named referees. These proposals, put forward in 1827, were quietly shelved by the Council, but many of their recommendations were implemented over the next twenty years. Sectional Committees, each with responsibility for a particular group of disciplines, were initially set up in the 1830s to adjudicate the award of George IV's Royal Medals. But individual members of these Committees were soon put to work reporting on and evaluating papers submitted to the Society, and these evaluations began to be used as the basis of recommendations to the Committee of Papers, who would then rubber-stamp decisions made by the Sectional Committees. Despite its flaws – it was inconsistent in its application and not free of abuses, as occasional detractors pointed out – this system remained at the heart of the Society's procedures for publishing until 1847, when the Sectional Committees were dissolved; the practice of sending most papers out for review remained, however.

The reformers of the 1820s proposed a more limited membership, to protect the Society's reputation; they also argued for the systematic, expert evaluation of papers for the *Transactions* by named referees.

Opposite
Fellows had to sign for copies of the journal. The signature-book bears the mark of an unexpected subscriber: 'His Royal Highness the Damn'd Bloody Devil, by Note from Himself'.

Printing text and image

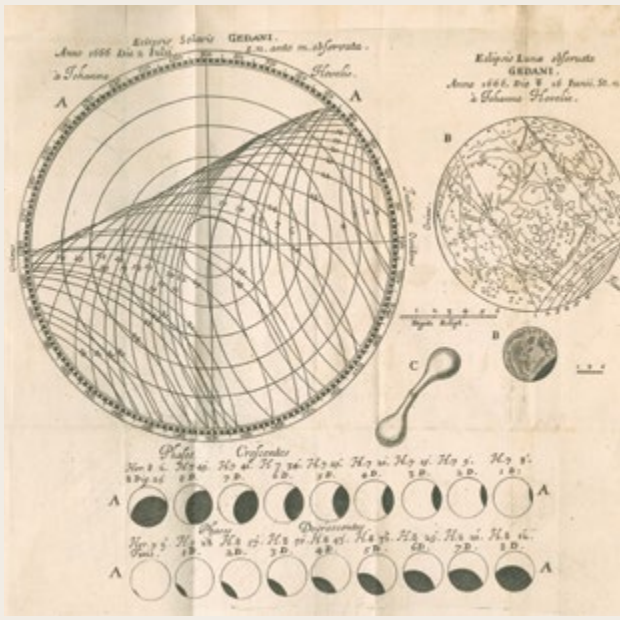
It was not until later in the nineteenth century that engravings gave way to other illustrative techniques, starting with lithography and then, in the 1880s and 1890s, photo-mechanical printing techniques.

By the 1820s, printing was being handled by William Nicol, whose shop was on St James's Street in Piccadilly. The Society took the quality of printing in the *Transactions* very seriously indeed. In 1827 Nicol was summoned for a dressing-down about the shoddiness of his work, which the Society denounced as expensive, error-strewn, and slow; his response was to resign the office of Printer to the Society, and the Committee put the job out to tender. Richard Taylor was rapidly chosen to succeed him.

Back in 1814, Taylor had been one of the backers of Friedrich König's new steam-powered printing machine, which revolutionised the production of newspapers and cheap print. He subsequently made his name by printing the transactions and administrative papers of numerous London learned societies, including those of the Royal Society from 1828. In addition to this contract printing, he developed a list of scientific journals, including *Philosophical Magazine*, *Annals of Natural History* and *Chemical Gazette*. With his scholarly connections, business skills and a good print-shop, Taylor seemed to disprove the cliché that scientific journal publishing was necessarily difficult and unprofitable. Though part of the Royal Society committee's brief was to reduce the cost of printing, Taylor wasn't the cheapest of the options presented to them; he seems to have represented a good compromise between quality and cost, however, and his firm – later Taylor & Francis – kept the contract for fifty years, as well as securing the custom of many other London learned and scientific societies.

Illustrations had been a natural and essential aspect of the scientific periodical since the later seventeenth century. Engravings (cut into metal plates) were used for detailed illustrations, particularly where realism was required; while wood-cuts (and, from the early nineteenth century, wood-engravings) were used for diagrams, as they could be easily combined with letterpress. From 1770, the vast majority of the engraved plates for the *Transactions* were produced in the Basire workshop. The Basire family included several generations of engravers and printmakers, and they would hold the post of engravers to the Society for more than sixty years. It was not until later in the nineteenth century that engravings gave way to other illustrative techniques, starting with lithography and then, in the 1880s and 1890s, photo-mechanical printing techniques. These new techniques enabled images to be reproduced without the aid of an intermediary (such as an engraver), and marked a fundamental shift in the relationship between the production of scientific evidence and its reproduction in images and words (whereby the image is given greater authority). Despite the technological transformations in printing in the first half of the nineteenth century, usually associated with mass market cheap print, the average cost of producing the *Transactions* gradually crept up between 1770 and the mid-1820s (apart from a brief dip after 1800). It was never a publication for the masses, with the retail price of individual parts fluctuating from 7s.6d. to 30s. depending on length. There were also significant variations in the

total annual cost of the journal. Figures for the 1820s, including the costs of printing, engraving, paper, and stitching, vary between £600 at the low end and a very steep £1850 at the other extreme – figures that represent respectively 20% and 50% of the Society's average annual income. Expenditures on engraving at this time were particularly heavy – often the single largest item in the production costs, amounting in 1822 to almost £600, about a sixth of the Society's bank balance for that year. Taylor's appointment brought overall production costs steadily down over the next three decades.



Opposite
Richard Taylor won the tender to become Printer to the Society in 1828. His firm, later Taylor & Francis, retained this position until 1877.

Left
Red Lion Court, premises of Taylor & Francis.

Above
The style and techniques used to create images in the journal have changed dramatically over the centuries. Here, anticlockwise from right, a schematic of solar and lunar eclipses in a 1665 paper by Hevelius is followed by an image of the 1860 solar eclipse by Warren de la Rue, then a photograph from Dyson, Eddington and Davidson's 1920 paper, which offered them the opportunity to measure the deflection of light by the Sun's gravitational field. This phenomenon of light being bent by gravity was predicted by Einstein's theory of General Relativity only a few years earlier.

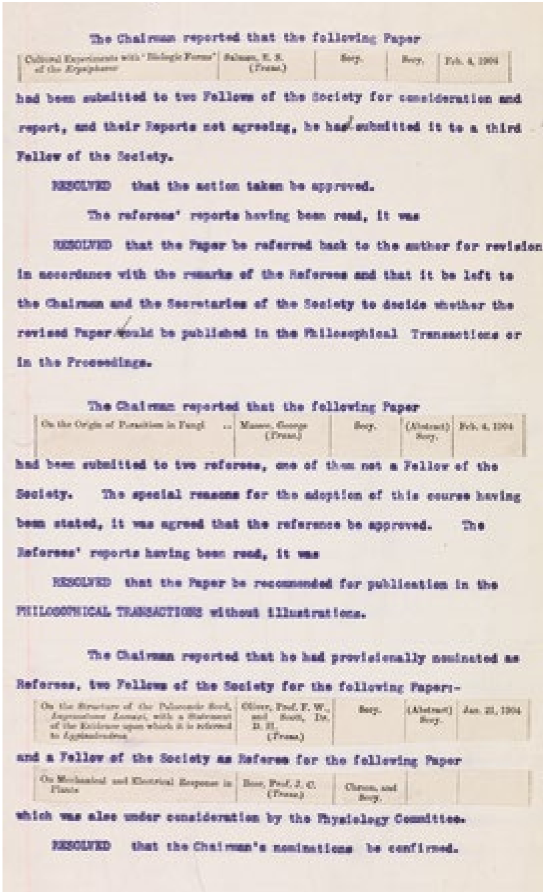
The *Transactions* and the professionalization of science

1000

The print run of the journal throughout the Taylor (& Francis) period, 500 of which went to the fellowship.

By the mid-1850s, the cost of the *Transactions* to the Society was increasing again (and would keep doing so for the rest of the century); illustrations were always the largest outgoing. The journal was coming to be seen as a drain on the Society's finances and the treasurer, Edward Sabine, urged the Committee of Papers to restrict the length and number of papers published in the journal. In 1852, for example, the amount expended on the *Transactions* was £1094, and only £276 of this was offset by sales income; Sabine felt this was more than the Society could comfortably sustain. The print run of the journal throughout the Taylor (& Francis) period was 1000 copies. Around 500 of these went to the fellowship, in return for their membership dues, and since authors now received up to 150 off-prints for free, to circulate through their personal networks, the demand for the *Transactions* through the book trade must have been limited.

In the mid-nineteenth century, the response to strained finances was an attempt to reduce production costs – there was little effort to generate more sales. Sabine suggested that the criteria for getting into the *Transactions* should be made stricter, so that more papers would be printed only in abstract in the Society's *Proceedings*, rather than in full in the *Transactions*. His suggestion had little impact, although the *Proceedings* did continue to act as support for the *Transactions* until the early twentieth century (when it became a research journal in its own right). The concerns with cost eventually led to a change in printer in 1877 from Taylor & Francis to Harrison & Sons – the latter was a larger commercial printer, able to offer the Society a more financially viable contract, although it was less experienced in printing scientific works.



The Chairman reported that the following Paper

Cultural Experiments with 'Biologic Forms' of the Erysiphaceae | Salmon, E. S. (Trans.) | Secy. | Secy. | Feb. 4, 1904

had been submitted to two Fellows of the Society for consideration and report, and their Reports not agreeing, he had submitted it to a third Fellow of the Society.

RESOLVED that the action taken be approved.

The referees' reports having been read, it was

RESOLVED that the Paper be referred back to the author for revision in accordance with the remarks of the Referees and that it be left to the Chairman and the Secretaries of the Society to decide whether the revised Paper would be published in the Philosophical Transactions or in the Proceedings.

The Chairman reported that the following Paper

On the Origin of Parasitism in Fungi .. | Massee, George (Trans.) | Secy. | (Abstract) Secy. | Feb. 4, 1904

had been submitted to two referees, one of them not a Fellow of the Society. The special reasons for the adoption of this course having been stated, it was agreed that the reference be approved. The Referees' reports having been read, it was

RESOLVED that the Paper be recommended for publication in the PHILOSOPHICAL TRANSACTIONS without illustrations.

The Chairman reported that he had provisionally nominated as Referees, two Fellows of the Society for the following Paper:-

On the Structure of the Palaeozoic Seed, Lagenostoma Lomaxi, with a Statement of the Evidence upon which it is referred to Lyginodendron | Oliver, Prof. F. W., and Scott, Dr. D. H. (Trans.) | Secy. | (Abstract) Secy. | Jan. 21, 1904

and a Fellow of the Society as Referee for the following Paper

On Mechanical and Electrical Response in Plants | Bose, Prof. J. C. (Trans.) | Chmn. and Secy.

which was also under consideration by the Physiology Committee.

RESOLVED that the Chairman's nominations be confirmed.

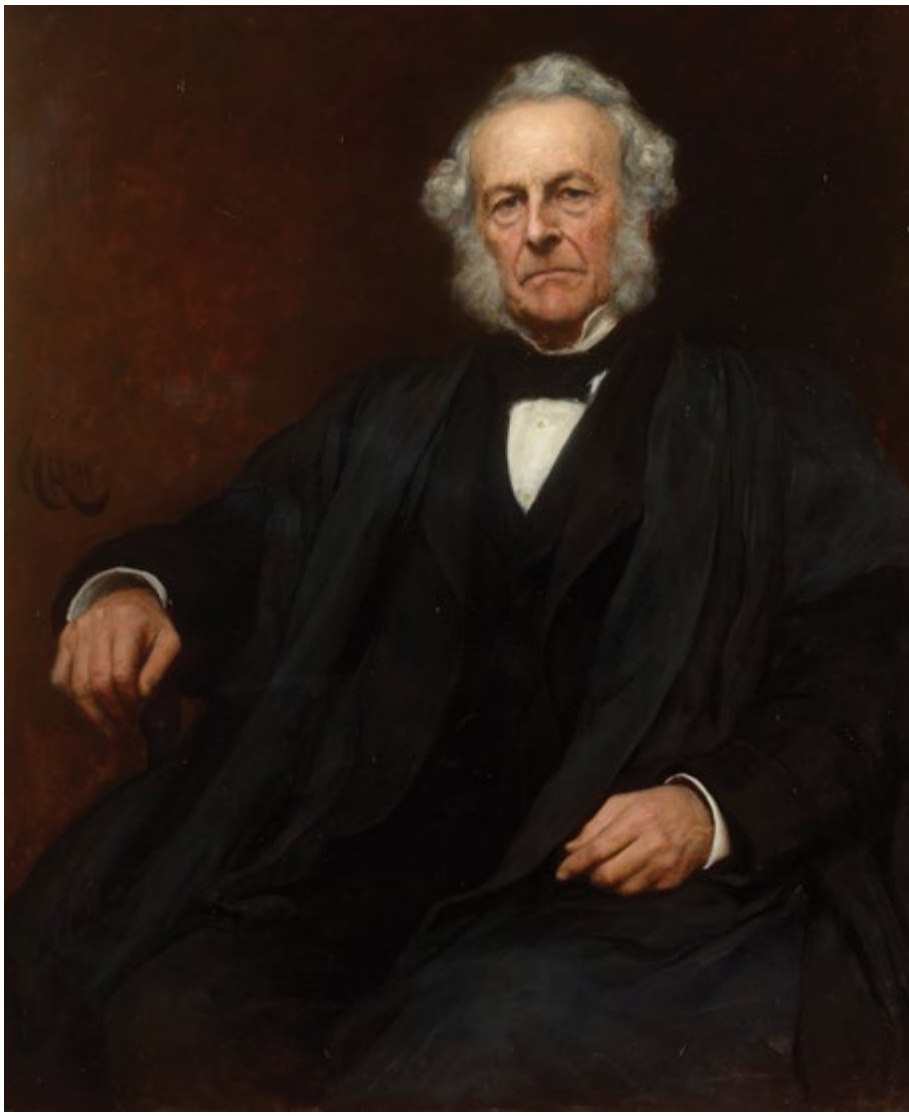
While expenditure was a worry for the Treasurer, as Secretary (from 1854), George Gabriel Stokes was preoccupied with the actual content of the *Transactions* and his extensive correspondence with authors over his thirty-one-years as Secretary took up most of his time beyond his duties as Lucasian Professor at Cambridge. Stokes's approach to editing marks him out as the first modern scientific editor. The process of getting a paper published in the *Transactions* still relied on the reading of papers by a Fellow. By the mid-nineteenth century, many papers were sent immediately for printing in abstract form in *Proceedings*; but those which were being considered for printing in full in *Transactions* were usually sent to two referees for comment before the final decision was made by

Opposite
George Stokes, Secretary of the Society and effectively Editor of the *Philosophical Transactions* between 1854 – 1885.

Above
Minutes from the meeting of the Botany Sectional Committee, 12 February 1904.

the Committee of Papers. During Stokes's time, authors were given the opportunity to discuss their paper at length with him before, during and after its official submission to the Committee of Papers. Stokes acted variously as secretary, editor, and referee, and worked on papers by John Tyndall, William Crookes, Norman Lockyer, and Arthur Cayley, among many others. Through his selection of referees, his encouragement and guidance to them (and his efforts to get them to respond promptly), Stokes was paramount in establishing a more formalised refereeing process at the Royal Society. Even though the Committee of Papers was officially responsible for coordinating the production of the journal, Stokes was the principal actor in the process of editing the Society's publications.

Stokes gave up the Secretaryship in 1885, to become President. In 1887, the *Transactions* split into series A and B, dealing with the physical and biological sciences respectively, in a late acknowledgement of the growing specialisation of science. It was not until Stokes's Presidency ended, in 1890, that his influence over the journal finally diminished. In 1897, the model of collective responsibility for the editing of the *Transactions* was emphasized by the re-establishment of the Sectional Committees. The six Sectional Committees covered Mathematics, Botany, Zoology, Physiology, Chemistry & Physics, and Geology, and were composed of Fellows of the Society with relevant expertise. The Sectional Committees took on the task of managing the refereeing process after papers had been read before the Society; they communicated referee reports to authors; and sent reports to the Committee of Papers for final sanction. The Sectional Committees were intended to reduce the burden on the Secretaries and Council. Consequently, the



Secretary in the 1890s, Arthur Rücker, no longer coordinated the refereeing of papers, nor did he generally correspond extensively with authors about their papers as Stokes had done. However, he continued to be the first port of call for authors submitting papers. The introduction of fixed terms for Society officers precluded subsequent editors from taking on Stokes's mantle, and meant that the Society operated its editorial practices more collectively than it had done since the mechanisms for it were established in 1752.

During Stokes's time, authors were given the opportunity to discuss their paper at length with him before, during and after its official submission to the Committee of Papers.

By the early twentieth century, refereeing was standard practice. Organised by the chairmen of Sectional Committees along with the Secretary of the Society, each paper accepted for publication, whether in *Transactions* or *Proceedings*, was sent to two referees.

Guiding authors and making money

Referees were usually Fellows, except in a small number of cases where the topic was beyond the knowledge of the fellowship (or at least, of those willing to referee). Authors were increasingly expected to submit manuscripts in a standardised format and style. From 1896, they were encouraged to submit typed papers on foolscap-folio-sized paper in order to lighten the work of getting papers ready for printing, and to reduce the chance of error in the process. When *Proceedings* became a full research journal, in 1905, its front page carried instructions on the proper way of submitting papers, including an insistence on typed papers. A publishable paper now had to present its information in an appropriate manner, as well as being of remarkable scientific interest. For a brief period between 1907 and 1914, authors were under even more pressure to conform to the Society's expectations, due to a decision to discuss cost estimates of candidate papers alongside referees' reports. The committees could require authors to reduce the number of illustrations or tables or, indeed, the overall length of the paper, as a condition of acceptance. It was hoped that this policy would reduce the still-rising costs of production, which had reached £1747 in 1906; but the effect appears to have been negligible, and the cost estimates ceased to be routine practice after 1914. It was only after the Second World War that the Society's concerns about the cost of its journals were finally allayed. There had been a one-off surplus in 1932, but it was only from 1948 that the *Transactions* began regularly to end the year in surplus. That year, despite a three-fold increase in production costs (it was a bumper year for papers), there was a surplus of almost £400.

Part of the post-war financial success of the *Transactions* was due to the rising subscriptions received, and a growing number of subscriptions from British and international institutions, including universities, industry, and government; this was at the same time as private subscriptions, outside of fellows, were non-existent. By the early 1970s, institutional subscription was the main channel of income from publication sales for the Society. In 1970 – 1971, 43,760 copies of *Transactions* were sold, of which casual purchasers accounted for only 2070 copies.

All of the Society's publications now had a substantial international circulation; in 1973, for example, just 11% of institutional subscriptions were from the UK; 50% were from the U.S. Contributions, however, were still mostly from British authors: 69% of Royal Society authors were from the UK in 1974. A Publications Policy Committee suggested that more overseas scientists could be encouraged to submit papers if the requirement to have papers communicated by Fellows was dropped. This did not happen until 1990. There was also a suggestion to create a 'C' journal for molecular sciences to attract more authors in that area, but the idea never materialised. The conclusion in 1973 was a general appeal to encourage more British scientists (whether Fellows or not) to publish papers with the Society and to pass on the message to their overseas colleagues; by the early 2000s, the proportion of non-UK authors had risen to around a half; and by 2009 it had passed 70%.

As the twentieth century came to a close, the editing of the *Transactions* and the Society's other journals became more professional with the employment of a growing in-house staff of editors, designers and marketers. In 1968 there were about eleven staff in the Publishing Section; for the first time, the Year Book for that year outlined the 'organisation of the Royal Society office', and listed the team dealing with 'editorial', distribution' and 'other matters' relating to the publications of the Society, including *Transactions*, *Proceedings*, *Notes and Records* – a history of science journal – and non-serial productions including Isaac Newton's correspondence.

69%

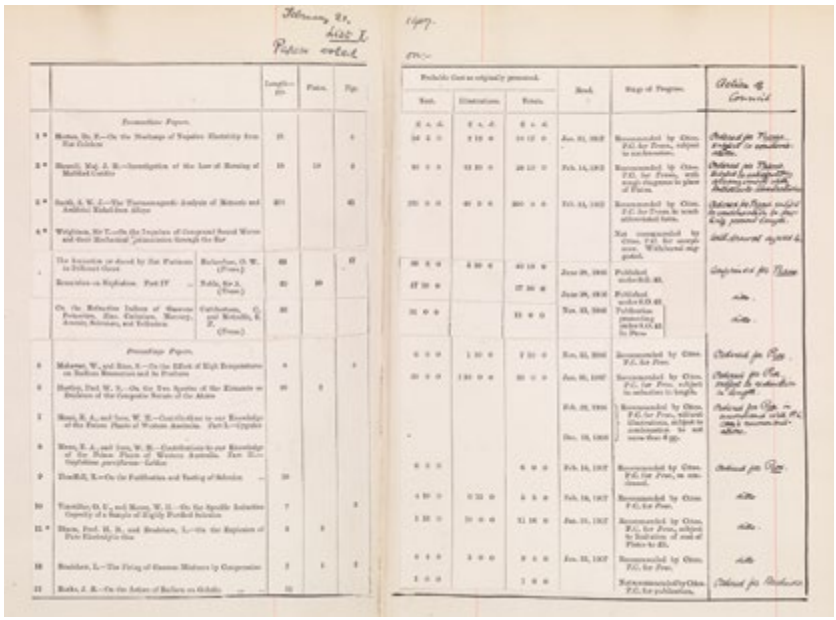
The proportion of Royal Society authors from the UK in 1979.

In the 1990s, as these changes to the publishing and editorial teams were implemented, the Publishing Section acquired its first computer for administration; the *Transactions* went online in 1997.

In 1990, there was twenty-two staff in the Publishing Section, which was managed by Bruce Goatly and consisted of a Production Manager; a production and editorial team; a designer; a sales and marketing team; stock and warehouse workers; and a small team of finance staff. Today, the number of staff has not expanded greatly – there are twenty five people in the Publishing Section – but the Section is now headed up by a Commercial Director, and includes a Publishing Manager; Publishing editors of each of the Society's eight journals, as well as editorial coordinators for each publication; and a Publishing Operations team, who deal with E-publishing, marketing, sales, customer services, and production. Warehousing is no longer required due to electronic publishing, and finance is now managed by the Society's Production team.

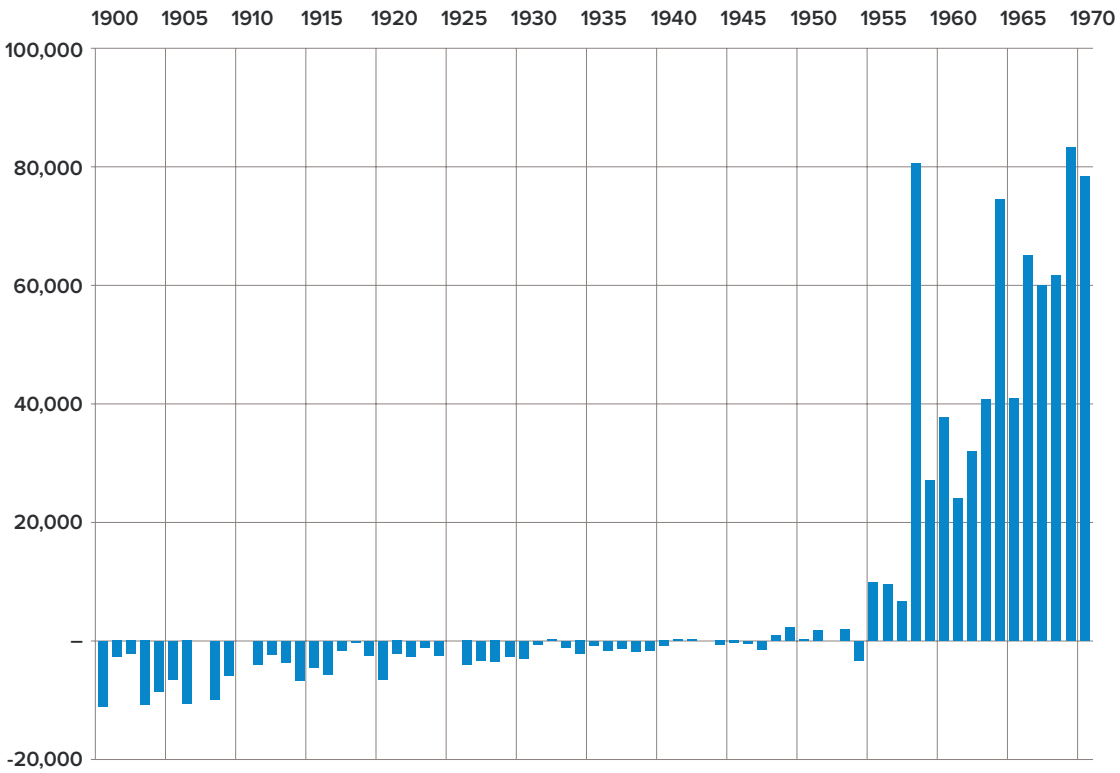
The editorial processes were also transformed in the late twentieth century, perhaps in an attempt to streamline decision-making. In 1968 the Sectional Committees had been abolished (again). Instead, the Secretaries, Harrie Steward Massey (physicist) and Bernard Katz (physiologist), were each assigned a group of Fellows to act as Associate Editors for each series (A and B) of the *Transactions*. The role of Associate Editors in the editing of *Transactions* continues today. The Committee of Papers was abolished in 1989 and since 1990 two Fellows (rather than the Secretaries) have acted as the Editors with assistance from Associate Editors. The Editors serve on the Publishing Board, established in 1997 to monitor publishing and report to the Council.

In the 1990s, as these changes to the publishing and editorial teams were implemented, the Publishing Section acquired its first computer for administration; the *Transactions* went online in 1997. While the subscription figures have been increasingly international since 1970, the growth of online access has brought the journal to new audiences: in 2008, for example, 49% of the Society's institutional subscriptions were from North America, 19% from Europe, 12% from Asia, 11% from the U.K. and 8% from the Pacific, Latin America and the Middle East. Authorship has also become increasingly international, although Europe dominates, with 55% of contributors to the *Transactions* in 2013; compared with 28% from North America and 8% from Asia. In the early twenty-first century, therefore, the Society continues to expand its publishing activities.



Referee Name	Number of times Refereed
George Gabriel Stokes	41
William Allen Miller	26
George Busk	23
William Sharpey	23
Edward Frankland	20
William Hallowes Miller	20
John Herschel	15
Arthur Cayley	15
William Benjamin Carpenter	13
Alexander William Williamson	13

Philosophical Transactions **Surplus/Deficit, 1900 – 1970 (adjusted to 1970£)**



Top
Graph of profit and loss for *Philosophical Transactions* between 1900 – 1970.

Bottom
Author locations in 1665 and 2013.

Opposite left
At the Committee of Papers' meetings there was no discussion of papers, and votes were cast in secret. The Committee could vote to publish, postpone or reject a paper; they could recommend alterations or cuts, or call in expert help to assess its merit.

Opposite right
Top *Philosophical Transactions* Referees 1860 – 1879.

Location of authors in *Philosophical Transactions*	Number of authors 1665 – 1666	% of Total	Number of Authors 2013	% of Total
England	91	50	677	19.5
Scotland	1		137	3.9
Wales			35	1
Ireland			36	1
Italy	17	9	86	2.5
France	42	23	173	5
Poland	5	3	16	0.5
Spain	3	2	66	1.9
Greece			12	0.3
Germany	2	1	227	6.5
Switzerland	1	1	83	2.4
The Netherlands	3	2	85	2.4
Sweden			81	2.3
Rest of Europe	2	2	224	6.3
Rest of the World	4	2	1550	44.6
Unknown	16	9		

Stories behind selected papers from the exhibition

In 1901, Alice Lee became one of a select group of women who had managed to get a paper printed in the Transactions.

Adam Sedgwick, reporting on Charles Darwin's 1839 paper on the parallel roads of Glen Roy – his only paper in the journal – was full of praise for the quality of insight, but deplored the paper's unnecessary wordiness.

Papers in the *Philosophical Transactions* were astonishingly varied. They covered all scientific disciplines, and a range of specific subjects from birdsong and bird migration to deep-sea diving apparatus to the electromagnetic wave theory of light.

1 Daines Barrington's Paper on Birdsong (1773)

Knowing that their papers would automatically be considered for publication under the new regime, some authors began to pay more attention to the requirements of printers and editors. Here we can see that the text has been divided into columns, one for the main text and the other for references, annotations, and instructions to the printer. Where alterations have to be made the relevant column is overlaid with a new strip of paper, sealed down with wax wafers, and overwritten with the revised text.

2 Copy of James Clerk Maxwell's paper on 'A dynamical theory of the electromagnetic field', Phil Trans 1865

James Clerk Maxwell's paper on 'A dynamical theory of the electromagnetic field' was published in the *Transactions* in 1865. The final sentence on page 63 of Maxwell's paper records his revelation regarding the nature of light:

'The agreement of the results seems to show that light and magnetism are affections of the same substance and that light is an electromagnetic disturbance propagated through the field according to electromagnetic laws'.

3 Charles Darwin, long-winded geologist

From 1831 many more papers were sent to expert referees, but there were no guidelines on the criteria for acceptance. Adam Sedgwick, reporting on Charles Darwin's 1839 paper on the parallel roads of Glen Roy – his only paper in the journal – was full of praise for the quality of insight, but deplored the paper's unnecessary wordiness.

4 Delays to publishing

By the mid-nineteenth century most papers were sent to referees. The physician Charles H. Jones's paper 'On the construction and development of the liver' met with an unfortunate fate during the reviewing process. His paper submitted in June 1847 was read soon after, but by July 1848 it had gone astray. Jones was asked to re-submit it, but this lost copy may have been his only one. It took until 1849 before Jones's paper was finally published in the *Transactions*.

5 Alice Lee

In 1901, Alice Lee became one of a select group of women who had managed to get a paper printed in the *Transactions*. Lee's paper on 'Mathematical contributions to the evolution of man' was based on her PhD research at University College London. Lee's paper was communicated to the Society by her supervisor Karl Pearson in 1900, but was unusually sent to two referees before it was even read before the Society. The secretary Joseph Larmor felt the paper required additional vetting. In the end, it was published in 1901.

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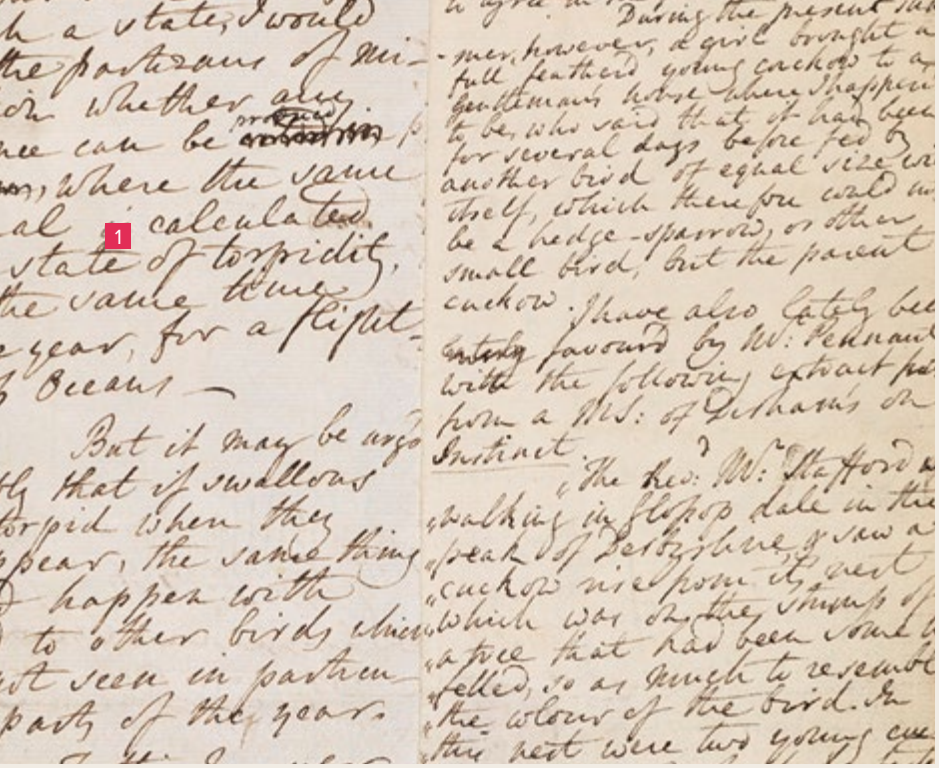

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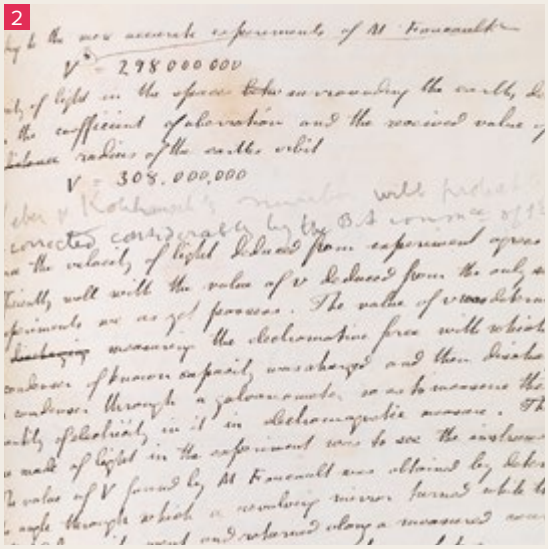

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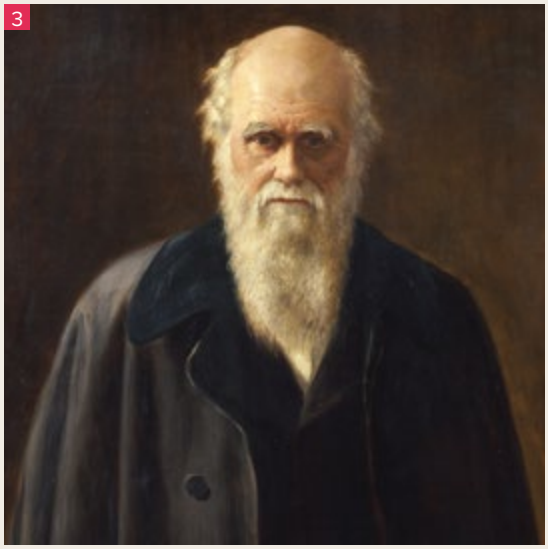

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5

Publishing at the Royal Society today

The journals are managed by a professional team, which still draws on the expertise of the Fellowship and the wider scientific community.

The Society's first step into open access (in 2006) was to provide optional open access on its subscription journals. *Open Biology* (our first exclusively open access journal) was launched in 2011, in part to learn and prepare for future scenarios.

Publishing at the Royal Society has developed considerably in the last few years. The publishing team have launched several new journals in response to changes in science and publishing – together they cover the breadth of scientific endeavour, though they are inevitably stronger in some areas than others.

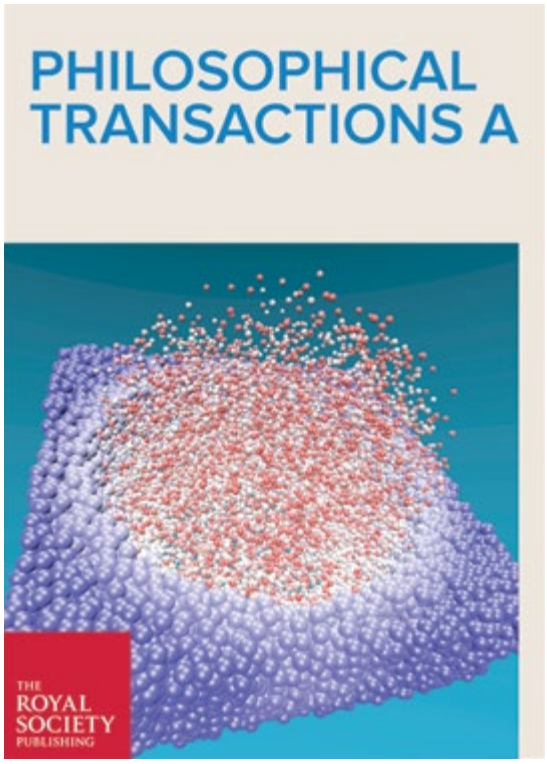
The new journals include *Interface* which was launched in 2004 in response to the growth in cross-disciplinary research and *Open Biology* in 2011, covering cellular and molecular biology and the Society's first fully open access journal.

Every stage from manuscript submission to online publication is now fully electronic. The print editions of the journals now serve a purely archival function and only a small minority of subscribers still take print. The journals are managed by a professional team, which still draws on the expertise of the Fellowship and the wider scientific community. A Fellow acts as academic Editor-in-Chief on each journal and is supported by associate editors, independent reviewers and in-house publishers.

Subscription remains the predominant business model with many institutions purchasing packages of all the journals. However, the most important development today is the emergence of open access publishing. The open access model requires the author (or funder) to pay an 'article processing charge' to allow an article to be made freely available and reusable immediately on publication.

The Society's first step into open access (in 2006) was to provide optional open access on its subscription journals. *Open Biology* (our first exclusively open access journal) was launched in 2011, in part to learn and prepare for future scenarios. *Royal Society Open Science*, a much more ambitious open access journal covering all of science, engineering and mathematics, and operating objective peer review, was launched in 2014.

Philosophical Transactions goes from strength to strength: we are publishing over 50 themed issues in 2014, covering the full range of science and reaching scientists all around the world.



Right
Recent front covers of Royal Society science journals.

About the project

This commemorative brochure accompanies an exhibition at the Royal Society from December 2014 to June 2015, to celebrate the 350th anniversary of the *Philosophical Transactions*. The exhibition showcases the work being carried out by the 'Publishing the *Philosophical Transactions*: the social, cultural and economic history of a learned journal, 1665 – 2015' project. The project runs from 2013 to 2017, and is led by Aileen Fyfe at the University of St Andrews and funded by the Arts and Humanities Research Council (grant K001841/1). Researchers Noah Moxham and Julie McDougall-Waters are working in collaboration with the Royal Society's library and publishing divisions to investigate the challenges and opportunities of scholarly publishing over the past 350 years.

As well as the exhibition, the project team is organising a variety of other events in 2015, including a major academic conference in March. By 2017, the team plans to have written the definitive history of the commercial and editorial practices of the *Philosophical Transactions*. It is also using the Royal Society's archive to compile a series of historical economic data series relating to the book trade, which will be made freely available online.

To follow the project, or download a PDF version of this brochure, visit our website at **arts.st-andrews.ac.uk/philosophicaltransactions/exhibition**

For other events in the Publishing Anniversary year, visit **royalsociety.org/publishing350**

University of St Andrews

Arts & Humanities Research Council

The Royal Society is a self-governing Fellowship of many of the world's most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society's fundamental purpose, as it has been since its foundation in 1660, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

The Society's strategic priorities emphasise its commitment to the highest quality science, to curiosity-driven research, and to the development and use of science for the benefit of society. These priorities are:

- Promoting science and its benefits
- Recognising excellence in science
- Supporting outstanding science
- Providing scientific advice for policy
- Fostering international and global cooperation
- Education and public engagement

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