Introduction: 350 Years of Scientific Periodicals

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> If all the books in the world, except the *Philosophical Transactions*, were destroyed, it is safe to say that the foundations of physical science would remain unshaken, and that the vast intellectual progress of the last two centuries would be largely, though incompletely, recorded.[1]

Thus, Thomas Henry Huxley, in a lay sermon on intellectual progress delivered in January 1866, proclaimed one of the central roles of the scientific periodical: as a record of the progress of the sciences. By Huxley's time, the *Philosophical Transactions*, published by the Royal Society of London, was just one of many scientific journals issued by learned societies and commercial publishers.[2] The Royal Society's project to create a *Catalogue of Scientific Papers* had just finished indexing almost 1,400 such journals from all over the world.[3] What made the *Philosophical Transactions* unique, as Huxley knew, was its longevity. Other journals enabled more rapid publication, and other journals contained more specialist research, but no other journal had a back-run which could compare to the *Transactions*. And since the *Transactions* is still with us today, the length of its back-run remains unique: 350 years and still counting.

Over those 350 years, scientific periodicals have performed many roles. As well as storing records of research for the future, they have enabled geographically-dispersed scholars to communicate, and sometimes to coordinate, their research. They have helped to establish and police knowledge-communities. They have served as currency in exchanges which built and maintained relationships between learned societies, and between individual researchers. They have always been part of an interlocking web of oral, manuscript and printed (and, recently, digital) forms through which knowledge and knowledge-claims have been transmitted and translated between cultural, linguistic, and disciplinary contexts. But, amidst that array of communication tools, periodicals have come to be the dominant means by which scientists (or, increasingly, teams of scientists) gain credit for discoveries and build their reputations and

careers. The editorial processes for selecting and evaluating papers for publication have become increasingly complex as the social stakes of publication have increased, and, with the professionalization of other fields of academic endeavour over the last century, the practices of science journals and their editors have informed the standards for scholarly publishing in non-scientific fields.

The research printed in scientific periodicals has long been mined by historians of science; but communication practices have received more attention since the rise of constructivist accounts of natural knowledge in the 1970s.[4] Historians and sociologists of science have investigated the processes, both formal and informal, through which experimentally-based knowledge was disseminated, and thus transformed into publicly-acknowledged facts. The first scholarly journals (the *Journal de Sçavans* and the *Philosophical Transactions*, in 1665) are now well-established elements, alongside scientific societies and academies, of the history of early modern science; and the names of scientific periodicals (and some of their editors) have become familiar bit-players in histories of late modern science, and were studied in their own right by A.J. Meadows and W.H. Brock.[5]

Since the 1990s, our understanding of both the language and also the publishing of science has been transformed. The emergence (by the late nineteenth century) of an apparent objectivity in scientific writing, through increasingly impersonal reporting, and a standardisation of the structure and material layout of articles, has been identified by scholars undertaking a sociolinguistic analysis of a corpus of published articles.[6] Meanwhile, the work of James Secord, Adrian Johns and Jonathon Topham, among others, has transformed our understanding of the authorship, readership and publishing of science.[7] However, this understanding is still limited: in the early modern period, we usually know more about the foundation of journals than about their subsequent working lives;[8] and in the late modern period, we know far more about communication to educated and lay publics, than about communications between scholars.[9] It could be said that we are now rich in snapshots of the history of scientific periodicals – we have studies of specific editors, and specific journals, at particular points in time – but, except for the rhetoric of scientific articles, we lack the big picture.[10]

Few if any of the attributes and functions now associated with scientific periodicals are straightforwardly transhistorical. Studying the emergence of a (relatively) stable and standardised form of scientific communication thus offers a means of tracking change in scientific communication practices over time, investigating how, when, and where those

changes came about, whether they proved lasting, who benefited from them, and what alternatives existed. The answers reveal shifts in epistemic standards and priorities, in patterns of specialisation and discipline formation, in the influence of and relations between learned societies, and in the power relations between different communities of practitioners and researchers.

Publishing the *Philosophical Transactions*

The essays in this special issue of *Notes & Records* are a small selection of the 36 papers presented at a conference held at the Royal Society on 19-21 March 2015, under the title 'Publish or perish? The past, present and future of the scientific periodical'.[11] The conference (nearly) coincided with the 350th anniversary of the *Philosophical Transactions*, and was organised under the auspices of our AHRC-funded project, 'Publishing the *Philosophical Transactions: the social, cultural and economic history of a learned journal, 1665-2015*'.[12] Launched in 2013, our project aims to provide a comprehensive study of the oldest scientific periodical. The *Philosophical Transactions* is not merely Huxley's symbol of intellectual progress: it supplies a near-continuous thread that spans the entire history of periodical publishing in the sciences, and so can act simultaneously as a case study and the core of a *longue-durée* analysis. It began as a private commercial venture but became an official learned society publication. It has at different times been paid for by members of the print trade, by private editors, by the Royal Society, and indirectly by the Treasury. It has changed publishers and printers a dozen times. Because of its comprehensive archive, held in the Royal Society's library, it affords unique historical insights into editorial practices in science publishing (through the many correspondences and diaries of editors); the finances of scholarly publishing (through the Society's account books, and the archives of printers William Bowyer and Taylor & Francis); executive direction (through the Society's Council minutes); and the dissemination of scientific research, not only through the distribution practices of the *Transactions* itself but through its replication into many other forms (other specialist periodicals, in Britain and on the Continent, but also abstracts, abridgements, and the general periodical press).[13]

The 'Publishing the *Philosophical Transactions*' project is grounded in the history of the print trades, and will provide an account of learned periodical publication that embraces the full range of its cultural complexity: a production history, certainly, but one that engages fully with the variety and materiality of periodical production and its afterlives, with shifting conceptions and patterns of authorship, with changes in the nature of scientific organisation in Britain and

elsewhere, with patterns of public engagement, willing or otherwise, with different editorial regimes and new epistemic standards and priorities for science, with the rise of commercial journals and the proliferation of learned society publishing in the nineteenth century, and with Big Science, state oversight and internationalism in the twentieth century.

The project will run to 2017, by which time its chronological scope will extend to the present, when the dominant position of current publishing models in the sciences outlined above is coming under increasing internal and external strain. The competing claims of publishers, researchers and the public, coupled with the rise of online circulation, open-access publishing, and preprint servers are pointing to new (or not so new!) possibilities for information-sharing and knowledge accreditation, and new economic norms that threaten the stability of traditional forms. The cultural, epistemic, social and economic position of the scientific journal is being called urgently into question; and we believe that the historical variety and contestation underlying the present situation can contribute to those debates.

Before introducing the contents of the special issue, which showcase the variety of fruitful themes currently being investigated, we wish to take this opportunity to present a foretaste of the findings (to date!) of our project. The story starts, of course, with Henry Oldenburg; yet, despite his prominence in the historiography of *Philosophical Transactions*, he was its editor for only twelve of 350 years…

Editing the early Transactions

Philosophical Transactions: Giving some Accompt of the Present Undertakings, Studies and Labours of the Ingenious in Many Considerable Parts of the World began life as the personal venture of the Royal Society's industrious first Secretary, Henry Oldenburg. In the summer of 1664, Oldenburg had an idea for a new money-making scheme. He told Robert Boyle 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.[14] Shortly thereafter news came from Paris of the launch of the *Journal des Sçavans*, a printed weekly containing reviews of books on theology, history, medicine, and natural philosophy. Oldenburg had been invited to supply the *Journal* with accounts of new books and other goings-on in the world of English learning; and 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'.[15] This was a draft, or perhaps a proof copy, of the first issue of *Philosophical Transactions*, which appeared in print on 6 March 1665.

The *Transactions* under Oldenburg looked very different from a modern science journal, and also from the formal learned society publication it would become in the eighteenth- and nineteenth centuries. There was no formal submission process, and Oldenburg was the publisher, compiler, and even, as he occasionally called himself, the author.[16] The contents 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.[17] The early *Transactions* relied on Oldenburg's prodigious network of natural-philosophical contacts, and his considerable skills as a linguist.

Although the *Transactions* was licensed by the Royal Society, and the first issues were printed by the Society's official printers, John Martyn and James Allestree,[18] the Society had no involvement in the commercial aspects of the project. Oldenburg thought he would break even if he sold 300 copies,[19] and in mid-1665, the print run for commercial sale was negotiated at 1000 copies (more than in the eighteenth century, and the same as in the nineteenth-century!).[20] Oldenburg never did succeed in gaining his living from the *Transactions* – the most it had ever done, he noted in 1667, was to cover the rent on his house in Piccadilly[21] – 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.

Oldenburg's death, in 1677, could easily have been the end of the *Transactions*. Yet, by the end of Newton's presidency, in 1727, the *Transactions* had reached its 34th volume, and passed (though not always smoothly) through the hands of 9 different editors, most notably, Edmond Halley, Hans Sloane and James Jurin. The *Transactions* had continued to be the financial responsibility of the successive editor-secretaries, but fortunately, there was no shortage of wealthy fellows at the Society. Hans Sloane spent £1,500 on producing the *Transactions* in the course of twenty years – hardly a small sum, but one he could easily cover with his extensive wealth.[22] One of the fascinating aspects of our project has been untangling how the *Transactions* was handed on from one secretary of the Royal Society to another, despite the Society's formal distance from the publication; and how the Society contrived to exercise *de facto* intellectual ownership over it, despite having no commercial or legal claim.

Becoming an Institutional Publication

Changes of editorial regime created opportunities for individual editors and for the institution to set new directions for the *Transactions*, and to broaden the scope of natural philosophical publishing at the Society. There were several such attempts in the late 1670 and 1680s. These

mainly depended upon the securing of a substantial body of research to which the Society could stake some claim of ownership, however, and were predicated on attempts to revitalise the Society's flagging experimental programme. When by the early 1690s these proved to be unsustainable, the activity of weekly meetings began to consist primarily of hearing individual research communications, which in turn increasingly dominated the content of the *Transactions*.

Around 1751, *Philosophical Transactions* was experiencing something of a crisis, 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.[23]

The Society was quick to point out that it was not officially responsible for the *Transactions*. But Hill's attacks gained force from the fact that the *Transactions* and the Society were inextricably linked in the minds of most contemporary readers.[24] As Noah Moxham shows elsewhere in this special issue, the Society's institutional affiliation with the *Transactions* was not straightforward in the late seventeenth- and early eighteenth-century. The Society had ensured that the *Transactions* was continued in a (mostly) timely manner; it appointed the editors; and, in contrast to the reviews, reports and extracts from letters that Oldenburg had published, most of the papers that appeared in the *Transactions* in the early eighteenth century had been read before the Society at its weekly meetings. There was a widespread assumption that the *Transactions* came out with the Society's approval and under its supervision, and the Society had often benefitted from reflected glory.

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 to have the *Transactions* formally taken over by the Society. In spring 1752, the Council agreed that the *Transactions* should henceforth be published 'for the sole use and benefit of this Society'; and that the 'great

Charge and Expence' incurred would now be 'defrayed out of the Stock or Fund of the Society'.[25] The move was predominantly about securing the honour, credit and reputation of the Society, but, by shifting the ownership of the *Transactions* (in a physical ink-and-paper sense, as well as intellectually) to the Society, it provided the Society with greater opportunities to use copies of the *Transactions* as perquisites for members and as gifts to correspondents and learned institutions. As Aileen Fyfe shows elsewhere in this special issue, it thus marks the start of the Society's extensive programme of institutional exchanges and free circulation. In clear contrast to the earlier editorial regime, the post-1752 *Transactions* was to be edited by a standing Committee of Papers (in practice the Society's governing Council), who would use a secret ballot to generate a collective decision, thus avoiding any imputation that Committee members might have been bribed or coerced.

Collective Editorial Practices in the Banks Era

Although the Society had taken on the *Transactions*, the business of negotiating with printers and booksellers remained the preserve of one of the Secretaries; but now the bills for paper, engraving and printing were paid by the Society; and editorial control was exercised through regular meetings of the Committee of Papers. The emphasis on collective (or corporate) editorial responsibility distinguished the post-1752 *Transactions* both from its predecessor, and from periodicals controlled by an individual editor. The breadth of membership of the committee made some provision for a breadth of scholarly interests, but the statutes also enabled a designated ordinary member of the Society to be invited to Committee meetings to provide expert evaluation of particular papers. In the eighteenth century, this provision for the reviewing of papers was seldom used in practice – only four times for over 400 papers considered by the Committee of Papers between 1780 and 1790.[26]

The contents of the *Transactions* were now firmly linked to Society meetings. Any paper read before the Society was automatically considered by the Committee. Only fellows could read papers, but they could do so on behalf of others.[27] The Society's series of 'Archived Papers' (i.e. papers rejected for publication) contain a strikingly high proportion of foreign papers in this period. The proliferation of learned societies across Europe, with publications of their own, meant that the Royal Society's *Transactions* were no longer unique.[28] Scholars on the Continent frequently preferred to publish more locally; and the Royal Society was not interested in the proposals for longitude solutions, perpetual motion machines, and squaring the circle that did come in.

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. About half of the print run was reserved for fellows, who were expected to sign for their copies in person. With so many copies distributed for free to the journal's natural market, sales were generally slow, and, as Fyfe demonstrates in her essay, the Society had to support the *Transactions* financially. That its fellows did so, willingly, indicates the non-financial 'benefit' that the *Transactions* were perceived to bring to the Society.

The statutes laid down that the Committee should vote on each paper read before the Society in silence and without discussion. Without being a fly on the wall in the Committee's meetings, it is impossible to know how closely these instructions were followed; but there is plenty of evidence that the President and Secretaries could, and did, bypass or subvert the official editorial procedures. For instance, as president from 1778 to 1820, Joseph Banks exerted a strong personal influence on all areas of the Society's business. The work of the Committee of Papers continued fairly efficiently, with the President himself in frequent attendance; at the same time, however, Banks or one of the secretaries could prevent papers from ever reaching the Committee by not allowing them to be read at a meeting 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.[29] There is also evidence of editorial interventions, with Banks himself, or a trusted deputy, proposing cuts or emendations to particular contributions. The proofs were sometimes corrected at Banks's home (*frontispiece?*).[30] Despite this apparent subversion of collective editing, a paper in the *Transactions* carried a high degree of prestige.

The Transactions *in the age of professionalisation*

Since the death of Banks, both the Royal Society and the organisation of science have been transformed. In the late 1820s, a group of reformers, including Charles Babbage, proposed that the Society should select only men of scientific attainments, as measured by their publications. And if publication was to become a measure of reputation, then it would be equally critical that the processes for the evaluation of papers for publication should be improved, perhaps by the use of referees. These proposals were quietly shelved, but many of their recommendations were

implemented over the next twenty years, culminating with the Royal Society statute reforms of 1847.[31]

As the nineteenth century wore on, the increased desire to publish articles was reflected in the increased bulk of the volumes of *Philosophical Transactions*; its split into A (physical) and B (biological) series in 1887; the launch of *Abstracts of the papers communicated to the Royal Society of London* in 1832, and its transformation into *Proceedings of the Royal Society of London* in 1854; and, much more recently, the launch of five new Royal Society journals. Printed papers were, however, the tip of the iceberg. The number of submissions to the Royal Society in the second half of the nineteenth century grew faster than the number of papers printed.[32] In the nineteenth century, there was a qualitative distinction between *Transactions* and *Proceedings*, with only those articles marking 'a distinct step in the advancement of Natural Knowledge' being admitted to *Transactions*.[33] From 1914, the distinction would depend purely on length and quantity of illustrations: papers over 24 pages, and those requiring 'numerous elaborate illustrations' would be considered for the *Transactions*.[34] Despite the rise in specialist journals – especially after the Second World War – neither *Transactions* nor *Proceedings* split beyond A and B, retaining a commitment to the broad scope of 'physical' or 'biological' sciences.[35] With the increasing prominence of *Proceedings*, the role of *Transactions* became less clear; until, in the 1990s, the Society decided to transform it into a series of thematic issues arising from Society-hosted discussion meetings. There are now around fifty of these issues published every year.

By the late nineteenth century, the Royal Society had become involved in a wider range of activities; in addition to its weekly meetings and its publications, it administered virtually all of the government funds for scientific research. During the twentieth century, it shifted towards the provision of independent policy advice, international scientific diplomacy, some direct funding of research, and liaising with other scientific societies.[36] This meant that, while the *Transactions* remained an important public expression of the Society's reputation, it was a much smaller part of the Society's activities than it had once been. The Society's growing international outlook, however, was reflected in the *Transactions*. In 1974, 69% of Royal Society authors were still from the UK, but by 2006, the proportion of non-UK authors had passed 70%.[37] During the remaining years of our project, we hope to be able to shed light on how this internationalisation of the *Transactions* was enabled, and what its implications were for the running of the journal.

The Business of Publishing

In Oldenburg's day, periodicals had been typeset by hand, printed on hand-presses on hand-made paper, and folded and stitched by hand. During the nineteenth century, all of these processes were mechanised, and the unit costs of paper, printing and, eventually, typesetting fell.[38] During the same period, the reproduction of images was transformed by innovations, from lithography to photography.[39] The Royal Society's records yield good data, which will ultimately become part of the online resource produced by our project, on production costs (paper, printing, illustrations) from the mid-eighteenth century onwards, and sales income (but not sales numbers) from the mid-nineteenth century onwards. However, as Fyfe argues, prior to the mid-twentieth century, it is misleading to think about the *Transactions* as if it were a commercial enterprise. The Royal Society supported the publication and circulation of scientific knowledge, and did not expect to recoup much of the cost from sales. More attention was paid in the eighteenth and nineteenth century to print quality than to controlling costs.

By the 1890s, this philanthropic approach to publishing was coming under strain at the Royal Society, as the publishing programme became more expensive, and the Society's range of other activities grew. For several decades, the publishing programme was assisted by government grants-in-aid and by private donations. In the 1920s, there was a conscious cutting-back of the free circulation of the *Transactions* (and *Proceedings*), and a price-increase for *Proceedings*,[40] which helped to increase sales income somewhat. But it was not until the late 1940s, that the *Transactions* – and Society publishing more generally – began occasionally to show a surplus. From the late 1950s, vastly increased sales income, and regular surpluses, suggest a transformation of the Society's commercial activities that we have yet to investigate.[41] The story will include the Society's decision in the mid-1950s to remove the marketing and distribution aspects of publishing from the printers (then Cambridge University Press), and develop an in-house publishing division.

The Royal Society's publishing division has managed to participate in the growing profitability of science journals in the second half of the twentieth century, and publishing has become a very successful income-generation stream for the Royal Society. In 2014, the publishing division reported a surplus of £2.6m, amounting just over a fifth of the total unrestricted income of the Royal Society.[42] From a model based on the free circulation of scientific research, supported by the Society, the *Transactions* had moved to a model funded by subscriptions. However, the Society has retained its philanthropic commitment to the dissemination of

research, significantly aided by the ease with which the online edition can now be made accessible to readers and institutions all over the world.

Refereeing and Expert Evaluation

The Royal Society archives are a rich resource for the history of the editorial processes of journal publishing. There are minute books for the various committees with editorial responsibilities, principally the Committee of Papers (1752-1990), the several discipline-based Sectional Committees (1838-47, and 1897-1968), and the Editorial Boards (1968--). There is also a continuous series of ledgers (the 'Register of Papers') recording the editorial progress and fate of every paper submitted from 1853 until computerisation; the correspondence of the secretaries who edited the *Transactions* (and the staff who helped them); and, from 1832, an extensive collection of referees' reports.

The Committee of Papers had always had the power to seek additional expertise, but had rarely used it. From 1832, the Committee began to 'refer' papers to named individuals for report. Work in progress by both Alex Csiszar and Julie McDougall-Waters is investigating how this early refereeing system worked: reports were occasionally jointly written, but usually not; they were occasionally delivered orally, but usually in writing; reports ranged from a single sentence to a dozen pages; there were usually two referees, but not always; the referees were publicly anonymous, but their names were an open secret to Society insiders.[43] During the second half of the nineteenth century, in the secretaryship of George Gabriel Stokes, refereeing settled into its mature form: two referees provided written reports, which were used both by the Committee of Papers in making the editorial decision, and (in extract) by the authors in making pre-publication revisions.[44]

Analysis of a sample of the 'Register of Papers' reveals that an increasing proportion of the fellowship was involved in refereeing over the second half of the nineteenth century: the size of the fellowship was decreasing, but the number of papers in need of referees was increasing. Officers and members of Council undertook a lot of the refereeing, but the reverse was also true: regular referees who were not initially on Council tended to end up there, including T.H. Huxley and George Carey Foster. Furthermore, the fact that William Thomson was one of the most active referees of the 1860s and 1870s, despite being based in Glasgow, hints at the role refereeing may have played in enabling distant fellows to participate in discussions about research presented at Society meetings. Then as now, some referees were speedier than others. During the 1850s to 1870s, the most likely time an author would have to wait, from receipt of

paper, through refereeing, to editorial decision, was five weeks, which stands up well to modern practice (even without the supposed advantages of electronic communication).[45]

Since the early eighteenth century, the contents of the *Transactions* had been closely linked to the meetings of the Society; yet the organisation of those meetings had been done by the secretaries (and sometimes the president), before, and separately from, the Committee of Papers evaluation for possible publication. In 1896, the processes were integrated.[46] Although the final decision still rested with Council, the Committee of Papers delegated most editorial matters to 'Sectional Committees' which dealt with particular fields of science. These sectional committees were involved in deciding which papers should be accepted for a meeting (and, thus, a short mention in *Proceedings*), and they also chose appropriate referees for those papers worthy of 'further consideration' for possible publication in the *Transactions*.[47] The sectional committees remained in operation until 1968, when they were replaced with boards of Associate Editors for each series of *Transactions*. Both structures provided the secretary-editors with advice, expertise and personal contacts stretching far beyond their individual specialisms. In 1990, for only the second time in the history of the *Transactions*, the historic link between secretary and editor was broken. The editors of the two series of *Transactions* are no longer the secretaries, thus spreading the burden of duties more widely among the fellowship. In addition, the long-standing Committee of Papers was abolished, leaving the fellows serving on the editorial boards with the task of representing the corporate body of the Society in the management of the *Transactions*.

Publish or Perish: the past, present and future of the scientific periodical

The 'Publish or Perish?' conference encouraged delegates to think about the format and genre of the scientific periodical, and about the business and editorial practices involved in running a journal. Unintentionally, but not unexpectedly, the nature and significance of institutional sponsorship of periodicals was an oft-repeated minor theme. It features in this issue in Noah Moxham's discussion of the Royal Society's ambiguous early relationship with *Philosophical Transactions*, where he shows how the *Transactions* moved from being one of several possible publishing activities of the Society in the 1680s, to being regarded as a good representation of institutional activity by the 1710s. Aileen Fyfe discusses the later financial implications of the institutional sponsorship of the *Transactions*, and Beth LeRoux shows that the Royal Society of South Africa had many similar problems, but went to enormous lengths to keep its *Transactions* going, despite the significant difficulties caused by the state of the local book

trade and the lack of a stable local readership. In contrast, Jim Mussell and Imogen Clarke show how Oliver Lodge valued the *Philosophical Magazine*'s lack of any institutional affiliation, believing that this allowed it to function as a more open space than the various society *Proceedings* with which it competed.

The papers selected here urge us to remember the practicalities of journal publishing in the days of paper, ink and physically bulky printed products. Thomas Broman's fascinating account of the distribution of periodicals in the Holy Roman Empire emphasises that profits were there to be made, by the postal service as well as by editors and publishers. His account provides an intriguing contrast to that of Fyfe, whose investigation of the Royal Society's strategies for supporting the *Transactions* financially shows how the expansion of the scientific enterprise in the later nineteenth century put the Society's financial arrangements under strain, and eventually led it to seek government support for the publication of scientific research. Similarly, LeRoux tells a story of South African journals in the twentieth century relying upon subsidies from universities and government.

Several essays touch in passing upon the format of scientific periodicals. Moxham's analysis of the experiments in publishing undertaken by those associated with the Royal Society after Oldenburg's death raises important questions about the perceived functional and epistemic distinction between periodicals and other formats. But it turns out to be by no means clear what physical format a 'periodical' might have, depending on place or time. In Oldenburg's day, *Philosophical Transactions* was issued as an unbound monthly, but was also available as a bound cumulation. In the nineteenth century, papers circulated among correspondence networks (and sometimes through the book trade) as 'separate copies', while bound volumes were exchanged between institutions. By the twentieth century, norms of periodicity had changed, as is apparent in the essays by Mussell and Clarke, and Baldwin, as the weekly *Nature* damaged the claim to rapidity of monthlies like the *Philosophical Magazine* and the *Proceedings*. And Beth LeRoux reminds us, even with the spread of online editions, some readers may need print-on-demand or CD-ROM formats.

Editorial practices, ranging from those of Oldenburg himself to the development of refereeing (later, peer review) as a crucial input into editorial decision-making, were a repeated theme of the conference. Moxham reveals how Hooke's and Halley's concepts of the editorial function differed from each other, as well as from Oldenburg. The use of referees was developed at the learned societies in the nineteenth century, but essays in this issue by Melinda Baldwin, and by

Mussell and Clarke reveal that, until the later twentieth century, the practice of refereeing remained firmly associated with society-sponsored publications. Mussell and Clarke's paper reveals that when the editorial standards at the *Philosophical Magazine* were criticised in the early twentieth century, the use of referees was not yet necessarily seen to be the answer. And Baldwin takes the case of *Nature*, where the editor's authority, coupled with his personal connections and social relations, determined decision-making at *Nature* in the mid-twentieth century, and systematic refereeing was not introduced until the early 1970s.

The conference also featured sessions on illustrations, both early modern and late modern; and some papers, though not enough, on the international dimensions of scientific journals, including translation of *Philosophical Transactions*, and the efforts of societies elsewhere in the world to establish their own publications. Some of these papers will be appearing elsewhere, or as part of forthcoming books, but we are delighted to have been able to include here a selection that illustrates the importance of thinking about the management and operation of periodicals, as well as their intellectual content. Without such sound business and editorial practices, and, in many cases, institutional support, our periodicals would, indeed, have perished.

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[1] T.H. Huxley, 'On the advisableness of improving natural knowledge' (1866) in *Collected Essays* (London: Macmillan, 1893) I, p.23. The address originated as a lay sermon delivered in St. Martin's Hall on Sunday, 7 Jan. 1866; published in the *Fortnightly Review* 3 (1866), pp. 626-37.

[2] Since the term 'scientific journal' was a creation of the early nineteenth century, we have tried to use 'periodical' when referring either to the earlier period, or to the *longue durée*. On the emergence of '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; and 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).

[3] H. White, editor, *Catalogue of Scientific Papers* [first series, 1800-1863]. (London: Royal Society, 1867-72), p. viii. Also A.J. Meadows, 'The Growth of Journal Literature: A Historical

Perspective' In: B. Cronin and H.B. Atkins, editors. *The Web of Knowledge: A Festschrift in honor of Eugene Garfield* (Medford NJ: Information Today Inc, 2000).

[4] However, David Kronick, with a background in library science, began his important series of books and articles on seventeenth and eighteenth-century scientific journals in the 1960s. In particular, see D.A. Kronick, *A history of scientific & technical periodicals: the origins and development of the scientific and technical press, 1665-1790* (Metuchen, NJ: Scarecrow Press, 1976); also D.A. Kronick, 'Scientific journal publication in the eighteenth century', *Papers of the Bibliographical Society of America* 59:(1), 28-44 (1965); D.A. Kronick, 'Authorship and authority in the scientific periodicals of the seventeenth and eighteenth centuries', *Library Quarterly* 48:(3), 225-75 (1978); D.A. Kronick, 'Anonymity and identity: editorial policy in the early scientific journal', *Library Quarterly* 58:(3), 221-37 (1988); and D.A. Kronick, 'Peer Review in 18th-Century Scientific Journalism', *Journal of the American Medical Association* 263:(10), 1321 (1990).

[5] A.J. Meadows, editor. *The Development of Science Publishing in Europe*. (Amsterdam: Elsevier, 1980), which includes an essay by W.H. Brock on 'The development of commercial science journals in Victorian Britain', p. 95-122; 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* (Edinburgh: Royal Scottish Museum, 1984). p. 37-44; W.H. Brock, 'Patronage and publishing: journals of microscopy 1839-1989', *Journal of Microscopy* 155, 249-66 (1989).

[6] A. Gross, J. Harmon and M. Reidy. *Communicating Science: The Scientific Article from the 17th Century to the Present* (Oxford: Oxford University Press, 2002); Dwight Atkinson, *Scientific Discourse in Sociohistorical Context: The Philosophical Transactions of the Royal Society of London, 1675–1975* (London: Laurence Erlbaum Associates, 1999).

[7] A. Johns, *The Nature of the Book: print and knowledge in the making* (Chicago: University of Chicago Press, 1998); J.A. Secord, *Victorian Sensation: the extraordinary publication, reception and secret authorship of Vestiges of the Natural History of Creation* (Chicago: University of Chicago Press, 2000); J.R. Topham, 'Scientific publishing and the reading of science in early nineteenth-century Britain: an historiographical survey and guide to sources', *Studies in History and Philosophy of Science* 31A, 559-612 (2000).

[8] Our understanding of eighteenth-century learned journals has recently been significantly enhanced by the many Continental case studies collected in J. Peiffer, M. Conforti, and P.

Delpiano, editors, *Les journaux savants dans l'Europe des XVIIe et XVIIIe siècles / Communication et construction des savoirs / Scholarly Journals in Early Modern Europe. Communication and the Construction of knowledge*, special issue of *Archives Internationales d'Histoire des Sciences* 63 (Turnhout: Brepols; 2013).

[9] G. Cantor *et al* (eds.), *Science in the Nineteenth-Century Periodical: Reading the Magazine of Nature* (Cambridge: Cambridge University Press, 2004); L. Henson *et al* (eds.), *Culture and Science in the Nineteenth-Century Media* (Farnham: Ashgate Publishing, 2004); G. Cantor and S. Shuttleworth, *Science Serialized: Representations of the Sciences in Nineteenth-Century Periodicals* (Cambridge MA: M.I.T. Press, 2004); A. Fyfe, *Science and Salvation: evangelicals and popular science publishing in Victorian Britain* (Chicago: University of Chicago Press, 2004); A. Fyfe and B. Lightman, editors, *Science in the Marketplace: nineteenth-century sites and experiences*. (Chicago: University of Chicago Press, 2007); B. Lightman, *Victorian Popularizers of Science: designing nature for new audiences* (Chicago: University of Chicago Press, 2007). This focus on the popular will be to some extent redressed by new work, such as M. Baldwin, *Making* Nature*: the history of a scientific journal* (Chicago: University of Chicago Press, 2015) and A. Csiszar, *The Rise of the Scientific Journal in Nineteenth-Century France and Britain* (Chicago: University of Chicago Press, forthcoming).

[10] J.A. Secord, 'Introduction: The Big Picture', *British Journal for the History of Science* 26:(4), 387-9 (1993).

[11] The conference was supported by the Arts and Humanities Research Council, and the Royal Society.

[12] AHRC grant AH/K001841.

[13] On 'literary replication', see J. Secord, 'Knowledge in Transit', *Isis* 95, 654-72 (2004), p. 660.

[14]A.R. Hall and M.B. Hall, eds., *The Correspondence of Henry Oldenburg*, 13 vols. (Madison, University of Wisconsin Press, 1966), 2: 210, Oldenburg to Robert Boyle (22 August 1664).

[15] Robert Moray to Christiaan Huygens, 13 February 1665 n.s., in *Oeuvres Complètes de Christiaan Huygens*, 22 vols. (Den Haag, Martinus Nijhoff, 1888-1950), 5 (1908) pp.234-5

[16] Henry Oldenburg, 'Advertisement', *PT* **2** (1667) 489-90.

[17] A. Johns, 'Miscellaneous Methods: Authors, Societies and Journals in Early Modern England', *British Journal for the History of Science* 33:(2), 159-86 (2000); and Marie Boas Hall, *Henry Oldenburg: Shaping the Royal Society* (Oxford University Press, Oxford, 2002), pp. 84-5. [AND OTHER REFS?]

[18] On early printers, see D.A. Kronick, 'Notes on the Printing History of the Early "Philosophical Transactions"', *Libraries & Culture* 25:(2), 243-68 (1990).

[19] Oldenburg, *Correspondence* II pp. 646-7.

[20] With the Oxford bookseller, Richard Davis (*Oldenburg Correspondence* II, p. 563); an additional 250 copies were printed that were not part of any profit-sharing agreement; 200 for the bookseller and 50 for Oldenburg personally.

[21] Oldenburg to Boyle, December 17, 1667. Oldenburg Correspondence, vol. 4 pp. 58-9.

[22] BL Sloane MS 4026 ff. 270-271

[23] *Lucina Sine Concubitu* (1750), *A Dissertation on Royal Societies* (1750), and *Review of the Works of the Royal Society* (1751). The first two were anonymously printed but the third appeared under Hill's own name. ~~ON HILL, SEE ROUSSEAU??~~On Hill, see George Rousseau, *The notorious Sir John Hill: the man destroyed by ambition in the age of celebrity* (Lehigh University Press, Bethlehem, PA, 2012), pp. 65-83.

[24] See RS JBO/22, 23 Jan. 1751/2

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

[26] RS CMB/90/1 (Committee of Papers minute-book).

[27] RS CMO/4 15 Feb. 1751/2.

[28] J. Peiffer, M. Conforti, P. Delpiano, *Les journaux savants dans l'Europe des XVIIe et XVIIIe siècles / Communication et construction des savoirs / Scholarly Journals in Early Modern Europe. Communication and the Construction of knowledge*, Archives Internationales d'Histoire des Sciences. (Turnhout: Brepols; 2013).

[29] Charles Blagden Diary, RS CB/3/3 f.8r, 3 July 1794; f.68r, 7 September 1795; f.77v 17 November 1795.

[30] See the pencil annotations on RS Letters & Papers, Decade IX, f.57.

[31] See for example the reforms proposed by the committee for reducing membership (RS CMB/1/20); and, notoriously, Charles Babbage's *Reflections on the Decline of Science in England* (B. Fellowes, London, 1830). The aftermath of the Banks presidency is discussed in M.B. Hall, *All scientists now: the Royal Society in the nineteenth century* (Cambridge University Press, Cambridge, 1984) pp. 17-62.

[32] The Register of Papers [MS/421 and following] is currently being transcribed into a Virtual Register of Papers database by our project team; it will ultimately be a rich resource for analysing editorial practice and the sociology of refereeing.

[33] RS CMP/7, 6 Dec. 1894.

[34] RS CMP/10, 21 May 1914.

[35] *Proceedings* split in 1905.

[36] P. Collins, 'A role in running UK science?', *Notes & Records of the Royal Society* 64:(Supplement 1), S119-S30 (2010). . On the Society in the twentieth century, see the other articles in the 2010 special issue of *Notes Rec. R. Soc*; and Peter Collins's forthcoming book on the post-1960 period.

[37] Figures provided by Royal Society publishing division.

[38] A. Weedon, *Victorian Publishing: the economics of book production for a mass market, 1836-1916* (Aldershot: Ashgate, 2003).

[39] M. Twyman, *Printing 1770-1970: an illustrated history of its development and uses in England* (London: British Library, 1998), Ch. 6. On the implications of this for science, see G. Belknap, "From a Photograph": Photography and the Periodical Print Press 1870-90 [PhD]: University of Cambridge; 2011, Ch. 2.

[40] Emergency Finance Committee, 1 Jul. 1920, CMB/86/1/2.

[41] This coincides with the so-called 'discovery phase' of modern journals, including the successes of Elsevier and Pergamon. See R. Campbell, E. Pentz, I. Borthwick, *Academic and Professional Publishing*: Elsevier Science, 2012), p.3.

[42] Total unrestricted income was £12.1m. See *Trustee's Report and Financial Statements* (London: Royal Society, 2014), p. 94, p. 82.

[43] Alex Csiszar's work particularly focuses on the early joint reports, and the issue of secret decision-making. A book-length study is expected: A. Csiszar, *The Rise of the Scientific Journal in Nineteenth-Century France and Britain* (Chicago: University of Chicago Press, forthcoming)

[44] The role of Stokes in the maturing of refereeing is the subject of a forthcoming paper by Julie McDougall-Waters.

[45] Analysis of decision times is based on our Virtual Register of Papers database. Some referees managed to report in less than a week, but there was a very, very long tail of referees who took much, much longer.

[46] They already overlapped significantly. For instance, by 1892 (if not earlier), the meetings moved to the pre-circulation of papers supplemented by discussion of selected papers involving 'experiments, diagrams &c' in an endeavour to make meetings more interesting, see CMP/6, 18 Feb. 1892.

[47] There was lengthy discussion of the merits of establishing sectional committees; Council approved them in CMP/7, 21 Feb. 1895; but then spent more months discussing how they should be composed, and how they should operate. There had also been sectional committees in operation in the 1840s.