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Résumé de l'article

How does open access relate to scholarly communication? Though there are many modern definitions stressing the accessibility of knowledge to everyone, sharing scientific knowledge has a much longer history. What might the concept of 'open access' have meant to scientists and knowledge practitioners over the past several hundred years? This paper poses some relevant questions and calls for better historicization of the idea of the knowledge commons at different periods of time, particularly the era of the 'Republic of Letters' and the 'Modern System of Science.' The concept of open access as it relates to academic publishing has been very nuanced, and hopefully, understanding the history of 'open access' in relation to scholarly communication can help us to have more informed debates about where open access needs to go in the future.

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COMMENTARY

Historicizing the Knowledge Commons: Open Access, Technical Knowledge, and the Industrial Application of Science

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How does open access relate to scholarly communication? Though there are many modern definitions stressing the accessibility of knowledge to everyone, sharing scientific knowledge has a much longer history. What might the concept of 'open access' have meant to scientists and knowledge practitioners over the past several hundred years? This paper poses some relevant questions and calls for better historicization of the idea of the knowledge commons at different periods of time, particularly the era of the 'Republic of Letters' and the 'Modern System of Science.' The concept of open access as it relates to academic publishing has been very nuanced, and hopefully, understanding the history of 'open access' in relation to scholarly communication can help us to have more informed debates about where open access needs to go in the future.

Keywords: Open access; Scholarly communication; publishing; history

Introduction

Open access, or availability that is 'digital, online, free of charge, and free of most copyright and licensing restrictions' (Suber 2004) is seen as a means to publicly release all scientific and other knowledge to this world. Historically, though, this kind of knowledge commons has been quite contested. As we discuss modern ways of disclosing research results, perhaps it might be beneficial to look at the past and think about the ways both early modern alchemists and modern scientists chose to share their work. For hundreds of years, there has been a complex interplay between what we would now consider intellectual property, licensing, professional career objectives, and the question of what knowledge should be made widely available.

Open Access has become an extremely debated issue; recently, Aileen Fyfe and others (2017) have worked to provide some historical context for how open access has been discussed in more recent years and how these debates have been shaped by a long history of sharing scholarship, particularly in the context of the Royal Society of London. Fyfe's report, however, falls within a fairly well established framework of investigation for scholarly communication. Christine Borgman (2000) defined scholarly communication as, 'the study of how scholars in any field (e.g. physical, biological, social, and behavioural sciences, humanities, technology) use and disseminate information through formal and informal channels' (413–14). Much of the scholarship utilizing Borgman's definition has focused on the idea of prestige and utilizes the theories of Robert Merton (1968) as its framework. Merton concentrated on the values of the modern scientific system and the ways in which individual scientists achieved status within their profession, and Eugene Garfield (2004), founder of the Institute for Scientific Information citation index, is but one example of the many sociologically trained scientists who has investigated scholarly communication according to Merton's methods: 'Those of us who have worked in the field of scientometrics and its antecedent bibliometrics almost universally recognize the debt we owe to Robert K. Merton' (54).

Other scholars, however, have questioned this framework of utilizing prestige as the most important factor in understanding scholarly communication and by extension open access. For example Scott Frickel and Neil Gross (2005), when discussing the approach of Merton and others to measurement of status,

suggest that 'we find it difficult to believe that the quest for prestige and status is the sole motive shaping intellectual innovation' (211). Therefore, it is important to ask what might be another possible framework for investigating both scholarly communication and open access within this very large period of time covering roughly four hundred years.

Jurgen Osterhammel (2014) has theorized that there are two periods in the formation of the 'modern knowledge society.' The first he terms as the 'Republic of Letters' that ends around 1820. The second is the 'Modern System of Science' which 'witnessed the constant enlargement, institutionalization, and routinization, and even the beginnings of its [knowledge's] globalization' (779). Utilizing Osterhammel's framework, keeping in mind the thoughts of Frickel and Gross to look beyond just factors of prestige, and applying these concepts specifically to the dissemination of academic knowledge during the two periods identified by Osterhammel can perhaps help us think about what exactly the "commons" was during these two periods of history. Moreover, how did practitioners interact with that commons, and can these historical debates help us to understand and think about current discussions of open access?

Early Science and Public Knowledge

Historians of medieval and renaissance science have long discussed how practitioners thought about disclosing their results during the early period of science. William Eamon (1994), in *Science and the Secrets of Nature*, has also investigated the early history of science in Britain. In particular, Eamon discusses the foundational figure, Francis Bacon, who is often credited as the founder of modern science. On the surface, Bacon and his followers condemned the kind of closed system 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 natures secrets are not forbidden' (Quoted in Eamon, 320). 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 technical knowledge, 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' (Quoted in Eamon, 323). Bacon believed Mechanical arts, 'as having in them some breath of life are continually growing and becoming more perfect' (Quoted in Eamon, 323); therefore, according to Bacon, it was necessary to leave philosophical inquiry to others and, rather, 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 of the members of the Royal Society agreed with Bacon, however. Robert Boyle for instance feared that the Royal Society might give access to what was 'privileged knowledge,' and alchemical secrets, to people who would not be morally equipped to understand it. 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' and ascending to 'Exotick, and very rare Seacretts' (like alchemy) at the top (Eamon, 331). 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' (Eamon, 331).

Therefore, elite institutions like the Royal Society focused their work of practical knowledge. In *Philosophical Transactions* (the Royal Society's journal), the authors explicitly acknowledge their focus on mechanical arts on several occasions: 'the largeness of our Commerce abroad, and the groth 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' (Oldenburg 1667). 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 were the so-called "Books of Secrets," which Elizabeth Tebeaux (1997) has discussed in The *Emergence of a Tradition*. Tebdeaux suggests that such books tended to be focused on practical medicine, navigation, gardening or other practical arts utilized by a large number of people. Furthermore, such books 'were directed more toward making the natural world predictable and explicable than exposing it as vulnerable to human manipulation' (157).

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' (158). Thus, at the end of the seventeenth century there were several approaches in competition. There is 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. This divide between practical and esoteric knowledge continued into the nineteenth century. Moreover, in the United States, the divide between scholarship that could be utilized for the benefit of industry versus more abstract philosophical concepts began to be institutionalized in the nascent American scientific organizations, particularly during the mid-nineteenth and late nineteenth century when American institutions of science first formed.

Modern Science and Commodification

During the eighteenth and early nineteenth centuries, one of the primary changes in scientific knowledge construction was the creation of specialists who could become experts in particular fields. Since it is difficult for one person to become a specialist in increasingly broad fields, professional organizations rapidly divided scientific knowledge into a variety of sub-fields. Albrecht von Haller, a physician in the mid-eighteenth century saw this tendency toward creating specialties as a great advantage because it 'divides the sciences into small parts and gives each man a small and limited responsibility' (Quoted in Burke 2012, 160). There were, however, some scientists who objected to this trend. By the early nineteenth century, the same trends of sub-division were being called 'superficial knowledge' by Thomas DeQuincey, who deplored the 'tendency in science … to extreme sub-division' (Burke, 160–61). DeQuincey's objections withstanding, science continued to sub-divide into the nineteenth and twentieth centuries.

In the United States, there is a similar trend toward the subdivision of science into smaller sub-units of knowledge but with an important additional characteristic. Janice Radway (2009) argues that during the late nineteenth century, sub-division of science acquired a more commercial aspect: 'By disciplining their work and that of the graduate specialists they [professors] sought to train, they professionalized thought, transforming it slowly into a business – the business of knowledge production' (202). Marcel LaFollette (2009) notices many of the same trends as Radway and focuses on the business side of knowledge production. He argues that scientific publishing had a bifurcated market within the United States. On the one hand, there was the market for professional academics in which 'the intended consumers were the same group of people who produced and evaluated the work' (243). This market created an insularity that 'encouraged development of an attitude within the research communities whereby scientists claimed ownership of their publication outlets, perceiving the journals and monograph series as "theirs," even though the intellectual property may have been produced, sold, and copyrighted by the publishers, who bore the financial risk of market failure and reaped much of the profit' (243–44). There was, on the other hand, also a popular market for science, but this market was not as predictable. Therefore publishers, overall, used scientific publishing as an opportunity for growth and contributed to 'the belief that open access to scientific and technical knowledge was an American birthright' (259). Open access in this sense does not mean work available without subscription, but rather that scientific knowledge is widely available to professional scientists and that this knowledge will continue to grow at an exponential rate.

Technical Knowledge and Industrial Application

In the United States during the nineteenth-century, the commodification of knowledge went a step further as prominent scientists advocated for the industrial application of scholarship. J. Lawrence Smith (1873), president of the American Association for the Advancement of Science (AAAS) in 1873 (the only scientific professional organization in the United States at that time), firmly described his views on how 'science' should be practiced. Smith gave a presidential address to the AAAS in which he favored technical knowledge: 'It is a very common attempt nowadays for scientists to transcend the limits of their legitimate studies; and in doing this they run into speculations apparently the most unphilosophical … a perversion of Bacon's philosophy' (8). Furthermore, Smith states, 'science is only an accurate record of the processes of nature; that its laws are only generalizations of its observations, and not a declaration of an inherent necessity; and that one of its observations is the uniformity of natural sequence' (8). One year later, Smith (1874) made quite apparent his attachment to science serving industry in another article: 'From these multiplied and diverse efforts — these incessant labors of an army of workers — arises an industry which has no sooner sprung into existence than it becomes important and prosperous' (70). In the same article, Smith suggested

that professional scientists are obligated to drive industry and suggests that 'In our days a useful discovery is scarcely made, or a happy application of one found out, before it is published, described in the scientific journals, or other technical periodicals, and especially in the specifications of patents' (70). Smith makes an interesting observation in this sentence. He focuses on two kinds of property that are essential to the scientist: 'scientific journals, or other technical periodicals' and, especially, 'patents.'

Smith was in fact drawing on a long American scientific and philosophical tradition. The American Philosophical Society, perhaps in part because of the philosophies of its founder, Benjamin Franklin, suggested the Preface to the first issue of the *Transactions of the American Philosophical Society* published in 1769; it states that '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' (i–ii). The Preface then goes on to say that the journal, and society generally, was dedicated to enacting these precepts. Therefore, unlike the Royal Society, which was of course also dedicated to practical knowledge, the American Philosophical Society focused much more explicitly on the need for knowledge that could apply directly to daily life, and 'mere speculation' was discouraged.

Other scientists within nineteenth-century America actually took some of these ideas about practical science a step further and explicitly stressed that science needed to be tied to industrial progress. Benjamin Silliman (1818), founder of the only scientific research journal with a national scope starting in 1818, the *American Journal of Science*, said in the introduction to his journal that there 'will be a leading object to illustrate American Natural History, and especially our Mineralogy and Geology. The applications of these sciences are obviously as numerous as physical arts and physical wants; for not one of these arts or wants can be named which is not connected with them' (v). Silliman's words echo in many ways those of earlier American scientific journals such as the *Transactions of the American Philosophical Society*, and perhaps even the *Philosophical Transactions of the Royal Society*.

Later scientists wrote much in the same vein. The vice president of the chemistry section for the American Association for the Advancement of Science, Harvey Wiley, wrote in its *Proceedings* (1886) that 'Men of affairs often criticize science because it is not practical ... I desire to say a few words respecting the economic aspects of Agricultural Chemistry' (125). Wiley's address then discussed the impact of chemistry on the farming industry. Wiley was addressing a small group of chemists who were attending the American Association for the Advancement of Science, yet the Proceedings were distributed broadly to all members of the association (or anyone else who subscribed). Chemistry is an interesting example of scientific organization both because it was one of the first specialized scientific organizations to form in the U.S., but also, chemistry as a scientific discipline was very friendly toward industrial concerns; two years later, the *Journal of the American Chemical Society* (1888) reported 'the outcome of the visit of the Society of Chemical Industry to the works of the above-mentioned company [Noble's Explosives Company]' (116) and the Journal often included entire sections dedicated to industrial chemistry. Benjamin Silliman (1886) also praised J. Lawrence Smith, for his ties to industry where Smith 'established a laboratory for the production of chemical reagents and of the rarer pharmaceutical preparations, in which enterprise he associated himself with Dr. E. R. Squibb, whose fame as a successful worker in pharmaceutical chemistry is well known' (235).

Conclusions

Though science has developed greatly since Silliman wrote those words praising an important leader in early scientific organization, it seems that some of the same issues about commodification of science and its industrial application remain. In the twenty-first century, one wonders how many problems modern researchers are left that have their origins in debates that have been going on since at least the seventeenth century – and these scientists have more questions than answers. In the early period of science, technical publishers sought to make knowledge available to a wider readership. In the modern period, publishers utilized a strategy that sought to sell professionalized scientists' work from within their own communities while at the same time giving those same scientists significant control over what was published. Scientists in both the early and modern periods shared their work primarily to advance the needs either of commerce (for the Royal Society) or those of industry (for the AAAS).

Thus it seems that modern scholars are left in a world where the illusion of 'open access to scientific and technical knowledge' that LaFollette articulates is in conflict with the practical realities of academic careers and a publishing system that arguably endeavors to commodify knowledge. Perhaps the modern scholarly communication system is at least partly the product of the economic realities of the nineteenth century. By understanding how the historical development of the social forces affecting knowledge production have shaped notions of open access, especially at a point when science first formed in the U.S., it may be possible

to have better discussions about how to influence the future of scholarly communication. Scientific practice and publishing in the nineteenth century U.S. was seen by prominent scientists as a means to advance the needs of a rapidly industrializing American economy. Therefore, it is not surprising that modern scientific publishing which has its origins in the late-nineteenth century has similar characteristics.

What does all of this have to do with open access, especially for the sciences? If scholars want to make their knowledge more available and to embrace the importance of a more truly open knowledge commons, they must also recognize the origins of the publication system they now utilize – which had very different goals and a very different concept of how research should be shared and who should pay for it. For scholars in the humanities, the publishing system was different; it also developed, however, during the same time period. A similar historical investigation into the figures who shaped scholarly communication practices and their motivations might be helpful for other academic disciplines to determine similarities and differences between sciences, humanities, and other disciplines at the point when the scholarly communication system first originated in the U.S. What are the current barriers to creating an open system of scholarship? At least for the sciences, and possibly for the humanities, some of those barriers have their origins in a nineteenth-century, industry-oriented publishing system. Orienting scholarly communication toward a more truly open access system will require a more thorough understanding of its historical development and potential ways for overcoming one hundred years of previous practice.

Competing Interests

The author has no competing interests to declare.

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