

History of Scientific Journals

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Abstract

Scholars who investigate the history of journals come from multiple disciplines and perspectives. Like those who have written about the history of professions and higher education. Mainly the fields that investigate the history of magazines are: the history of science, the history of the book, communications and information studies.

Academics in all these fields would probably agree that the research article is an important artifact that is produced from the larger socialization and bureaucratization trends of universities. Research articles became an exclusive writing genre for professional scientists. Despite the importance of the research article in so many different fields of scientific research, few scholars have investigated its origins.

Key words: Royal Society; history; journals; science; publications; academic communication; history of science; textual analysis.

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Historia de las revistas científicas

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Resumen

Los académicos que investigan la historia de las revistas provienen de múltiples disciplinas y perspectivas; al igual que aquellos que han escrito sobre la historia de las profesiones y la educación superior. Principalmente los campos que investigan la historia de las revistas son: la historia de la ciencia, la historia del libro, las comunicaciones y los estudios de información.

Los académicos de todos estos campos probablemente estarían de acuerdo en que el artículo de investigación es un artefacto importante que se produce a partir de las tendencias sociales más grandes de profesionalización y burocratización de las universidades. Los artículos de investigación se convirtieron en un género de escritura exclusivo para científicos profesionales. A pesar de la importancia del artículo de investigación en tantos campos diferentes de investigación científica, pocos académicos han investigado sus orígenes.

Palabras claves: Royal Society; historia; revistas; ciencia; publicaciones; comunicación académica; historia de la ciencia; análisis textual.

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História das Revistas Científicas

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Resumo

Os estudiosos que investigam a história dos periódicos vêm de várias disciplinas e perspectivas; como aqueles que escreveram sobre a história das profissões e do ensino superior. Os campos que investigam a história das revistas são principalmente: a história da ciência, a história do livro, os estudos sobre comunicação e informação.

Os acadêmicos de todas essas áreas provavelmente concordariam que o artigo de pesquisa é um artefato importante produzido a partir das tendências mais amplas de socialização e burocratização das universidades. Os artigos de pesquisa se tornaram um gênero de redação exclusivo para cientistas profissionais. Apesar da importância do artigo de pesquisa em tantos campos diferentes de pesquisa científica, poucos estudiosos investigaram suas origens.

Palavras chaves: Royal Society; história; revistas; ciência; publicações; comunicação acadêmica; história da ciência; análise textual.

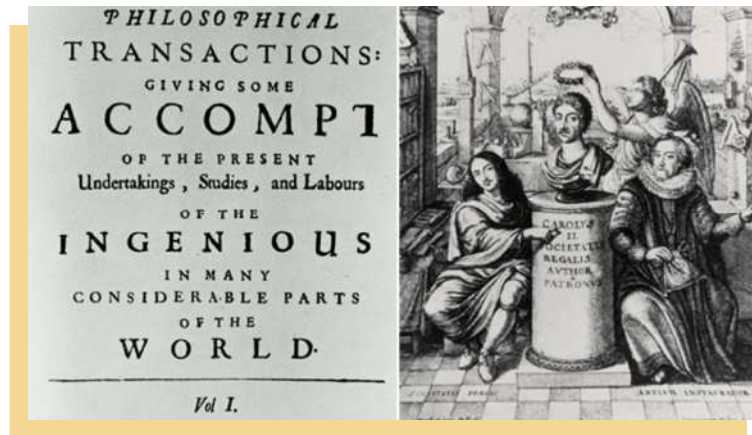
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Introduction

Within the body of scholarship about the history of journals, there has been much more written about the early history of academic journals in the seventeenth and eighteenth century than there has been about the development of research articles in the nineteenth century. Scholars have been chiefly interested in understanding the history of organizations such as the Royal Society, and its associated journals such as *the Philosophical Transactions of the Royal Society*. Generally, there has been less interest in journals begun at the time that American professional organizations such as the AAAS or the ACS were founded.

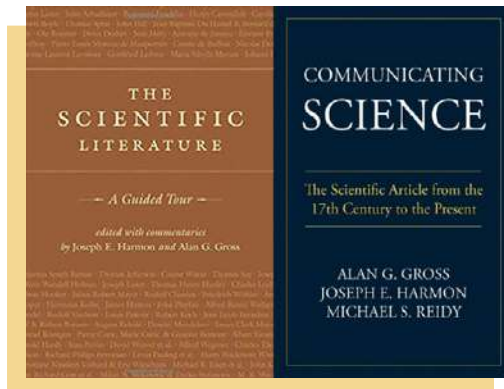


Primera revista científica "Transacciones filosóficas"

What interest there has been in the nineteenth-century period has two major constraints. First, this body of research has largely been confined geographically to Europe, particularly Britain and Germany. Additionally, this research has been written primarily by historians of science, thus limiting much of the application of the research to that field.

There is one research area that has cut across all of these historical periods, however: communication studies. More than any other research area, scholars studying rhetoric and composition have tended to cut across time and to write broad studies that span the course of hundreds of years. These studies, though valuable, have had one significant weakness, a tendency to use a relatively small set of articles as evidence to prove much broader points about the history of communication.

For instance, Gross, Harmon, and Reidy sample 100 passages from the *Philosophical Transactions* for their discussion of the seventeenth century and 188 passages from 37 English language journals for their discussion of the nineteenth century. Additionally, scholars in communication studies have tended to focus on the twentieth century and attempted to find the origins of modern composition in scientific articles in much earlier time periods.



This review will focus on just two time periods: the early history of scientific journals in the seventeenth and eighteenth centuries and the nineteenth century. These two periods in the development of the scientific journal can help to show two characteristics of early scholarly journals. First, it is possible to see how the developments in scientific writing shaped the most important aspect of histories of the journal. Second, one can trace the evolution of what started as brief reports of scientific

experiments in early journals to more well-developed mechanisms for producing research articles such as what might be found in modern scientific journals. Overall, the development of research articles began long before such outputs became a modern standard for tenure and promotion.

1. Early History of Journals: XVII and XVIII Centurie

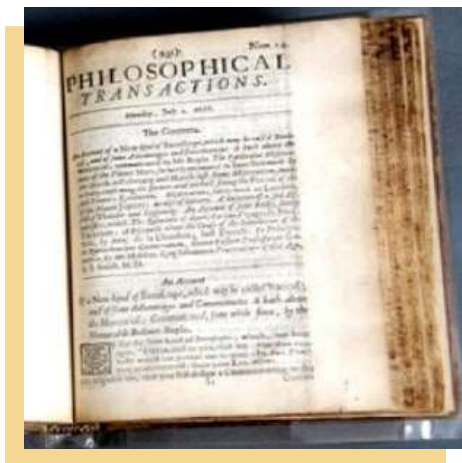
• Correspondence networks

It is important to note before even discussing journals such as the *Philosophical Transactions of the Royal Society*, that there had already been a long tradition of sharing research among scientists. Correspondence networks were an important part of early modern scientific communication, and, to a large degree, early journals relied on these pre-existing correspondence networks that persisted alongside journals throughout the eighteenth century. [1]



David Kronick has argued that letters between scientists and other natural philosophers had specific influential members who served as informal regulators of correspondence between members of these networks. Additionally, these organizations of correspondence provided for the institutionalization of many of the royal academies that developed in the seventeenth and eighteenth centuries. [2]

A prime example of an informal network that evolved into a formalized journal would be the correspondence network of Henry Oldenburg, later the editor of the *Philosophical Transactions of the Royal Society*. Oldenburg had a wide correspondence network and forwarded many of his letters to others who he thought might be performing similar experiments. Early issues of the journal often contained printed versions of letters Oldenburg received and which he believed would be of interest to other members of the Royal Society.

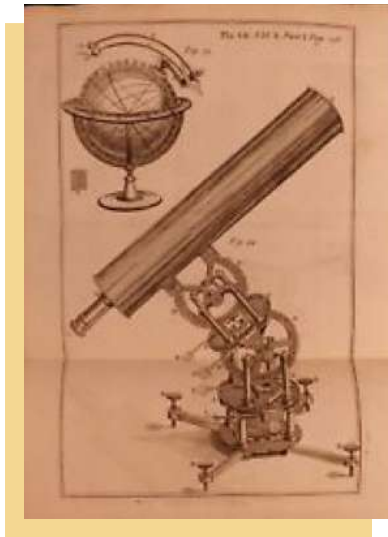


The informal networks of scientists working independently of formalized institutional structures has often been referred to as the “invisible college.” This invisible college of science is particularly interesting because, as Manuel Castells has argued, it transcended boundaries of both “spaces of place” and “spaces of flows” [3].

In other words, the scientific network was not bound by geographical constraints (spaces of place), nor was it bound by already existing trading routes (spaces of flows). Nonetheless, the correspondence network of scientists did create its own system of hubs and spokes based upon either certain individuals or geographical areas where scientists specialized in specific areas of study.

Therefore, the republic of letters was in many ways a precursor to what would become instantiated in the journals that would later print these letters of correspondence along with other genres of documenting research during the eighteenth and even into the nineteenth century. [4]

In fact, in the case of the *Philosophical Transactions of the Royal Society*, Henry Oldenburg played a major role in exploiting his correspondence network in order to create the journal for the Royal Society of London.[5]



In part because of the already existing scholarship on correspondence networks, the body of literature within history of journals in the seventeenth and eighteenth-centuries is probably the best developed and most diverse, including a wide variety of different studies from different disciplines. In the field of information studies, David Kronick has done extensive quantitative analysis on the types of scientific periodicals that were produced between 1665 and 1790.

Like Peter Burke, Kronick suggests that scientific publications were tied more closely to journalistic expectations of science, at least during this early period. [6] Communications theorists have also analyzed the research article using more quantitative methods and have come to the conclusion that rhetorical styles evolved significantly over time.



Revista Luciérnaga-Comunicación (2015). Edición N.13. Año. 7. Peter Burke. Multidisciplinariedad, Interdisciplinariedad y Especialización <https://www.youtube.com/watch?v=IOIFa9qels0>

The focus of communications scholars has been much wider than that of most historians, and communication scholars such as Alan Gross, Joseph Harmon, and Michael Reidy have argued that argumentative styles and the construction of fact are the two dimensions that have changed the most significantly between the initial formation of journals like the *Philosophical Transactions* and the scholarly media that exist currently.[7]

In all of these studies, scholars agree that there were two important factors that helped to create the phenomenon of the research article: authority and sociability. Authority has many different sources, and sociability, or the social realities of who was reading and who was writing these research articles, also contributed to the construction of authority.

Most of the research on the seventeenth and eighteenth centuries has focused on the social forces shaping the academies and societies, such as the Royal Society of London, that were developing during that time period. Like much of the history of journals in the nineteenth century, much of this research is concerned with the development of a social system of peer review. Additionally, many of these studies of journals in the seventeenth and eighteenth centuries have focused on the editors of particular journals and their assistants.

For instance, one example of a common focus of study is the founding editor of the *Philosophical Transactions*, Henry Oldenburg (1619-1677), who is often credited as the inventor of peer review. One reason many scholars focus on Oldenburg is because, officially, the *Philosophical Transactions*, at least in the early period, was not a publication from the Royal Society; it was a project of Oldenburg himself. Nonetheless, most contributors and readers of the periodical viewed the journal as a sanctioned publication of the society. [8]

In fact, Oldenburg's influence gave the *Philosophical Transactions* an authority that other journals did not have. For instance, many of the communications of the *Académie des Sciences*, were the product of a very loose confederation of authors and disciplinary clusters making it difficult to see which individuals or groups were actually behind particular categories of research. [9]

Oldenburg on the other hand possessed a large network of correspondents, some of whom were named specifically and

some of whom were not. Because of this network, Oldenburg was able to create a "textual representation of the scientific debate - an instrument for the construction of a 'collective intelligence'" which was unique in Europe. [10]

Robert Iliffe has identified another form of authority for editors like Oldenburg during the early modern period, including within journals like the *Philosophical Transactions*. During this period there was an explosion of information of various types, and even within England, there were several periodicals, such as the *Mercury*, that purported to provide scientific information.

Even though journals like the *Mercury* did not carry the imprimatur of the Royal Society, they did report on scientific news and from the point of view of many readers might have been seen as a legitimate source of news about scientific matters.

Also, within the periodical press, there were many attacks both on the character of individuals and on the ideas they presented. Iliffe suggests that, "in the Royal Society, whoever could successfully manage his name and identity was king, as was whoever controlled the public credibility of his targets." [11]

In the case of the *Philosophical Transactions*, Oldenburg controlled both the identity of authors and, if necessary, the credibility of those with whom the author might disagree (the "targets"). Therefore, editors like Oldenburg provided an essential service as a facilitator between the reader and the author.

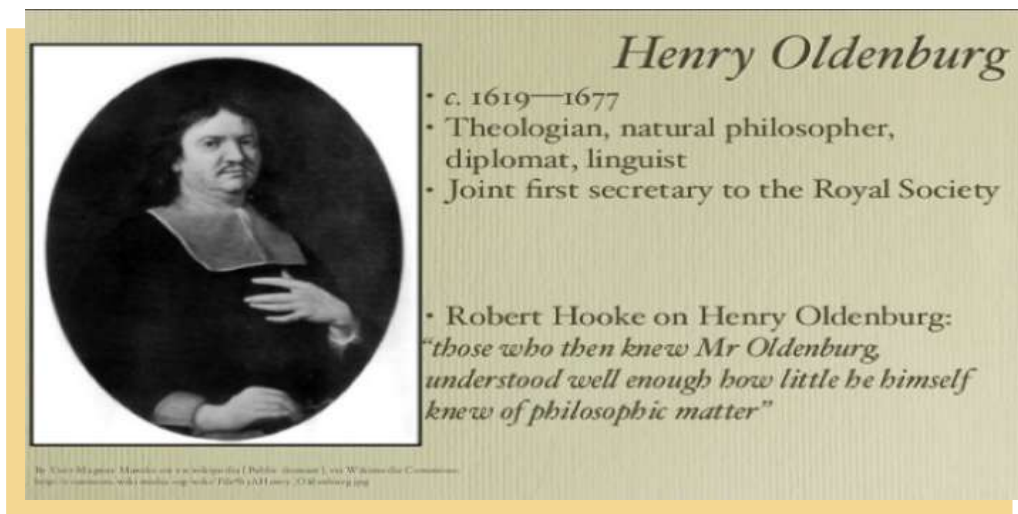
Overall, editors like Oldenburg provided a source of authority on multiple levels, including within the *Philosophical Transactions*. On the one hand, such editors were a source of authority that could mobilize a network of scientists and provide a newsletter for scientific issues throughout Europe. However, later editors saw themselves as advocates for promoting individual methods or scientific experiments within the Royal Society.

Noah Moxham has stated in his history of the Philosophical Transactions that, "Oldenburg's periodical had put the Society at the centre of a network of scientific communication; Grew's and Hooke's respective publications had the capacity to demonstrate its productivity in matters of research". [12]

Both of these views of editorial authority, however, rest on an assumption that these editors are getting their content from the

source of some type of individual author. The authority of those authors, in turn, helps the editors to maintain their influence both over the journal and within the broader research communities of which the editors were a part.

Individual authorship within the Philosophical Transactions is somewhat difficult to trace. In particular, during Oldenburg's editorship, his voice was quite strong and often tended to overshadow individuals writing to him. [13]



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Scholars have had different views about the role of this early period of the academic journals with David Kronick for instance suggesting "authority and credibility in science, nevertheless derived ultimately from the author or originator of the work." [14] Mario Biagioli on the other hand has argued for a more collective authorship in which individual voices were downplayed. [15]

Ellen Valle, however, suggests that the seventeenth and early eighteenth centuries are a transitional period in which the editor's role shifts with, "the relationship observable in the texts between the editorial and the authorial voice, and the gradual emergence and strengthening of

the latter at the expense of the former." [16] In a way, individual authorial credibility during the early period of academic journals derives from hybrid sources. On the one hand, individuals have some credibility.

On the other hand, their credibility rests with an editor's ability to validate results and to channel the patronage and authority conveyed by the editor's authorizing institution or journal. In other words, though the editor's role may diminish in terms of what a reader can visibly see in the periodical (in terms of whose name is attached to an individual piece of writing), the editor still conveys greater authority to individual authors.

David Kronick has also suggested that individual authors during this period were not the source of authority themselves but rather, "an 'expert witness.' In other words an author's credibility and authority are established through a system of social and intellectual controls which apparently have not yet been adequately analyzed or described." [17] In the thirty years since Kronick's book was published, however, Biagioli and other scholars have described the development of these social controls.

Biagioli argues that the social norms of authors and editors are a product of patronage and the authority of the governing body, "The recognition of individual authorship... effectively allowed the academicians to articulate institutional protocols so that they could legitimize their work through their own interdependence rather than through their dependence on the prince." [18]

Ellen Valle takes a more practical view and sees the editor's role not as a form of legitimation but rather as a way of regulating the flow of information. [19] Overall, however, all of these scholars recognize that individual authors have a certain amount of credibility, and that reliability is enhanced by the editor, the editor's network, and, most importantly the institution that the editor represents.

Scholars have also identified a second source of authority beyond authors and readers. Institutional authority is perhaps the most important of these types of authority and in fact combines the separate authorities of the government, editor, and author. Most importantly, however, institutional authority rests on the ability of multiple witnesses to read and verify the researches of individual authors.

David Kronick compares the power of institutions like the Royal Society to a court of law where the authority of an individual is tied to the credentials that an individual institution conveys upon it. To prove his point Kronick discusses two particularly relevant examples. First, the Académie des Sciences had particular regulations about what needed to be witnessed in order to be printed in their journals, and apparently the Académie de Chirurgi went even further in their regulations which forbade individuals from using the name of the society without similar witnessing "on pain of exclusion from the society." [20]

Biagioli agrees in part with the arguments that Kronick makes, but suggests that the authority of institutions is not necessarily in the credentials that they convey and the regulations they make in order to enforce those credentials, but rather the network that they provide which legitimizes the work of individual authors. [21]



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2. writing articles XVII and XVIII Centurie

All of these social factors arguably affect the very ways in which articles are written, or how genre is created during the seventeenth and eighteenth centuries within these early academic journals. *Philosophical Transactions* contains several different genres of writing. These genres are fairly mercurial and can often appear somewhat differently even within a single issue. Nonetheless, there are three categories that appear consistently during the late seventeenth and early eighteenth century: **book reviews, correspondence reports, and registers.**

Two of these categories, book reviews and correspondence reports, are dominated by an editorial voice, and in many cases were actually written by the editor himself. The third, registration, or the publication of experiments that had been observed and witnessed in front of members of the Royal Society, was still heavily influenced by the

editor, but at the same time takes on the voice of individual authors.

Over time, a new genre began to emerge, an idea of reports on original research which now of course is common and expected within academic journals, but during this period was still not fully developed. This nascent concept of a “research article” became a tool that Lorraine Daston described as a repository of data that scientific practitioners could use to test their own theories, or a tool “for discovering invisible patterns and regularities as a first step to building theories.” [22] Furthermore, Daston has suggested that this tool eventually became and is now considered the cornerstone of research communication, but in the seventeenth century that concept evolved quite significantly.



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Thus, knowledge claims, “research articles”, or perhaps more appropriately stated knowledge claims about experiments, came to be registered publicly through the *Philosophical Transactions* rather than just the Royal Society’s public register. The official move to institutionalize a procedure of registering knowledge claims did not happen until 1752 when the Royal Society officially acknowledged the journal as its publication and assured that there were editors who could maintain continuity over time.

Noah Moxham identifies “two strands of Royal Society publishing, both of them more closely tied to the institution than any that had

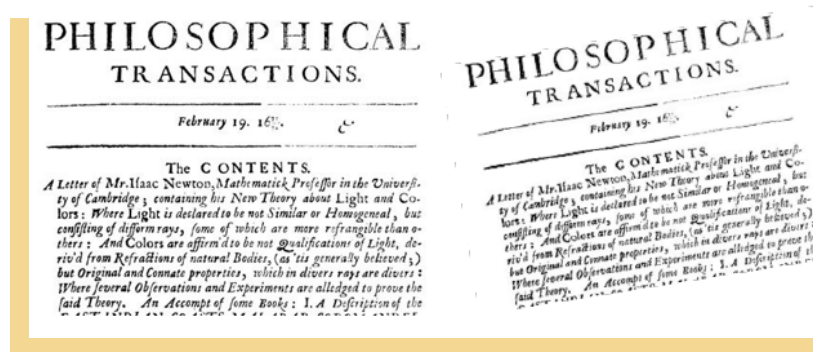
previously existed: one formally linked to a renewed programme of experimentation and the other taking advantage of a repository of material languishing unpublished in the Society’s archives.” [23]

Thus a new idea of what should be included in a journal emerged. In the eighteenth century the journal of a scientific society, at least that of the Royal Society, was not simply a method for creating news about scientific issues throughout Europe; nor was the journal a mechanism for extending such news by reviewing books that related to the journal’s content. Furthermore, the journal was not about maintaining a correspondence of scientists throughout

Europe, as Oldenburg had done. Rather, the *Philosophical Transactions* became a way of registering knowledge.

It is important to point out that the individual articles within the journal were still not “research articles” in the modern sense, even in the midst of this evolution. Articles were not peer-reviewed, “the Society did and did not peer-review the journal: it reviewed each issue of the *Transactions* as a book, but did not select each article through peer review.” [24]

There was also still some doubt as to what the journal should contain. Edmond Halley in 1714 stated that the function



Nonetheless, despite these multiple views of what the *Philosophical Transactions* should be, there is one indisputable fact. By 1752 it was no longer the same type of publication that it had been in 1665 when it started. By 1752 the journal was now publishing and registering knowledge claims both by its own members and by correspondents outside of the society.

These knowledge claims took a new form that was very different from simply edited reports of what others were doing. Individual authors became more prominent, and the essential elements of what would

of the periodical should only be about preservation of tracts too short for a book, publication of letters, and printing of experiments performed at society meetings, despite the fact that the journal had long been doing things very different from this. [25]

Furthermore, the Royal Society itself long debated whether *Philosophical Transactions* was the appropriate venue to register knowledge claims. At times the society appeared to think that the journal should only be for foreign correspondents. At other times it felt that the journal should only be for knowledge that the society itself could register and exploit. [26]

eventually constitute the “research article” took shape from a combination of genres, social practices, and authorities.

All of these forces combined to evolve into a new form of knowledge claim for which the *Philosophical Transactions* became a primary provider throughout Europe. It was, however, a mechanism that had a unique combination of important characteristics that helped it to become both the hub of a network and a forum to present knowledge claims that may in turn have influenced the development of research elsewhere. [27]

3. Later History of Journals: XIX Century

The evolution of the research article continued even beyond the eighteenth century. Communications scholars such

as Alan G. Gross, Joseph E. Harmon, and Michael Reidy in addition to studying the rhetoric of scientific writing during the

seventeenth and eighteenth centuries have also extended their studies into the nineteenth century.

Within this later time-period, these researchers have noticed two particularly important changes in scientific writing. First, scientific articles in the nineteenth century became more interested in establishing

the concept of "fact" or what science could do to establish laws, principles, and methods that constitute something being definitively known. Prior to the nineteenth century, science was interested more in philosophical speculations that tried to relate scientific observations to religious or social theories about the nature of the world.



In the nineteenth century such practices changed, and scientists were not interested as much in proving philosophical precepts but were interested in establishing ideas that could be determined as definitively true. In part these changes were a result of professionalization; as more and more disciplines established authority over certain areas of knowledge, the focus of research narrowed to more definitively provable questions.

In part this interest in fact was because of overall changes in the philosophical principles of science which during the nineteenth century changed from a method of study that tried to link scientific phenomena to theological principles toward a more empirically based methodology. [28] Furthermore, the method for establishing these facts became the process of experimentation and quantitatively measuring observed

phenomena in nature.

Secondly, and somewhat ironically considering the first move away from philosophical speculations, the field shifts from what was initially a science of description into a field of theory in part because the phenomena being described were often quite complex. Therefore, the sciences were interested in determining causes of phenomena. These causes were, however, different from the methods for establishing causes utilized by scientists in previous centuries.

The causes scientists strove to understand were determined by observable facts, not by a-priori philosophical suppositions. For physics and chemistry specifically, "the move is steadily in the direction of turning qualitative into quantitative facts and in creating a permanent reciprocity between experiment and theory." [29]



Rom Harré, a philosopher of science and social theorist has tied some of the themes identified by Gross, Harmon, and Reidy into his more generalized theories about social affordances within science. By drawing both Wittgenstein's theories on hinge-practices (a supposition that precedes from a certainty) and mereology (a relation between the whole and the parts) Harré argues that scientists were able to theorize more effectively when they limited themselves to only parts of a whole. By doing so they were able to create more effective models through inferences about a rather limited set of observations.

According to Harré "The evidence for these inferences comes from the *affordances* which are disciplined with respect to realist or heuristic interpretations by attention to *hinge-practice and hinge-proposition*

pairs which incorporate the working metaphysics of an era." [30] According to Harré modern philosophy of science is an extension of some of the earlier trends identified by Gross, Harmon, and Reidy. Less philosophical studies like those of Charles Bazerman, have focused on rhetoric and have been particularly interested in the historical development of scientific arguments within journals. [31]

Like the studies of Gross Harmon, Reidy and also of Harré that have discussed some general trend in the evolution of scientific research articles during the nineteenth century, much of the work focusing on the historical contexts of journals and their role in the construction of scientific fact has also focused on journals in Britain and Europe. The situation in Europe was quite different from the United States.

4. Scientific Societies

Generalist societies like the Royal Society of London had formed in the seventeenth and eighteenth centuries, and, as a result, when research questions began to become more specialized, new more focused academies on subjects such as astronomy or botany formed; these organizations were often also supported by the government, particularly in Britain and Germany. Like the Royal Society these specialized academies produced journals. In contrast, within the United States, there was no government-sponsored general science society.

Therefore, these more specialized academies never formed. It was not until the formation of professional associations in the late nineteenth century that the manner of specialized scientific publishing common in Europe in the late eighteenth and early nineteenth centuries began in the U.S. [32]



Csiszar, like many of the scholars focusing on seventeenth- and eighteenth-century scientific publication, is particularly interested in the development of peer-review and does not focus as much on the links between professionalization and the development of universities. Melinda Baldwin's research on the other hand focuses on more than just peer-review practices, but only in relation to a single journal, *Nature*, also a British scientific journal.

Csiszar concentrates primarily on the development of scientific authority in nineteenth-century Britain. During this period, the idea of a peer-reviewed scientific journal was still very much under development, and scientists tended to publish not in the specialized journals produced by the various state-sponsored academies, but rather in newspapers of the time. According to Csiszar, there were two categories of institutional

authorities that became prominent in the nineteenth century that were quite different from earlier periods.

The first of these were indexes. During the nineteenth century, important men of science would create indexes of the most important scientific discoveries and publish them either in newspapers or quite often as books. The second source of authority, related to the first, was the government that utilized these indexes and created its own indexes for use of government officials within the U.K. and its colonies who were tasked with scientific work.



These two types of authorities combined, according to Csiszar, address "the failure of the authority of the collectives that had traditionally adjudicated the boundaries of scientific authority." [33] Thus, it was particularly because of the failures of the state-sponsored academies to effectively create scientific authority that scientists turned to the periodical press. Because of the proliferation of scientific articles coming out of these presses, indexes became more necessary, and those indexes became the primary source of authority for scientists in Britain particularly, and to a degree in other countries of Europe.

Csiszar links these authoritative indexes into another area often discussed by other scholars interested in the history of journals: genre. In "Objectivities in Print" Csiszar makes arguments quite similar to Harmon, Reidy, and Gross, that during the nineteenth century, there was a greater interest among scientists to create a sense of objectivity in the articles that they were writing. [34] Yet, Csiszar makes a further distinction that also reflects some of the points made by Harré.



Csiszar emphasizes that scientists were responsive to particular communities, and, during the nineteenth century, "the scientific literature did not develop purely as a means of guaranteeing objectivity within expert communities. Rather it evolved through the relationship that these communities have cultivated with the wider polities within which they are active participants." [35]

In his book on the history of the British journal in the nineteenth century, Csiszar emphasizes these points by suggesting that, "journals became not only the purveyors of scientific news but also archives of discovery, it became more common to conceive of science as a series of discrete discovery events localized in time and connected with an individual author." [36]

These expert communities of authors were becoming specialized and focused not on large generalized wholes, but rather on more focused areas of science. Overall, the genre of objective scholarly articles was part of a larger response to a scientific reading community within the U.K. and France that was interested in increasingly specialized content.

Melinda Baldwin's work *Making Nature* serves as an excellent complement to Csiszar's more general research on scientific periodicals in nineteenth-century Britain. Baldwin is also researching the same general time-period of the middle to late nineteenth century

for the first half of her book (the second half discusses developments in the twentieth and twenty-first centuries).

However, Baldwin looks only at one of these journals, *Nature*, that arguably today is one of the most significant scientific journals. Baldwin emphasizes many of Csiszar's points about the increasing demand by audiences for scientific content. In fact, when *Nature* was founded, editors emphasized the fact that they were not a specialized journal but rather a type of periodical that was meant for anyone interested in science. [37]

Over the course of the century, however, that dynamic changed and *Nature* became a specialized scientific journal that, unlike many other journals of the time, was able to get its issues out more quickly than others, and, as a result, to be picked up by the indexes more swiftly. [38] Interestingly, because of Baldwin's long scope of investigation, she makes a particular point of trying to tie *Nature's* earlier history to more modern developments, especially peer-review.



Baldwin argues that, "it is tempting to view *Nature's* editorial staff as all-powerful gatekeepers of scientific success.... Since 1869, researchers have chosen *Nature* as a publication venue not because an anonymous authority decreed that *Nature* would be important but because they found that journal particularly useful." In other words, the reasons that *Nature* has been successful have differed tremendously over time, and even changed over the course of the nineteenth century.

The work on journals in the United States, at least nineteenth-century journals, is much smaller, in part, because the number of specialized scientific journals in the U.S. was also much smaller. In fact, there was only one major scientific journal published consistently throughout the nineteenth century in the U.S.: the *American Journal of Science* which began publishing in 1818 and continues into the present day.

Though this journal also existed for many of the same reasons as the journals in Britain and Europe, the *American Journal of Science* also included a genre of scholarly writing that was quite different from its European counterparts during the nineteenth century: news from the field. The news found in the *American Journal of Science*, though it bears some resemblance to correspondence reports on experimental research found in British journals, was a more important feature of scientific journals in the United States during the late nineteenth century than European journals during the same time period.



According to Simon Baatz, the *American Journal of Science*, the primary journal for American science throughout most of the nineteenth century, was able to bring together divergent metropolitan groups in cities like New York, Philadelphia, and Boston in ways that more localized journals such as the *Transactions of the American Philosophical Society* were not. [39]

Furthermore, the *American Journal of Science* dedicated much of its content to “announce such developments as the founding of scientific societies, changes in curricula in the colleges, reviews of new textbooks” and other news that basically inscribed the very cultural and social affordances described by Harré that were developing in the United States at the time.[40]

This news function of journals in the United States sets it apart from its counterpart journals in Europe. Whereas Europe was quite specialized in scientific knowledge production as early as the eighteenth

century, the methods and organizations for producing science in the United States were much less established until the late nineteenth century, as Reingold suggested when discussing the state of the professional field. Therefore, the most prominent journal in the United States during the nineteenth century may also have been reflecting the professional state of the scientific community at the time.

News was not the only category of material published in the *American Journal of Science*, however. Overtime, it also became known as a place for quality content and scientific research articles. As Gross, Harmon, Reidy and Harré have pointed out, there was a tremendous emphasis on establishing fact. The *American Journal of Science*, perhaps because of American preferences for more practical and less theoretical science discussed by Alexandra Oleson and John Voss, also skewed more toward publication of practical and factual observation of science rather than generalizing theory.[41]

5. The Intersections of Institutionalization, Professionalization, and Journals

In all, in addition to promoting useful knowledge through facts and quantifiable observations, scientific documents in nineteenth-century America, through journals such as the *American Journal of Science*, were ways of inscribing developments in colleges and professional societies at the time. These observations

about inscriptions and professional development have long been noted by scholars of information science, especially those within the field of archival studies and diplomatics. Luciana Duranti, in discussing scientific documentation has suggested that, “the form of a document reveals and perpetuates the function it serves.” [42]

Similarly, Fiorella Foscarini, also within the field of diplomatics, has suggested that “genres provide social codes of behavior including not only the official ‘rules of the game,’ but also any other components of ‘ceremony’... surrounding the main ‘moves’ of the game - that all those involved in a dialogic exchange must learn in order to be able to ‘act together.’”[43]



According to Foscarini, genre theory also provides a way for researchers studying particular genres to “learn how to master the genres of specific workplaces with the aim of becoming full participants in their professional communities and it includes issues of identity building, ideology, and power relations.”[44] In other words, genres also allow researchers outside of these situated social constructs to understand how these practitioners are using forms of writing that reflect the rules by which their professional games are played.

In the case of scientific journals and research articles in the nineteenth-century United States, the rules of the game are very similar to those that Abbott suggested, a linked information ecosystem of social affordances including universities,

industry, and professional associations that perpetuate a method for industry to replicate itself through students and through practical research useful for exploitation of industry.

This “linked ecology” also plays an essential role in legitimating many of the acts of inscription that are noted by Duranti and Foscarini. More importantly, this linked ecology helps to instantiate the hinge-practices and material affordances of journals that are particularly important within the scholarly communication ecosystem.

These hinge mechanisms created by cultural, social, and material affordances include specialized disciplines, journal publishing, and higher education bureaucracy, and are a part of a long narrative going perhaps as far back as the seventeenth century when organizations such as the Royal Society first emerged at the beginning of the scientific revolution. Most certainly these issues date to the late nineteenth-century in the United States. At a time when research universities were still in their infancy, when scientific journals served as a source of news in addition to research, and at a time when professional disciplinary societies were just beginning to define themselves, the scholarly communication system first began to take shape, and continues to evolve even now.

There has already been extensive research on all of the aspects of scholarly communication such as the history of professionalization and universities as well as the history of journals. Yet, if one is to really understand the complete history of scholarly communication, it is necessary to understand how all three of these components of the infrastructure of scholarship interrelate.

6. Pre-History of American academic communication

Systems for publishing and sharing ideas existed long before formal journals or scholarly societies appeared in the United States, and many of the methods for distributing scholarship in the United States were based upon models that European academies and government-sponsored institutions created. Yet, there were some significant differences

between the institutionalization of science in the United States and in Europe, specifically Britain, France, and Germany. First, there was little if any government sponsorship of scientific activities in what would become the U.S.

Most scientists in the American colonies and early Republic were either members of European academies and societies or were strongly tied to the European Republic of Letters. Second, unlike many European countries, the United States was highly decentralized both geographically and politically. In Europe the central government usually controlled universities or were major sponsors of societies such as the Royal Society of London.

The United States on the other hand, often relied on individual citizens to sponsor scientific pursuits with little or no government support. Finally, because there was no established system of scientific organization, there were significant struggles for power among individual scientific leaders about who should control science. This distinctive American situation led to a unique blending of scientific authority vested in societies and universities that was quite different from European models of scientific organization. How did this American state of affairs for scientific organization evolve? From 1660 - 1746 scientists in the American colonies had no professional societies of their own and were often part of groups like the Royal Society of London (founded in 1660) or other European academies and societies.



In 1746, Benjamin Franklin and fellow businessmen in the city of Philadelphia founded the American Philosophical Society, America's first learned society. By the early nineteenth century, Philadelphia was host to several such groups including the Franklin Institute and the Academy of Natural Sciences. Boston had rival groups like the American Academy of Arts and Sciences, and New York the Lyceum of Natural History.

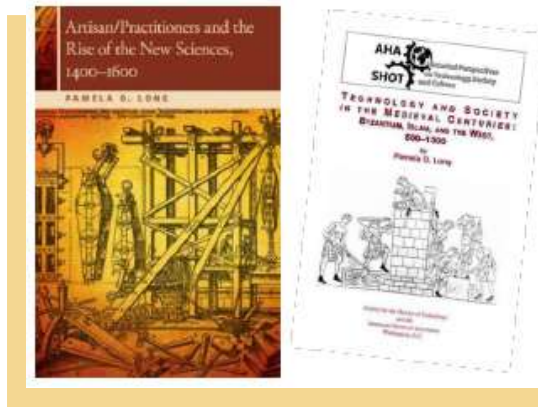


In the 1840s, there were efforts by prominent scientists to establish national organizations and institutions. The American Association for the Advancement of Science (AAAS) became the predominant such national group. That outcome was by no means inevitable, however. In fact, the founders of what became the American Medical Association and the American Association of Geologists and Naturalists both vied for dominance in the early part of the nineteenth century, and their struggle in part contributed to the split professionally between medical practitioners and other forms of science in the United States.

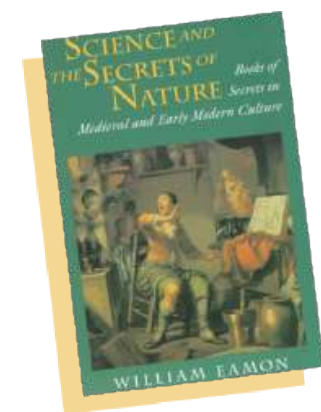
• Early Science in England

Los historiadores de la ciencia medieval y del renacimiento han debatido durante mucho tiempo. Historians of medieval and renaissance science have long discussed how practitioners thought about disclosing their results during the early period of science. Pamela Long has researched the notion of authorship all the way back to Greek and Roman times and has proposed several important concepts relevant to all scientific endeavors.

First, she has suggested that particularly during the earlier periods of scientific discovery there was a separation and mixing of two kinds of practice, artisanal or applied knowledge and academic/esoteric work. Long also argues that there were “trading zones” in which people moved between these two spheres with relative fluidity. She goes on to suggest that in the modern age, such trading zones are less fluid because of current requirements (university degrees, licensure, etc.) to be considered a professional. [45]



William Eamon has also investigated the early history of science in Britain and tried to understand the divides between practical and esoteric knowledge. Eamon discusses the foundational figure, Francis Bacon, who is often credited as the founder of modern science. Eamon has found in Bacon's enterprise a divide similar to that articulated by Pamela Long.



On the surface, Bacon and his followers condemned the kind of “esoteric” knowledge that was utilized by alchemists because they thought that it inhibited the progress of science. On the other hand, one of the reasons that Bacon believed that the arcane wisdom [of the alchemists] should be avoided was because he believed that there was a natural division between different kinds of knowledge,

“Whereas God forbade inquiry into the precepts of morality and religion which are to be accepted on faith, he argued, inquiry into nature's secrets are not forbidden.” [46]

In other words, theology, philosophy, and other types of theoretical learning were outside the bounds of what “science” was. Bacon believed that science should utilize the mechanical arts, or the kinds of artisanal knowledge that Long identified rather than philosophy because

“philosophical systems flourish at the hands of the first author” and “stand like statues worshipped and celebrated but not moved or advanced.”

Bacon creía que las artes mecánicas tienen “en ellas un soplo de vida [y] están Mechanical arts, Bacon believed, have “in them some breath of life [and] are continually growing and becoming more perfect.” [47] Therefore, according to Bacon, philosophical inquiry should be left to others and scientists should devote their own work to discovery of the “facts” of nature, a precept later institutionalized by the Royal Society of London.

Not all members of the Royal Society agreed with Bacon, however. Robert Boyle for instance feared that the Royal Society might give unwarranted access to “privileged knowledge” and alchemical secrets to people who would not be morally equipped to understand them. Additionally, John Evelyn, another of the Royal Society's founders, was himself interested in alchemy.

Though Evelyn largely supported Bacon's ideas and also believed in the same division between mechanical and what he called “aristocratic” or esoteric arts, Evelyn suggested that there should be a hierarchical ranking of knowledge supported by the Royal Society starting at the bottom with the “Useful and purely Mechanic” (artisanal knowledge) at the

bottom and ascending to “Exotick, and very rare Seacretts” (like alchemy) at the top.

Evelyn later opted against working with the Royal Society on such projects, however, because he believed that publishing his results would “debase much of their esteem by prostituting them to the vulgar” and would be similar to “conversing with mechanical and capricious persons.” [48]

THE ROYAL SOCIETY

There was something else underlying both Boyle’s and Evelyn’s concerns, however. Steven Shapin has argued that in the seventeenth century there was an underlying assumption that one could not practice science unless one was a “gentleman.” Being a gentleman required

several overlapping requirements “a secular knightly code which laid great stress upon blood, individual honor, and reputation; a partly secular humanist culture of virtue which sought to define and defend gentry by displaying sanctioned codes of social behavior; and a highly Christianized culture of virtue.” [49]

Thomas Sprat in his history of the Royal Society, published shortly after the society’s foundation seems to confirm Shapin’s argument. Sprat states that, “the Society entertains very many men of *particular Professions* yet the farr greater Number are *Gentlemen*, free and unconfin’d.” [50] As a result of this underlying assumption, Eamon suggests that practically speaking, the Royal Society was restricted only to creditable gentlemen who were “worthy of the scientific calling.” [51]



Thomas Sprat (1659-1720)

There were of course other reasons for limiting membership in the society beyond the class limitations identified by Shapin. Michael Hunter has suggested that there were practical financial reasons for including members of certain classes within the Royal Society. [52]

Hunter has also argued that membership in the society became more widely spread among the classes over time, but there remained a certain level of education that was common to all people who attended meetings of or were affiliated with the Royal Society. [53]

Nonetheless, regardless of whether the main criteria for including some people

in the Royal Society and excluding others were for class, financial, or educational status, one additional factor was paramount. In English society at the time, there was a great divergence of views on religion (Puritan and High Church), on philosophical precepts of science, and on politics. [54]

Thus, for the Royal Society to maintain its scientific authority, it was necessary for it to find a strictly defined philosophy that would avoid very difficult political and social topics. The solution was to espouse “mechanical philosophy” which had many different definitions but was oriented toward observable and replicable truths. [55]

With an emphasis on mechanical philosophical principles, elite institutions like the Royal Society often focused their work on creating practical knowledge. The *Philosophical Transactions* (the Royal Society's journal) explicitly acknowledged its focus on mechanical arts Henry Oldenburg, editor of the *Philosophical Transactions* wrote that,

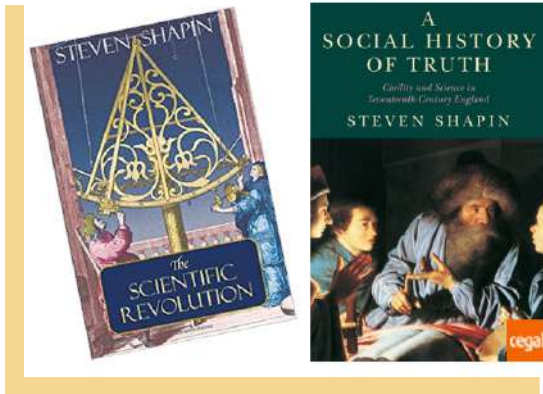
“the largeness of our Commerce abroad, and the growth of Arts at home, and the Observations of judicious Antiquaries will be a threefold advantage for the reputation and benefit of England, and cast an acceptable and obliging aspect over all his Majesties Dominions.” [56]

Additionally, a great deal of scientific publishing in the sixteenth and seventeenth century focused on technical books that could be understood by the general public. Just one example of such technical writing included so-called Books of Secrets which Elizabeth Tebdeaux has discussed in *The Emergence of a Tradition*.

Tebdeaux suggests that such books tended to focus on practical medicine, navigation, gardening or other practical arts utilized by non-scientists and scientists alike. Furthermore, such books “were directed more toward making the natural world predictable and explicable than exposing it as vulnerable to human manipulation.” [57]

Most importantly, according to Tebdeaux, much of the technical publishing during the sixteenth and seventeenth centuries was dedicated to “making formerly private knowledge and behavior part of the public domain,” and “making knowledge previously reserved for academics and aristocrats available to a broad audience.” [58]

Steven Shapin has also noticed a gradual shift in truth claims over the course of the sixteenth and seventeenth centuries, Shapin suggests that the culture of the gentlemen eventually was appropriated by members of the merchant class who claimed that, “the gentry were debased and had lost their legitimate claims to deference; the mercantile classes were the genuinely honorable and truthful ones.” [59]



Thus, in England at the end of the seventeenth century there were several methods for creation and dissemination of scientific knowledge in competition with each other. First, there was a divide between practical and esoteric knowledge which had long existed, but practical knowledge seems to be more reliably disseminated by both the Royal Society and by technical publishers.

Second, there is a belief that only “gentlemen” should be practicing science. On the other hand, there is a divide between what constitutes “gentlemanly” behavior.

Are gentlemen limited only to the old elite knightly class, or are merchants and the middle class also part of this group? These competing debates about how scientific knowledge should be constructed and who should be allowed to contribute to scientific debates continued in a new American colonial context as colonists created their own institutions for creation of new scientific knowledge.

• American Science Before Centralization

During the seventeenth century, there were a variety of “philosophical societies” that tried to establish themselves in the American colonies. Most of them did not last very long and succumbed to unstable political circumstances and a lack of consistent government or commercial patronage. In the early eighteenth century, Philadelphia was the largest city in the American colonies and hosted the only scientific association in what would become the United States.

The American Philosophical Society founded in 1746 by Benjamin Franklin aspired to be the equivalent of the Royal Society of London in the Americas. [60]



The society was dedicated to all branches of knowledge, not just science. There was another essential difference between the Royal Society and the Philosophical Society. In light of the failures of earlier American societies dedicated to creation and dissemination of knowledge, Franklin depended on the patronage of fellow entrepreneurs within the city to fund this organization.

In 1769, the preface to the first issue of the *Transactions of the American Philosophical Society*, written perhaps by Benjamin Franklin himself or at least influenced by him, stated,

“knowledge is of little use when confined to mere speculation: But when speculative truths are reduced to practice...are applied to the common purposes of life; and when by these agriculture is improved, trade enlarged, the arts of living made more easy and comfortable...knowledge then becomes really useful.”



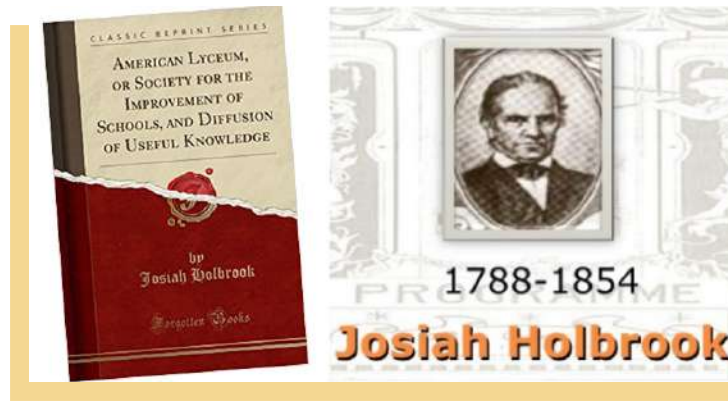
The preface then further stated that the journal and the society generally were dedicated to enacting these precepts. [61] Because of this focus on commerce, societies like the American Philosophical Society often did not have the laboratory or equipment facilities needed to perform certain scientific

experiments, and by the early nineteenth century, more specialized societies such as the Academy of Natural Sciences of Philadelphia (dedicated to geology and natural history) came into existence to meet this need. [62]

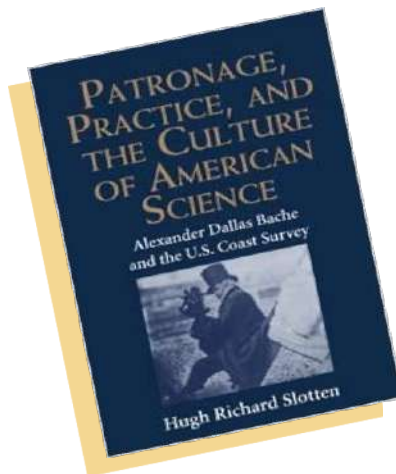
In tandem with the foundations of the Academy of Natural Sciences, and later the Franklin Institute (dedicated specifically to experiments related to industrial application), the Lyceum movement was also influencing the American educational and scientific systems.

Josiah Holbrook in Massachusetts envisioned a federation of lyceums around the country that would stimulate the founding of organizations to promote the growth of scientific and other knowledge in the United States.

The lyceum movement did indeed lead to the founding of museums, popular scientific lecture circuits, institutes often affiliated with universities and museums, and, more indirectly, what became the U.S. public school system. [63]



The institutions that branched from the lyceum movement were, however, incredibly decentralized into local systems and museums that often competed with one another. Furthermore, these institutions were often more interested in local scientific problems and often were not dedicated to any large national scientific project, a problem Alexander Dallas Bache bemoaned when he was elected to the Board of the Franklin Institute, named after his ancestor, Benjamin Franklin. [64]



There were some organizations though that were attempting to bring together local scientific interests and to combine them into a more nationally focused research agenda. One of the few government-sponsored research projects (at both state and national levels) were geological surveys. Many scientists were directly or indirectly employed by state geological surveys that sought to extract minerals and other natural resources. Later, the federal government would do similar types of surveys in what would become the U.S. Coastal Survey (headed by Alexander Dallas Bache) and the U. S. Geological Survey.

The American Association of Geologists and Naturalists, founded in 1819, tried to bring together these scattered geologists into a national organization so that they could better coordinate their efforts. [65]

In the 1830s, there were also efforts to unify science in Britain. During the Industrial Revolution, the Royal Society had been unable to sustain its preeminence in scientific advancements, particularly in industrial applications.

Moreover, the Royal Society had become dominated by aristocratic families who often were averse to allowing scientists from lower classes to enter the society. Because of these problems within the Royal Society, many local industrial scientific societies began in large industrial centers such as Manchester and Birmingham to foster science in local towns and to provide opportunities for scientists who were not tied to the British scientific elite.

Over time, these local societies recognized a need to communicate and to advance a more national agenda that was impossible to move through the Royal Society. Therefore, scientists from these local organizations founded the British Association for the Advancement of Science in 1831 in the City of York. [66].

Conclusions

The body of literature within history of journals in the seventeenth and eighteenth-centuries is probably the best developed and most diverse, including a wide variety of different studies from different disciplines.

In all of these studies, scholars agree that there were two important factors that helped to create the phenomenon of the research article: authority and sociability. Authority has many different sources, and sociability, or the social realities of who was reading and who was writing these research articles, also contributed to the construction of authority.

In a way, individual authorial credibility during the early period of academic journals derives from hybrid sources. On the one hand, individuals have some credibility.

In the eighteenth century the journal of a scientific society, at least that of the Royal Society, was not simply a method for creating news about scientific issues throughout Europe; nor was the journal a mechanism for extending such news by reviewing books that related to the journal's content. Furthermore, the journal was not about maintaining a correspondence of scientists throughout Europe, as Oldenburg had done. Rather, the *Philosophical Transactions* became a way of registering knowledge.

Like the studies of Gross Harmon, Reidy and also of Harré that have discussed some general trend in the evolution of scientific research articles during the nineteenth century, much of the work focusing on the historical contexts of journals and their role in the construction of scientific fact.

Generalist societies like the Royal Society of London had formed in the seventeenth

and eighteenth centuries, and, as a result, when research questions began to become more specialized, new more focused academies on subjects such as astronomy or botany formed; these organizations were often also supported by the government, particularly in Britain and Germany. Like the Royal Society these specialized academies produced journals. In contrast, within the United States, there was no government-sponsored general science society.

Nature became a specialized scientific journal that, unlike many other journals of the time, was able to get its issues out more quickly than others, and, as a result, to be picked up by the indexes more swiftly.[38][1] Interestingly, because of Baldwin's long scope of investigation, she makes a particular point of trying to tie Nature's earlier history to more modern developments, especially peer-review.

American science formed in response to the need for geologists from the American Association of Geologists and Naturalists to organize more broadly and from an awareness of how similar types of organization were establishing in Britain. On the one hand there were many scattered and competing scientific institutions spread around the United States; whatever centralized organization existed was primarily through state and limited national geological surveys.

Like the British, Americans also felt the need to create a national agenda for the progress of science. Unlike Britain, where there was ample government patronage of science and a need for middle-class scientists to communicate their work without the constraints of a more rigid class system, Americans had little if any government or centralized patronage of their work but a class system that was much more fluid.

As a result, the American Association for the Advancement of Science (AAAS) shared one of the same goals as its British counterpart, the creation of a national

agenda for scientific endeavors, but was structurally and intellectually a very different organization.

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