

Forays Into a New Field: Experimental Science and the First Four Years of the Royal Society

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Introduction

The Royal Society and its role in seventeenth and eighteenth century experimental philosophy has been the subject of intense scholarly debate since the early twentieth century. Questions over the date of its foundation, over who was a member of the Society and what they achieved or contributed to early modern science, have been the source of countless essays and studies. This should not be surprising, as it was, in the words of Martha Ornstein, the ‘first among the pioneer reforming bodies of the century’.¹ This paper examines the first four decades of the Royal Society’s life, and through an examination of the existing and contemporary literature makes three arguments: first, the Royal was a body comprised of an eclectic band of men, most becoming fellows through connection rather than achievement. Second, it argues that the Royal Society comprised more an ‘open network’ rather than a closed circle of elites. Third, it argues that the experimental activities of the Society demonstrate the interests of individual members (notably Robert Hooke) steered the work of the Society, rather than the reverse.

Origins and Membership

Histories of the Royal Society (since Thomas Sprat’s first written history of the organisation in 1667) state that it was founded in November 1660. As Michael Cooper suggests, it is possible to chart the origins of the Royal Society back to 1645, when a group of professors with similar interests in the natural world began meeting informally at Oxford to discuss their research, experimentation and studies. Little is known about these early sporadic gatherings, but on 28 November 1660 these meetings suddenly became formalised regular events when the Royal Society at Gresham College in London was formed and where weekly recorded meetings began on Wednesdays at three o’clock.² Charles II became aware of the group’s interests and quickly supported its foundation, the name Royal Society can be seen in use from 1661, although the issuance of a first Royal Charter did not take place until 1662.³ In her 1960s book on the history of the Society, Margaret Purver laments the ‘general state of confusion’ over the question of when the Royal Society was formed. Her work dwells on the inconsistencies between the work of the

1 Martha Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Chicago: University of Chicago Press, 1963), p. 138.

2 Michael Cooper, ‘Hooke’s Career,’ in *London’s Leonardo: The Life and Work of Robert Hooke*, eds. Jim Bennett, Michael Hunter, Michael Cooper, Lisa Jardine (Oxford: Oxford University Press, 2003), p. 8.

3 ‘History’, *The Royal Society*, 2016, <https://royalsociety.org/about-us/history/>, accessed 22.10.2016.

Oxford-based groups in the 1640s and 1650s which included future Society members such as Robert Hooke, Robert Boyle and Samuel Hartlib and his associates, compared to the purposes for the foundation of the Society in 1660.⁴ Purver may have a point that the tendency to look before 1660 has been over-emphasised in some works. However, it is necessary to point out that many in the network of the 1660 Society were meeting for some years previously – the foundation of the Society should therefore be seen as a formalised consolidation.

Who were the men that formed the group at Gresham College in the year of the Restoration and what was the commonality between them? Despite holding a Royal Charter Michael Hunter points out that the Royal Society was, as an institution, ‘an almost entirely amateur body’ whose members came from a variety of backgrounds and occupations.⁵ Its members included the Viscount Brouncker (who would become its first president, Boyle having been the titular head for 1660-1662), Sir Christopher Wren, Henry Oldenburg, Robert Boyle and Robert Hooke to list some of the more eminent names; membership following the second royal charter in 1663 had reached one hundred and thirty one, a moderate growth in numbers.⁶

Hunter’s analysis of the membership of the Society in its early decade demonstrates that, despite its wide network of correspondents from across the country, it was representative of London’s society in the seventeenth century rather than England’s.⁷ Furthermore, there were notable omissions from its membership that historians may assume were natural candidates for membership, the instrument-maker Samuel Morland was never a member despite his well-documented connections to Hooke and others and his work in horological instruments.⁸ Defining those who were members along dangerously loaded social or ‘class’ distinctions can prove difficult and misleading, and Hunter instead looks at the occupations or livelihoods of the fellows and members as a means to examining the overall composition of the group. Analysing the total membership lists between 1660-1685, he concludes that fifteen percent were courtiers, politicians and diplomats, fourteen percent were those whose income came from independent means (such as lawyers, who comprised four percent) and thirteen percent came from the aristocracy⁹.

At first glance, this seems a varied and broad spectrum of members, but Hunter considers the number of aristocrats, courtiers and politicians overall to be ‘especially [...] high’.¹⁰ Further analysis in the 1980s by Lotte and Glenn Mulligan sought to determine if any patterns on the makeup of the members at different times is observable; they categorised the membership into five periods, each an affectation of the incumbent secretary’s own agenda and approach to admitting new members.¹¹ It is worth considering their conclusions in conjunction with Hunter’s broader, meta-analysis of professions. Mulligan and

4, Margaret Purver, *The Royal Society: Concept and Creation* (Oxford: Routledge, 2009): p.22.

5 Michael Hunter, “The Social Basis and Changing Fortunes of an Early Scientific Institution: An Analysis of the Membership of the Royal Society, 1660-1685”, *Notes and Records of the Royal Society of London* 31, no. 1 (1976), pp. 9-114.

6 Hunter, p.13.

7 Ibid.

8 Ibid.

9 Hunter, pp. 34-35.

10 Ibid.

11 Lotte Mulligan and Glenn Mulligan, “Reconstructing Restoration Science: Styles of Leadership and Social Composition of the Early Royal Society”, *Social Studies of Science*, 3, no. 3 (1981), pp. 327-364.

Mulligan examine the following five periods: The Original Fellows (1660-1663), Oldenburg's secretaryship (1663-1677), Hooke's secretaryship (1677-1682), The 'Eighties' and Sloane's secretaryship (from 1692)¹².

They argue the 'Original Fellows' were men of distinction in society rather than experts in natural philosophy and 'scientific' areas. The Oldenburg years were characterised by a declining membership and a move towards being more of a 'gentleman's club' with members selected more for their social rank. Hooke's years as Secretary saw more members of a lower social standing than previously joining and a renewed focus on utilitarian experimentation, whilst the 'Eighties' saw younger, more amateurish gentlemen of social standing joining, and Sloane's years, they conclude, led to a 'decline in the Society's reputation' as he focused on medical science.¹³ What stands out here is the fact that Hooke, of lower distinction, changed the social makeup of the Society during his time, whilst Hans Sloane (of higher social background) did the same during his tenure.

A 1998 article by David Lux and Harold Cook examines the subtle differences of so-called 'scientific networks' across Europe during the period, and categorises them as either 'closed' or 'open'. 'Closed circles' were elite, and they cite the Royal Society and universities as prime examples, whereas 'open networks' were much broader, less elite and more likely to be distant, correspondence-based relationships.¹⁴ At first glance, the Society was a closed circle in the sense that membership was not universal, and it was certainly not open to everyone who applied. However, as Mulligan and Mulligan's work shows, it was open to those of different social standing at different times, although this does not necessarily mean it should be considered as 'open'. Its correspondence network, however, regulated by Henry Oldenburg and centred around its publication the *Philosophical Transactions*, is a good example of the Lux-Cook definition of an 'open network' and one which they miss. Hence, a dilemma arises: do the Society's activities make it a closed circle, or an open network? To answer this, an understanding of the Royal Society's intellectual purpose, and subsequently an overview of its activities, is necessary at this point.

Intellectual Purpose

As a starting point, Michael Cooper is correct in that the major difficulty for identifying the Society's mission or purpose is that it supposedly had two, potentially complementary but more likely to be conflicting, outward aims: to at once be a 'learned society' and also a 'research institute' at the same time.¹⁵ As Adamson says in a 1978 essay on the intellectual foundations of the organisation: 'The debate upon the intellectual origins of the Royal Society has caused several historians to glance fleetingly at

12 Mulligan & Mulligan, pp. 329-330.

13 Mulligan & Mulligan, p. 352.

14 David Lux and Harold Cook, 'Closed Circles or Open Networks?: Communicating at a Distance During the Scientific Revolution', *History of Science* 35 (1998), pp. 179-211.

15 Cooper, p. 11.

Gresham College [for answers]'.¹⁶ The two were founded at different times and for different reasons; the college at Gresham was opened in 1597 through the bequest of the deceased Thomas Gresham, who stipulated that seven professors were to be paid for and whose duties would be to deliver daily lectures to the 'unlettered people' on 'divinity, astronomy, music, geometry, law, physics and rhetoric'.¹⁷ Adamson traces the convenient, practical solutions to the internal problems of both groups that being housed together solved: 'they lived together for fifty years. They were thrown together partly by accident but stayed together for so long mainly through self-interest.'¹⁸ But whilst the College's purpose was to deliver lectures on the classic subjects listed above, using ancient texts as the authority, the Society's purpose was altogether part of a much newer approach.

To this day, the Royal Society's motto remains the first means of understanding its mission: '*Nullius in verba*' which roughly translates from Latin as 'take nobody's word for it'.¹⁹ It was suggested as a motto by John Evelyn and adopted at a meeting of the Society in 1662.²⁰ Evelyn's choice of phrase gives an excellent and succinct insight into the rather complex intellectual purpose that led to the setup of the Society. In the seventeenth century, a number of thinkers (including Descartes and Francis Bacon to name two examples) began to theorise what the standard of authority in obtaining knowledge of the natural world should be. For scholars during the High Middle Ages, and the Humanists especially, this had been the ancient texts, perhaps most notably Aristotle and Cicero. These 'authoritative texts' were the gold standards of intellectual thought and understanding, that laid down the 'accepted framework of discourse and interpretation'.²¹ One of the issues advanced during the course of seventeenth century discourse was what interpretative framework should replace the Aristotelian dogma at a time when new 'discoveries' were being made, as thinkers moved to a more empirical mode of learning.

No longer was an ancient text of wisdom the standard-bearer of intellectual jurisdiction, in the seventeenth century this authority transferred to those directly involved in the pursuit of knowledge of the natural world. Peter Dear summarises how the purpose of the Royal Society reflected how fundamentally different the outlook of its members was, compared to previous generations, such as the lecturers Gresham would have had in mind:

When a fellow of the Royal Society made a contribution to knowledge, he did so by reporting an experience. That experience differed in important respects from the definition informing scholastic practice; rather than being a generalised statement about how some aspect of the world *behaves*, it was instead a report of how, in one instance, the world had *behaved*.²²

In other words, it was the actual event that a natural philosopher had himself personally observed or experienced rather than a general occurrence or theoretical understanding of the natural world; the latter

¹⁶ Ian Adamson, 'The Royal Society and Gresham College 1660-1711', *Notes and Records of the Royal Society of London* 33, no. 1 (1978), p. 1.

¹⁷ Ornstein, p. 100.

¹⁸ Adamson, p. 14.

¹⁹ 'History', *The Royal Society*, <https://royalsociety.org/about-us/history/>, accessed 22.10.2016.

²⁰ Peter Dear, 'Totius in Verbus: Rhetoric and Authority in the Early Royal Society', *Isis* 76, no. 2 (1995), pp. 144-161.

²¹ *Ibid.*, p. 149.

²² *Ibid.*, p. 152.

being exactly what the classical texts laid down. This was an important distinction and the implication of this shift in thought was a greater change in the emphasis of natural philosophy generally: the move towards experimentation, and the repetition of experimentation for verification, as the medium to channel observation and understanding natural phenomena. With experimentation, the authority was no longer bound to the wisdom imparted by a fifteen hundred year old text, but instead ‘rooted in the authority of the individual reporter as the actor in a well-defined, particular experience’.²³ In short, this was the early Royal Society’s common intellectual purpose: the style, rather than substance, of the ‘science’ that its fellows performed.²⁴ That style was to not rely on another’s word (such as Aristotle), as Evelyn’s motto confirms, but to experiment, observe and record.

Purver also argues that the group’s original ‘*raison d’être*’ has been clouded by the emphasis given to Thomas Sprat’s 1667 *History of the Royal Society* and the consequent misreading of the place and views of Francis Bacon within his *History* that have, in her view, led historians down the wrong path since the nineteenth century.²⁵ Much has been written by historians about the role and influence of Francis Bacon’s ideas on the state of nature and man’s understanding of the natural world and it is possible to see his earlier ideas taking effect in the Society’s work. It was Bacon, argues Barbara Shapiro, who was the ‘central agent’ in the ‘transformation’ of what was understood as a ‘fact’, from being one borne out of general Aristotelian consensus, to one that was particular, unique and derived from experiment.²⁶ Ornstein declares that the Royal Society was a ‘pioneer’ body in leading this experimental approach, but the intellectual origins, in England at least, lie with the influence of Bacon.²⁷

Activities

The work of the Society fell into two categories: experimentation and publication. Experimentation reinforced the authority of the witness or experimenter; the personal credit of a single experiment witnessed by one was worth far less than a series of experiments each producing the same output and witnessed by dozens.²⁸ Robert Hooke’s work for Robert Boyle on the air pump was well known and in 1663 he was appointed as ‘Curator of Experiments’ for the Society as a result of their work on this. The weekly demands that the Society placed on Hooke for demonstrations of experiments to observe natural phenomena, as well as those with a practical and applicable end, meant that the early Society came to rely on him for a substantive part of its work.²⁹ Experiments and demonstrations required instruments and Hooke’s expertise in this area was another factor that led to his appointment. As Lisa Jardine argues, technical instruments from the mid-seventeenth century onwards became ‘catalysts’ for advances in

23 Ibid., p. 157.

24 Ibid., p. 159.

25 Purver, p. 22.

26 Barbara Shapiro, *A Culture of Fact: England 1550-1720* (London: Cambridge University Press, 2003), p. 107.

27 Ornstein, p. 138.

28 Simon Schaffer, ‘Glass Works: Newton’s Prisms and the Uses of Experiment’ in *The Uses of Experiment: Studies in the Natural Sciences*, eds. David Gooding, Trevor Pinch, Simon Schaffer (Cambridge: Cambridge University Press, 1993), p. 67.

29 Jim Bennett, ‘Robert Hooke as Mechanic and Natural Philosopher’, *Notes and Records of the Royal Society of London*, 35, no. 1 (1980), pp. 33-48.

natural philosophy: microscopes, telescopes, pendulum clocks, balance spring watches, the air pump, are those she lists as particularly noteworthy.³⁰ Partly due to the wide-ranging nature of Hooke's role, these instruments are also ones in which he was closely involved with during his decades with the Royal Society.

An extensive analysis of all of Hooke's instruments and experiments is unnecessary at this point. It is important to emphasise that the race to improve these instruments by Hooke and many of those around him was a result of the newly assigned criticality of experimentation that Bacon had first encapsulated in his discourses. Jim Bennett argues that there are three facets to the role of scientific instruments in Hooke's work for the Royal Society: first, that instruments 'enlarge[d] the senses and [made] them more precise and reliable'; second, that instruments were conceived as 'useful device[s] [...] [with] a practical end'; third that experimentation with instruments led to the 'conceptualisation of a problem or the explanation of a phenomenon'.³¹ Bennett sees the first two as consistent with Baconian thinking, whilst the last is an addition typical to Hooke and the outlook of the Society that was generally 'not entirely original, but most prolific'.³² Nonetheless, it ties in with the intellectual origins previously discussed and the consequent use of instrumentation that was the hallmark of the group's work, with Hooke as curator at its centre.

Another revealing indicator of the growth in importance of instruments occurred at the time of a well-documented dispute between Hooke and a young Isaac Newton in the 1670s; Newton was invited informally to address the Fellows. When he presented a paper to the Society in 1672 stating that light was a composite of all colour, the instruments that Newton purported to have used to conclude this became a crucial part of the rather bitter and personal dispute over his findings between the two. Newton believed in what he referred to as the *experimentum crucis*; the implication that his critics, including Hooke, drew from this was that the replication of the trial of an experiment for verification was to Newton unnecessary, and therefore, without any successful replication, Newton's conclusions could not be verified.³³

Central to the argument between Hooke and Newton on his theory of light and colour was that others struggled to replicate Newton's experiment based on his account; crucially however, Newton's supporters defended his work by claiming those that failed to reproduce the experiment must have used defective *instruments*.³⁴ This reveals two things: first, the importance the society gave to Hooke in the realm of experimentation (unlike Newton, he was not a scholar); this was the Society's purpose and Newton's subsequent work is characterised by an emphasis on mathematical proof rather than experimentation. Second, for Newton and his supporters it was the supremacy of the instruments (if they failed) that was the most important part of the experiment. This was at the heart of the conflict: for Hooke and many of those in the Society, the authority in any experiment came not from the integrity of

30 Lisa Jardine, *Ingenious Pursuits: Building the Scientific Revolution* (London: Abacus, 1999), p. 9.

31 Bennett, p. 44.

32 Ibid.

33 Schaffer, p. 85.

34 Ibid., p. 92.

the instruments alone, but by the successful replication of an experiment and its observation by witnesses who had experienced it and the credit and authority that they gave. The argument between the two men and their supporters culminated in Newton's resignation from the Society in 1673, although he would return as the head of the organisation at the turn of the eighteenth century (in 1704 he published *Opticks*, demonstrating with proof his theories on light so savaged by Hooke).

The second element of activity that characterised the output of the early decades was the publication of the *Philosophical Transactions* (first in 1665), that was edited by Royal Society secretary Henry Oldenburg until his death in 1677. It is a commonly held view that the *Transactions* was Oldenburg's 'own project' and was essentially the publication of his correspondence with those with an interest in mechanical experimentation from across the country.³⁵ As he drew no wage as Secretary (the first four decades of the Royal Society were characterised by persistent financial woes; a key reason for its residence at Gresham) but the *Transactions* became increasingly profitable from the late 1660s with the emergence of advertisements from instrument makers especially.³⁶ Oldenburg had overall control over the content of the publication. Whilst the demonstrations of experiments restricted to the fellows of the Society was a sign of the 'closed circle' theorised by Cook and Lux as detailed earlier, the *Transactions* represents more of a grey area as earlier implied: in their essay, Cook and Lux describe correspondence based relationships as 'open networks'. At first this seems to indicate something of a conflict, but the role of the *Transactions* also fulfilled a function that perhaps actually reinforced the Society's 'closed circle' nature.

At the start of this essay, Ornstein's referral to the *Cimento* in Florence and the *Académie* in Paris as comparable but less pioneering organisations was alluded to. Mario Biagioli argues that the importance of the *Transactions* in the functioning of the Society came from a characteristic that was common to the *Cimento* and *Académie*, but was absent to the Royal Society: the role of princely patronage.³⁷ The organisations in France and Florence were established by their rulers (Louis XIV in 1666 and Leopold de Medici in 1657) and as such its members worked, and were paid, on behalf of their respective rulers at their behest. This has been a long-established point of divergence between the English and continental institutions, for whilst Charles II issued Royal Warrants indicating his approval, and in 1662 ordered that patents should not be issued unless the instruments were offered to the Royal Society for use first, the relationship was more of informal support and not what should be considered as princely patronage.³⁸ Biagioli argues that, 'paradoxically', despite being 'prince-independent' it was the Royal Society out of the three institutions that in fact 'constituted its authority in the republic of letters most like a king within his court' and it achieved this through the publication of the *Philosophical Transactions*.³⁹

This idea is linked to credit and Biagioli says that although the Society was not 'naturally endowed' with power, its authority was allowed to grow and its reputation sustained through the activity

35 Jeffrey Wigelsworth, *Selling Science in the Age of Newton: Advertising and the Commoditization of Knowledge* (London: Ashgate, 2010), p. 21.

36 Wigelsworth, p. 31.

37 Mario Biagioli, 'Etiquette, Interdependence, and Sociability in Seventeenth-Century Science', *Critical Inquiry* 22, no. 2. (1996), pp. 193-238.

38 Ornstein, p. 121.

39 Biagioli, p. 208.

of granting credit to its correspondents, whom he equates to ‘subjects’ through publication of their letters in the *Transactions*; this editorial power was then reflected back onto its readers as credibility and authority.⁴⁰ Critically, his theory on the authority of the *Philosophical Transactions* as a self-sustaining mechanism that reciprocally gave credit to others whilst simultaneously increasing its own, revises the application of the Lux and Cook hypothesis to the Royal Society. Whilst normal correspondence networks were open, Oldenburg’s was not: it was a tool through which the Society could remain closed, elite and consolidate their authority in natural philosophical and mechanical affairs. Oldenburg decided (and by default through him therefore the Society decided) what was worthy of publication and in doing so, positioned themselves as the arbiters of what was considered acceptable experimental practice.

Conclusions

This essay has given an overview of some of the complexities that the literature on early modern ‘science’, society and the Royal Society leads to when studying the early decades of the organisation. It has sought to explain the origins of the Royal Society, describe its early work, its intellectual origins and its purpose. There are many divisions amongst historians in almost all aspects of the Society (from its foundation to its theoretical inspiration) and this essay has argued that whilst the Society was founded as a corporation in 1660, the previous fifteen years of informal meeting amongst many of the network involved in the early decades should not be discounted as irrelevant, as some have tried to. It was during this time that the networks that became a closed circle were first forged. Finally, that it was a closed circle with membership more often decided on social connection than on ‘scientific’ achievement; a body that was able to design for itself, through its association with the King and its selective membership and through the *Philosophical Transactions*, a reputation as the power base for standards and advance in the English context of late seventeenth century natural philosophy.

⁴⁰ Biagioli, p. 209.

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