Open Access Journals: Towards a Digital Commons for Scholarly Communication

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INTRODUCTION

According to cognitive psychologist and well-known open access advocate Stevan Harnad, there have been four major revolutions in the means of producing knowledge: language, writing, the printing press, and electronic journals (1991). While singling out these human developments as "revolutions" may be arguable, what is more important is Harnad's insistence, as a cognitivist, that these revolutions of human communication are linked to our cognition. In short, as these revolutions emerge to improve the production of knowledge, they have the potential to change the way we think. Stated much less dramatically, the missions of libraries and academic institutions are often filled with stock phrases regarding knowledge: to discover, examine, transmit and apply it, and ultimately contribute this knowledge to engender a greater public good. It is through the form of scholarly communication that this knowledge is produced, and while we have seen the coming and early fruition of Harnad's fourth revolution, within the last decade scholarly communication has been under threat as it adjusts to the new constraints of the digital environment.

For over three hundred years the creation of new knowledge and different means of communication have helped to shape the way scholars think. Over time, peer-review, verified research, immediacy, resource and information sharing, open communication, and the scholarly rewards system have emerged to become characteristics of scholarly communication, but more importantly aspects of a commons of knowledge or a system of shared resources. Scholarly communication has taken the dominant form of the peer-reviewed journal, however, as the fourth revolution in the electronic medium, certain tendencies arise in this medium that challenge the potential for the fourth revolution to truly take place.

Much like the practice of science in the 17th century, the first scholarly journals were dependent upon free and open channels of communication between scholars and scientists. This paradigm created a scholarly commons of knowledge that spurred the growth of science, and more broadly higher education, libraries and scholarly inquiry. Research and development in publishing and communication technology was centered on immediacy of open information, which contributed to the growth of the commons in both the sciences and humanities, and ultimately led to the creation of the Internet. Yet, as journal publishing has moved towards the electronic, journals have diverged into two roads—one that is an open system and another that is a closed system. Open access journals published by libraries help return the scholarly journal back to a healthy and open scholarly commons environment that does not heavily depend upon commercial interests in knowledge to thrive. In Harnad's words, open access journals help to ensure the fulfillment of the fourth revolution in the means of production knowledge. This paper will examine this argument in a historical context and argue that open systems of knowledge have greater potential to thrive, review how open access journals can build a commons of knowledge, and provide a direction forward for libraries to reclaim their relevance in the digital age by facilitating open access publishing and creating social networks to actualize an open commons of knowledge in the digital environment.

ON KNOWLEDGE AS A COMMONS

The idea of the commons as applied to the study of knowledge, and especially scholarly communication is relatively in its infancy. In the middle of the 1990s, the concept of an information commons was being used by an increasing number of scholars, finding that it helped them better understand issues they were noting with the rapid rise of distributed digital

information. For example, in the field of information science, this term was being used to conceptualize and examine problems in virtual communities or problems on the web such as web traffic congestion.

As Hess and Ostrom (2007) describe it, the analysis of knowledge as commons derives from the study of shared natural resources—in short, referring to a resource that is shared by a group of people. Specifically, this paper will examine the journal as one component of scholarly communication in both the analog and digital environment. As such, the term knowledge commons or commons of knowledge is helpful. Here it is used to conceptualize the peer-reviewed journal as a shared digital and analog resource among scientists, scholars, researchers, non-academics, and essentially anyone who can gain legitimate access to journals.

While open access is one such way to improve and encourage the growth of a commons of knowledge, it is by no means synonymous with the term. Rather, open access refers to free, unrestrictive access to knowledge in the form of peer-reviewed, royalty-free articles that authors choose to make available for free. A commons of knowledge does need to provide free access to knowledge in order to be a commons of knowledge. Although, it is argued herein that commodification of shared resources—journals in this case—is detrimental to the commons as a whole and for the creation of new knowledge that is shared within. Additionally, as Ostrum and Hess point out the use of the word commons should not be value laden. Meaning, the multiple outcomes of a commons of knowledge can be good or bad, sustainable or unsustainable—there are many social and political variables beyond peer-review journals that are at work within such a commons, and therefore the act of openness does not mean or guarantee sustainability.

Most importantly, a commons of scholarly knowledge is not synonymous with a utopia of knowledge that many interpret it to be. However, herein it is believed that a commons should be

reflected in a positive light based on its principle of sharing resources for the greater public good. The reason: cumulative effects of sharing ideas and information through open access peer-reviewed journals, and using copyrights that allow for this open sharing of knowledge, will inherently increase the amount of those who can participate in the commons.

By knowledge, this paper depends upon a flexible use of the term, but some basic properties are offered. Traditionally knowledge, as others have indicated "derives from information as information derives from data" (Hess and Ostrum, 2007, p. 8). However, this paper views knowledge as cumulative, and in reference to all sorts of ways of understanding that is gained from experience or study. While knowledge does not have to derive solely from scientific and scholarly experience or study, most of this paper will refer to knowledge derived from these sources because it deals with scholarly and scientific communication. Most importantly, knowledge is cumulative, and the cumulative effect of ideas is a public good. This paper will argue that it is only truly a public good if people have access to those cumulative store-houses of knowledge. Ostrum and Hess (2007) write that "ensuring access to knowledge is made easier by examining the nature of knowledge and identifying ways in which it is a commons" (p. 8).

In considering scholarly communications, and particularly journals in the knowledge of commons, many scholars have written about the need for openness, especially in the sciences. In the late 1970s especially, there were many books written about scholarly communications, and journals in particular. In theorizing scholarly communication, Duncan Lindsey (1978) writes:

> I take seriously the idea that science, and here I refer to the social and behavioral sciences especially, ought to be universalistic, open, and guided by compassionate and concerned scholarship. In fulfilling this ideal, science is responsive to both the wider community it serves and to the members of the scientific community (p. 2).

Lindsey then goes on to discuss the open, social system for scientist as theorized by Merton (1973). Merton specifically has argued for objectivity and fairness, while Ravetz (1971) and Kuhn (1962) tended to argue for a more iconoclastic form of science. Depending on your preference, Merton could be looked at idealistically, as something to attain, while Kuhn or Ravetz are helpful at theorizing the reality of scientific activity, knowledge creation, and scholarly communication. A knowledge commons, in this sense, should not be an ideal, because in the past it has appeared to catch glimpses of reality. Kuhn however helps to demonstrate…

THE PRICING AND PERMISSION CRISES

Before examining the historical context of the journal, it is important to lay bare certain tendencies of the electronic journal medium, commercial publishers and how these tendencies have affected both the building of a commons, but more specifically affected libraries. Peter Suber, one of the main voices for open access advocacy and philosopher at Earlham College, has succinctly pointed out that while the pricing crisis has existed for many years—dating back to the 1960s—the digital environment creates a new issue, a new tendency for commercial publishers and vendors to place restrictions on access to journals (2003). The combination of high prices and limited access has not only hurt library budgets and their users, but changed the shape of the scholarly commons of knowledge that has depended upon resource sharing amongst scholars.

The pricing crisis dates back to the 1960s, and largely results from commercial publishers and libraries conducting business within a closed system. Research on the economic relationship between libraries and publishers by Fry (1975) concluded the economic system of scholarly communication to be unstable because libraries were the publishers' only customers. If journal prices increased, this could result in lowered subscriptions from libraries, which would result in

higher prices, which would result in lowered subscriptions form libraries, and the cycle continues (Fry, 1975, p. 7).

The closed economic system of scholarly communication could serve as one explanation for the dramatic price increases libraries have seen in journal, but it can also serve as a reason why commodification of knowledge isn't sustainable from a commons perspective. In the last 15 years, the price of journals has increased 200% (Harboe-Ree, 2007, p. 22). Comparatively, the consumer price index has increased only 57% over the same time period. While the sciences are impacted by price increases more so than the humanities—primarily because their field is more dependent upon the medium of the journal—for both fields it should be clear that perhaps a profit-driven economic system is not beneficial or conducive to the creation of a thriving commons of knowledge. While scholars depend upon access to a wide variety of journals to share and build ideas through library subscriptions, no library can provide access to all of the journal literature, even the wealthiest of them (Harnad, 2004), (Willinsky, 2006). This pricing barrier limits the potential for the production of new and unique knowledge, as there will always be many ideas left uncovered by a researcher. In the sciences, it also increases the chance that a scientist may conduct research that is already underway elsewhere, thereby wasting the time and funding of their parent institution or granting agencies (Henderson, 2006).

In this sense, for-profit publishing of peer-reviewed literature as it stands today, contributes less to the growth of knowledge than non-profit publishers by their simple unaffordability. This is supported by way of comparison—across the board for-profit publishers have higher prices than non-profit publishers. Bergman and Bergman (2001) have discovered that the price per page of a for-profit physics journal to be $.63, while the price per page of a non-profit publisher was $.19. As such, for-profit publishers tend to operate based on the

bottom-line, as Fry points out that the commercial sector is "a self-purging system, in which most journals which do not operate profitably over time do not survive and therefore disappear" (1975, p. 10). Thus, while profits aren't extremely high for commercial journal publishers, their behavior demonstrates a motivation based on profit as opposed to extending scholarship. On the other hand, non-profit publishers, such as professional societies or university presses are not burdened by profit motivations, but can still limit the growth of a knowledge commons. By merely aiming to break even to continue the publication of new, and often esoteric scholarship, they are limited in their ability to innovate new publishing methods for scholarly materials and improvement (Fry, 1975, p. 11). University presses tend to serve as the greatest example of how attention to scholarship over the bottom-line in a closed economic system can cause a non-profit publisher to become financially unbalanced and unable to compete with commercial publishers. Perhaps this is one reason why the revolution of electronic journals published by non-profit publishers has been slow to reach achievement.

While much of the pricing discussion relates to both the digital and analog world of journal publication, there are specific factors of the digital environment that contribute to such out of control price increases. As evidenced in many knowledge sectors, such as music, art and entertainment industries, the digital environment creates considerable problems for copyright. Commercial publishers request authors' to turn over the intellectual property rights of their scholarly work, which in turn guarantees the publisher that the article will not appear in published form anywhere else. This type of control over knowledge that authors' don't expect payment for, royalty-free literature, gives publishers an upper-hand when it comes to setting prices and licenses for access to their journals.

In many ways, this leads into what Peter Suber has called the permissions crisis. This is not a print-journal issue; rather it pertains only to electronic formats, which is now the primary method of dissemination of the peer-reviewed journal. According to Suber "the permission crisis means that, even when they pay, libraries are hamstrung by licensing terms and software locks that prevent them from using electronic journals in the same full and free way that they may now use print journals" (2003). For example, when a library purchases a subscription to a journal that is print-only, it receives the print version of the journal. It is received, cataloged, placed on a shelf, and later bound for storage or preservation. Conversely, the digital environment no longer allows for this sort of indirect ownership of journals that have benefited libraries, and helped to create a commons of knowledge for any who can gain access to these materials—which literally is anyone who can physically make it into the library and find journal articles they are looking for. In short, in the digital environment it is as if libraries are leasing access to a journal, rather than purchasing the journal.

Access restrictions set by publishers or vendors are created through a variety of technological methods. Publishers (for and non-profit) limit both access and usage by password, IP address ranges, usage hours, institutional affiliation, physical location and other methods. These methods of restriction are the most glaring obstruction to the building of a robust commons for scholars. In addition, as Suber points out, libraries are "hamstrung" by publishers when it comes to the digital environment, unable to allow for wider access than to those affiliated with their university and thereby unable to help build a commons of knowledge that extends beyond institutional boundaries.

The access or permissions crisis also becomes a preservation issue in the digital environment. Because libraries do not retain digital copies of the journals they subscribe to—

these are kept by the publisher themselves—the task of preservation for future access becomes murky. For example, if a subscription to a journal is cancelled, then the library may no longer have access to the back issues they had previously "received." In other words, termination of subscription is met with termination of access. Additionally, with the ever increasing economic issues with journals, especially non-profit publishers as described above, it is not uncommon for journals to cease publication and go out of business. For libraries, their relevance as memory institutions is lost if unable to store digital copies. Again the preservation problem raises issues for the sustaining of a sound commons of knowledge in the digital environment.

There are current digital solutions to both the pricing and the permission crises that can help to build a digital commons of knowledge, and these come through open access publishing and non-profit initiatives in preservation. However, before exploring these solutions it is helpful to examine the development of the journal and its contributions to a commons of knowledge to better understand these and other issues. Because their purposes have not dramatically changed since they were first invented in the 17th century, briefly exploring the journal's history will help demonstrate the early establishment of a scholarly commons, the changes to these commons and how technology has impacted the knowledge commons of scholars. As well known library scholar Charles Osburn (1984) aptly pointed out in a piece on scholarly journals and communication an "understanding of the past can help us predict some of the chief considerations for the future of the scholarly journal" (p. 316).

EARLY COMMONS: SCIENTISTS, JOURNALS AND LIBRARIES

Scholarly journals have been circulating the globe for over three hundred years. Interestingly, through the many improvements to the technology of printing and publishing over

three centuries, the chief purpose of the journal has changed very little. This is not to say that the journal has been left unaffected by the growth of technology. Rather, with the development of publishing technologies, the core purposes and functions of the journal have radically improved and been pushed to their limits, creating a scholarly commons of knowledge that relies primarily on the continual publication of scholarly research. Additionally, with the rise of the scholarly journal as a dominant mode of scholarly publication, the academic library was born and much of the academic rewards-system developed around the functions and purposes of scholarly journals.

The purpose of the first scholarly journals—each published in 1665 within months of one another, *Journal des Scavans* and *Philosophical Transactions*—provide a general outline for a loose definition of a scholarly commons of knowledge: a social network of both formal and informal correspondence and publication that is shared (Hess & Ostrum, 2007), (Schweik, 2007). Osburn (1984) has pointed out the purpose of the *Journal* was to "describe new books, provide obituaries of leaders in science, summarize experiments, discoveries, inventions, and observation of natural phenomena, disseminate principal decisions of tribunals and universities, and monitor current events in the world of letters" (p. 316). More generally, Osburn notes that the purpose of journals was to "encourage research and facilitate the flow of information about research and scientific thought nationally and internationally" (p. 316). In this sense, the purpose of scholarly journals was defined and supported by the existence and growth of a knowledge commons in the field of science, and as such it is no wonder that the development of journals is closely interlinked with the establishment and growth of learned societies and professional institutions (Lambert, 1984, p. 8).

In the 17th century, journals emerged out of a number of social and technical elements converging at once. Networks of scholars took the form of learned societies, and these societies

established the backbone of a knowledge commons. Through these networks, the process of critical review evolved from single letter correspondence between individuals announcing scientific findings, to an open shared system of letters by those within their learned society. For example, a researcher may issue a letter of his or her findings to a group, which would be circulated to the members of that group.

This type of resource sharing exemplifies the rational method of science. As the rational method became widely accepted and manifested through experimentation, the constant and required communication between scholars of their experiments eradicated the geographic boundaries that limited communication, and forced scientists to become "part of a community, creating a new body of knowledge that would no longer be static, but rather one that would constantly be refining itself and growing" (Osburn, 1984, p. 317). No doubt, Harnad's third revolution, the invention of the printing press in the 16th century paved the way for these communications to take the form of a shared information resource among scholars, and truly demolish any geographical limitations between individuals (Harnad, 1991). In the form of a journal, these communications increased the ability for peer-review and the production of reliable and verified scientific knowledge. Thus, what made journals successful around this time was their ability to bring the elements of rapid communication, peer-review, scientific inquiry, and scholarly networks together under a single form of publication.

Between the 18th century and the end of 19th century, two important developments had considerable influences upon journals and the notion of a knowledge commons. First, as Osburn and others have noted, is the increased importance of the university and its stake in the commons of knowledge. The university's bureaucratic structure allowed for it to become an effective

player in the sharing of information, but this structure also led to increased competition, specialization and professionalization of the sciences, and the need for more specialized journals.

One part of this structure relevant to the notion of the commons was the university's research library. More recently, Charles Lowry (2002) has pointed out this connection between scholarly communication and libraries in a discussion of the shifting role of the library, writing "the modern library was invented in response to the gradual emergence of scholarly communication" and to facilitate the growth of a commons in higher education by "the delivery of scholarly information to students for learning and to doctoral faculty for research" (p. ix). To facilitate the sharing of information to this ever increasingly specified knowledge commons, libraries collected, cataloged, organized and disseminated scholarly information in both book and journal format. However, it is important to contrast the university's commons of knowledge with its predecessor. Because its antecedent of the 17th century and early 18th century was less specialized and less professional, the community that had developed here tended to include a larger audience interested in a broader application of science. Thus, with the emergence of the research library, university, and specialized fields of study, the participants in the commons of knowledge narrowed to a professional group of scientific specialists. On the other hand, libraries served as gathering places for many types of people, and as journals were open and accessible to any whom set foot in the library, the research library also conversely extended the knowledge commons.

Secondly, the invention of linotype in the 1880s had a dramatic impact on scholarly journals and the commons of knowledge (Lowry, 2002, p. viii), which again helps to illustrate the important role of technology in scholarly journal publishing and communication. Linotype, although not one of Harnad's revolutions, was a minor-one for it allowed for the large-scale

production of journals through quicker typesetting and composition. Ultimately, this meant that journals could be produced and disseminated quicker, and in a scholarly environment increasingly reliant on immediacy of information—changed by their adopted forms of communication—this helped place the journal as the primary and dominant medium of the scientific commons. Speed of production allowed for journals to publish and disseminate to a growing scientific community that placed increasing emphasis on "swiftness in establishing priority claim, swiftness in participating in critical debate, and swiftness in gaining access to needing information" (Osburn, 1984, p. 318).

As such, it is important to understand that the scientific community's needs for immediacy and wide distribution channels tends to be met most readily by technological advancements in publishing. As the need for distribution and immediacy grew, the role of technology increased. Again, this relationship between journal and technology demonstrates the interlinking of the development of journals and a commons of knowledge, or as Harnad puts it, the links between modes of communication and how we think. Yet, exactly how digital technologies impact scholarly journals, the commons of knowledge and scholarly communication is a different matter and will be discussed later.

By the beginning of 20th century, the journal had evolved into a form that represents today's journals (another reason why the fourth revolution is protracted?). By this time, journals could be characterized as having increased specialization in the social sciences, humanities, and sciences, an ever-growing number of them (in 1895 there were around nine thousand compared to eight hundred in the late 18th century (Osburn, 1984, p. 319)), were published primarily by learned societies or members of the commons of knowledge, were the primary form of scholarly communication especially for the sciences, accessed most readily at institutions such as research

libraries of universities, and had interesting ties to the development of higher education, and more broadly human and scholarly communication. Additionally, the various functions of journals grew to extend the commons of knowledge, or in other words a public forum for scholars and scientists. These forums allowed for the rapid communication and exchange of ideas, for scholars to establish priority claim of their work, and to validate their own work. Most importantly, journals allowed for the process of peer-review, which "is essential to the quality of information as well as to the dialectic on which the scholarly communication system depends" (Osburn, 1984, p. 321). However, with the increasing number of scholars came an increase in output of scholars, which resulted in an increase in the number of journals. This caused the need for more immediate and efficient distribution, as noticed by both the government and private companies, and herein the commons of knowledge as established by journals would be threatened.

ON THE PRIVATIZATION AND COMMODIFICATION OF KNOWLEDGE

Much of the access, permission and pricing issues that today are hampering libraries, the growth of a commons of knowledge, and the electronic journal revolution can be traced back to WWII. In short, the privatization and commodification of knowledge after WWII led to a change in how many viewed knowledge, rather than a public good, it became a privatized profit generator. From the beginning, it should be recognized that not all aspects of commodification of knowledge were ultimately negative. Through privatization came the desire to improve services, increases in government funding, research into ways to improve scholarly communication and a shared commons for scholars, all which ultimately led to distributed networks, or the earliest forms of the Internet. However, with the benefit of hindsight given the

current permission and pricing crises, in post-War United States, privatization and commodification would sow the seeds that would tie journals and their royalty-free content to commercial interests once the digital era had become the dominant mode of dissemination and replaced print journals.

After World War II, a new course for journals and the community of professional scholars built around them emerged, information and research was a new economic venture. With the increasing specialization of science, the rapid post-war growth of technology and its solidified link to science, communication and extensive government funding, journals, science, and technology became a new industry for private corporations. (Tenopir & King, 2000; Willinsky, 2006). At first for private publishers their role began as indexer and abstracter, and this service quickly evolved into creating, editing and publishing new journals for large-scale science, technology and medicine (STM). The publishers and research corporations were much different than the non-profit learned societies and their commitment to open and shared information with the belief that this openness, this commons, would generate new scholarship. Instead STM publishers saw scholarly communication, technology and journal publishing as sure bets, and in many ways they were right. Previous to the post-war growth period in higher education, publishing scholarly journals was not a lucrative business, relied mainly upon institutional subscriptions, but a new emphasis on science and technology changed much of that (Tenopir & King, 2000). With this in mind, STM publishers' main concern was the bottom line. Learned societies were much too modest, and non-aggressive to compete in this market, and in this sort of manner, which is why today, many struggle to thrive the way they did during these enormous growth periods.

However, there is a sound explanation why non-profit publishers of journals sought to remain this way. Any sort of commons of knowledge, in the sciences, humanities, and social sciences, depends upon the open and non-commodified exchange of information, and before post-WWII and the privatization of journals the scholarly communication system had evolved to support non-profit publishers. The idea that it is unfair to commodify knowledge is closely linked to the practice of placing peer-review articles into royalty-free categories, meaning authors don't expect payment for them. Scholars do not expect payment from journals for this work because they already are paid by their institutions or granting agencies to produce this knowledge and granted academic freedom. In economic terms, academic freedom gives scholars the ability to become specialists on topics that may have little economic relevance to the rest of society. If a particular scholar's salary was composed of royalties from peer-reviewed work, such specialization would not be of interest to commercial publishers that are driven by bottom-lines. Thus, their research would not get published, their careers would not advance, they would receive the chance to become known experts on their subjects, and as a result, the commons of knowledge would not stand to benefit from their expertise because the literature would not exist. In sum, scholarship would not advance or thrive, and the missions of institutions would struggle to be met.

TRANSITION TO THE ELECTRONIC AGE: THE FOURTH REVOLUTION

In the United States, there are a few key developments that contributed to the creation of electronic journals, the Internet, and distributed networks of communication for scholars and scientists that would allow for an efficient electronic medium of communication. Between the 1960s and 1980s, the National Science Foundation conducted research on information retrieval,

scientific communication and innovation, and electronic journals. According to Tenopir and King (2000, p. 62) electronic journals and scientific communication received the least amount of attention and funding, however many of the studies conducted on these areas helped to initiate the development of distributed networks where information and resource sharing could take place. The second development was born out of the NSF funded research through the creation of distributed networks linking computers to share information between universities. These networks bypassed the traditional route of scholarly publication and demonstrated the immense power of electronic communication.

Research on scientific communication as a whole found the greatest problems with the print scholarly journal, which ultimately led to research on alternative forms of communication. Most glaring were issues with efficiency and again, the immediacy of published work. Central to the problem was the so-called "information explosion," and journals were viewed as the prime culprit of this issue. From 1660 to 1960, it was found that the volume of published science had increased by a factor of one million, and thereby becoming an out of control disease (de Solla Price, 1975). These labels spurred an onslaught of research on scholarly journals, particular in the sciences since growth was so enormous here. It is interesting to note that if this were the case in the electronic medium, growth at this rate would be much more manageable and lauded, given the digital environment's ability to be much more efficient with space (although a host of other issues would like arise).

Coupled with the overflow of information, was the discovered fact that the journal portion of the commons of knowledge was not being utilized effectively. Studies around this time period concluded that a typical journal article was only read 5 to 20 times, and only one-tenth of published peer-reviewed articles were read (Tenopir & King, 2000, p. 67). So while

publication was rising, and readership was low, it seems reasonably fair to consider what had happened to the journal portion of the information commons was highly inefficient. Contributing to this characterization was the discovery that research reporting was found through many channels (for example journals, conferences, panels) both formal and informal and by the time a research study was published into a print journal, most scholars were already aware of the study. The greatest contributor to such inefficiency was caused by the print-medium and research process itself, one study (Lin, Garvey and Nelson, 1970) finding that on average research started "twenty-eight months prior to publication, was completed fifteen months before publication, and was written and submitted eight months prior to being published" (Tenopir & King, 2000, p. 68).

Harnad writes in his exploratory essay on the ability of electronic journals to meet the needs of the scholarly community and spur the fourth revolution, that print journals are a "prisoner to the temporal, geographic, and…'internoetic' constraints of the conventional paper publication medium" (1991, p. 44), again, meaning that journals lacked an overall ability to convey information in a timely fashion. Harnad uses the example:

> In that medium, new ideas and findings are written up and then submitted for peer review. The refereeing may take anywhere from three weeks to three months. Then the author revises in response to the peer evaluation and recommendations, and when the article is finally accepted, it again takes from three to nine months or more before the published version appears…That's not the end of the wait, however, merely the beginning…(1991, p. 44)

Harnad's thoughts stem from the second important development in the transition to electronic scholarly communication. By the 1980s, the information and computer industry had grown and advanced significantly, allowing for microcomputers or PCs to be linked to one another. While many private corporations, publishers and scholarly societies began to experiment with electronic journals even as early as the 1970s, many of these attempts to

translate the functions of print journals were ultimately failures. Ultimately it would be computerized networks of scholars and amateurs that would bypass the traditional methods of publishing scholarly information that would generate the necessary momentum to help transition journals into the electronic age.

In the late 1970s and early 1980s, two networks of computers were launched: USENET and BITNET. The former was a link between Yale and the City University of New York, while the latter was network set up by an innovative group of individual computer scientists (Suber, 2008). Over the course of the 1980s, many of the world's universities would become linked through these networks. In addition, through the innovation of TCP/IP protocol by the government funded ARPANET, universities and researchers were greeted with the birth of the Internet. USENET and BITNET would go on to form groups dealing primarily with sharing and discussing information related to computers and technology. However, as more universities and research institutions joined, these informal discussion groups began to deal with more specific topics, a cumulative effect of the knowledge of individuals joining and participating in these emerging information networks. Harkening back to the early days of the invention of the printed journal, broader groups of people (i.e. non-professional or academics) were able to connect and partake in the establishment of a new type of knowledge commons.

As Harnad recalls his own experiences within USENET to be rather chaotic, they largely inspired his concept of fourth revolution, or the idea of "scholarly skywriting" (1991, p. 47). The dramatic increase in participants as computer technology and network connections became cheaper, allowed for the rapid transmission of ideas in an open peer community, thereby benefiting individuals. For Harnad, many of these discussion groups unmediated to be generate the type of information that could live up to the scholarly standards. Either way, the technology

itself inspired groups of scholars to consider how to harness its immense potential and recreate the scholarly journal in the coming electronic age.

WHAT ARE OPEN ACCESS JOURNALS?

The open access movement has roots in a few important themes that have been described here: technology, sharing, and scholarly communication. Open access literature, as defined by Peter Suber (2004) is "digital, online, free of charge, and free of most copyright and licensing restrictions" which remove the pricing barriers and the permission barriers by allowing unrestricted access and allowing authors to keep their copyright and make their work more widely accessible and free. A more detailed and legal definition of open access comes from the 2001 Budapest Open Access Initiative, which demonstrates the power and potential for open access publishing to thrive in a commons of knowledge:

> By 'open access' to this literature we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself.

Open access journals fulfill the requirements of open access while at the same time the roles and functions of the traditional journal. Open access journals conduct peer-review, are produced by both non and for-profit publishers, allow their authors to retain copyright, and are funded much like radio or television broadcasting where those interested in disseminating the information pay an up front cost to ensure the information can be accessed for free, worldwide.

Although open access did not receive these labels and definitions until recently, many of the earliest forms of electronic journals took on the form of open access. From an early stage, Harnad captured the idea of open access in scholarly journals as "scholarly skywriting," just as if

"each contribution were being written in the sky, for all peers to see and append to" (1991, p. 48). Harnad was also keying in on the power of the Internet to be both open and immediate, in short promising to improve the speed of scholarly communication closer to our speed of thought, all the while connected to a global audience.

This type of ingenuity, coupled with the ease and lower costs of publishing on the net, gave birth to one of the first open access journals in 1989, *Psycholoquy*. Harnad saw immense potential for scholarly peer-reviewed journals to thrive in an open and rapid form of communication that benefitted exponentially by the fact that its channels of distribution were connected to many. Indeed his vision of the possibilities of the net was grand and utopian, as it often gets characterized today, writing, "the Net's speed, scope and interactive capabilities offer the possibility of a phase transition in the evolution of knowledge, one in which we break free from earthbound inertia that has encumbered human inquiry until now, soaring at last to the skyborn speeds to which our minds were organically destined" (1991, p. 48).

Psycholoquy was by no means alone, as many open journals began appearing within the same year and the years following, many of them from the humanities and social sciences, rather than the field of STM. *Public-Access Computer Systems Review* (1989), *Electronic Journal of Communication* (1990), *Postmodern Culture* (1990), *Bryn Mawr Classical Review* (1990), and *EJournal* (1991) all emerged before the release of the World Wide Web standard release in the middle of 1991 and began pioneering the movement to bring scholarly publications back into the hands of the scholarly community through open access to peer-reviewed literature.

Returning to the current problems facing libraries and scholars, the permission and pricing crises, and more broadly the stagnation in the development of a robust commons of knowledge, open access journals are a direct solution to these problems. As stated earlier, by

granting author's the ability to retain copyright to their peer-reviewed articles, access barriers are lifted, allowing the author to determine how their article is to be used by the public. More recently, the ability for author's to determine the licensing of their content is made possible through Lawrence Lessig's Creative Commons (2005). As noted open access scholar John Willinsky describes the Creative Commons "seeks to establish a new kind of 'reasonable copyright' by providing creators with a new set of copyright licenses that fine-tune an author's right to grant free use for noncommercial purposes…while protecting an author's right to be identified with the work and to keep the work intact" (2006, p. 40). While open access has been criticized for its non-restrictive and loose use of copyright via Creative Commons licensing, the ability for users to "read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose" (Budapest Open Access Initiative, 2001) is crucial to the building of a knowledge commons, where scholars and organizations can organize, improve access to, and build upon the ideas of individuals.

The issue of preservation, which stems from the permission crisis, can also be solved through the publication of open access journals. Briefly, because licenses used by authors allow for such preservation via Creative Commons licensing, libraries, authors, and non-profit preservation organizations such as LOCKSS (Lots of Copies Keep Stuff Safe) are able to archive articles for long-term preservation. Here, it should also be mentioned that following the lead of open access journals, increasing amounts of non-open access publishers are beginning to allow LOCKSS to archive their digital articles so libraries can be guaranteed access to the articles that they have paid subscription fees for. These are primarily non-profit publishers that have yet to switch to open formatting, another model that is gaining wider practice as non-profit publishers

look to sustain their relevance in the digital age. Knowledge commons, besides being shared resources of current information, will only gain in significance if they contain preserved materials, long runs of journal volumes, similar to the importance of the library as a memory archive.

As a solution to the pricing crisis, open access journals are dependent upon a set of direct and indirect factors, many which are out of the control of open access publishers. Most obviously, they help to solve the pricing crisis by giving libraries and others free access to their contents. But libraries are also dependent upon the cumulative success of open access journals as serving as viable competitors to commercial publishers. First, open access journals must sustain publication over a period of time. What is hoped is that considerable attention can be brought to open access journals as a successful reformation of scholarly communication, which in turn could generate journal policy changes for commercial publishers.

To scholars and libraries, open access journals may have two different meanings. For libraries, open access journals are solutions to the problems described above. Yet, for scholars, open access journals are an opportunity to give, as Suber puts it, "readers barrier-free access to the literature they need, and giving authors larger audiences and greater impact" (2003). As open access journals and their articles are quantitatively studied, it has been found that they do possess this great potential to have a greater impact. Harnad and Brody (2004) compared the citation counts of scientific open access and non-open access articles that appeared in the same journals, finding that articles that were open had significant citation advantages to non-open access articles. Regarding the concept of knowledge commons, the citation advantage of open access articles demonstrates an open systems ability to facilitate the growth of scholarship. It is in this sense that Harnad's fourth revolution, the electronic journal, should truly be redefined as

the open access journal that involves the collaboration and advocacy of both libraries and faculty to pursue avenues of publication that do not commodify knowledge, but look to extend and build upon it.

TOWARDS THE REVOLUTION: OPEN ACCESS JOURNALS AS SOCIAL NETWORKS

When plotting the future for open access publishing, and open access journals in particular, consideration of the many variables at play within scholarly communication and their histories should point libraries in the direction to help restore their own relevancy in the digital era. In considering a way to bring many of digital issues described here together—for scholars the need for a commons of knowledge or a public forum that facilitates peer-review, immediate delivery, and control of copyright; for libraries reduced subscription costs, less restrictive access and permissions, the ability to preserve the journals they pay for, and the call to provide a commons of knowledge, it seems fitting to consider the potential for open access journals published in the form of online social networks. Furthermore and perhaps more radically, the digital age allows libraries and scholars to respond to the problems and challenges of the publishing industry in new and exciting ways by designing, implementing and maintaining open access journals in the form of social networks themselves.

Social network sites are defined by Boyd and Ellison (2007) as "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system." Additionally, social network sites allow for the creation and sharing of information through the form of messaging, commenting, e-mail, video, voice chat, file sharing, blogging, and discussion groups. In this

sense, social network sites for open access journal publishers would be able to facilitate both a formal and informal commons of knowledge for scholars that would connect scholars with shared and similar interests, facilitate peer-review, and provide multiple means for scholars to communicate and share resources and information with one another.

In many ways, a social network site and a commons of knowledge have similar roots. Both are places that share resources, facilitate formal and informal modes of communication between individuals, are open and free to those who can access, and cannot be depleted. They also rely on the contributions of many to create a greater public good, in short, demonstrative of Metcalfe's law. Robert Metcalfe developed this law based on the idea that "'value' or 'power' of a network increases in proportion to the" (Khosrowpour, 2006, p. 439) number of connections in a network. Others have interpreted Metcalfe's Law as powerful tool, finding the "utility of a network rises in proportion to the square of the number of its users. This means that as more users get connected into a network, the marginal utility perceived by new users increases dramatically" (Khosrowpour, 2006, p. 439).

In short, a social network site and a commons of knowledge stand to benefit from larger numbers of connections or participants. Consider, for instance, the collective power of an online community encyclopedia like Wikipedia (http://www.wikipedia.org). It too relies on the collective nature of the World Wide Web—as the greater number of participants and contributors increases bringing their own specialized knowledge, the scope of Wikipedia itself increases. To date, Wikipedia contains 2,340,739 articles on Wikipedia, after beginning in 2002 at merely 19,700 articles (2008). While this type of rapid growth could be seen as exponential, it has also been suggested as logistic (Wikipedia, 2008). This type of model is based on the idea that more participants will lead to more content, which in turn leads to more traffic. An increase in traffic

leads to an increase in participants, which increases the creation of new content. The only limits herein are the collective knowledge of the community. While this type of collaboration may differ from that of the scholarly community, it is worthwhile noting the potential of this digital phenomenon to contribute to the building of a commons of knowledge for scholars. Like Harnad, who drew inspiration from USENET to give birth to *Psycholoquy*, libraries and scholars should draw inspiration from the logistic model of Wikipedia to encourage the creation of open access publications that facilitate social networking.

In the world of scholarly journal publishing, the Public Library of Science (http://plos.org), a non-profit publisher of several peer-reviewed open access journals, is already beginning to establish such an environment for scholars in the scientific community. On the social network level, users can create free accounts that include professional profiles, including areas of interest and research, school affiliation, and other professional details. Once a profile is created, the user is then able to "contribute" responses to articles. These usually take the form of advanced commenting, where a respondent can compose a reply that challenges or supports a statement in the article, always using citations in support of their arguments. Responses are moderated, and usually appear within a week of submission. Such types of responses mirror those conversations often found in the back pages of journals that are a type of post-publication review. Yet, as part of the digital environment, benefit from the cumulative participation of others and are not limited to two opposing voices.

Some of the journals at the Public Library of Science (PLoS) increase the user's ability to comment on articles and contribute to the post-publication review of an article. In their publication on genetics, post-publication review manifests itself in three separate categories: notes, comments and ratings. Notes attach themselves to specific passages of a research article,

and are meant to apply to a specific point in the web version of an article. PLoS suggests they be used to "highlight a minor point, to make additions or clarifications, or to identify and link to material, including more extensive discussions, presented elsewhere" (2008). Comments are used to add to the article, their purpose being more general and reflective of the author's content, conclusions and consequences. Ratings, much like those found in Amazon.com, allow users to rate individual articles to provide an overall rating once aggregated. This rating determines the ranking of the journal in the article. Similar features in other journals show the most viewed articles, but this is not dependent upon an individual user submitting a rating of an individual article, rather on page views or hits of a web article's page.

The implications of social network technology is yet to be fully harnessed by PLoS, but it appears that an initial framework of user accounts and profiles, rating and commenting is available. It would be interesting to see open access journal publishers begin to merge the social technologies of Facebook with the publishing and post-print review technology of PLoS, allowing users to connect with one another, and represent their real-world connections in the virtual environment and connect to relevant peer-reviewed scholarly material. Creating these types of services for scholars can add tremendous value to open access journals, and make them viable competitors to for-profit journals that are publishing only in the digital environment.

Furthermore, these ideas can allow for Harnad's fourth revolution to be fully realized. Revisiting this notion, it is not merely enough for journals to mirror that of the print-journal, this is truly what Harnad indicated, even in 1991, when he speaks of "scholarly skywriting." Today, it may be passé, or perhaps naïve to offer the idea that the World Wide Web offers far too many technological advantages and services—at low costs—that must be harnessed in order for open access journals to begin building a commons of knowledge for all disciplines. This is

particularly the case for the humanities, who have been slow to fully come on board with open access because their peer-review publishing is not as dramatically affected by the issues described herein. However, social network sites for humanities based open access journals may just the qualifier to get them more onboard with publishing to open access journals.

Yet, who is charged with the task of leading this revolution? Drawing from the ideas of Harboe-Ree (2007), Lynch, and others who see libraries stocked full of the technological capabilities to execute publishing in a digital environment to create new technologies and be stewards of intellectual property. Harboe-Ree points out that the "digital revolution allows universities to move beyond their historic relatively passive role of supporting established publishers…exploring more transformative new uses of the digital medium" (p. 16).

Libraries have a history of being innovative publishers in the digital era. In the mid 1990s, Stanford University began publishing peer-reviewed journals electronically through HighWire Press. While these journals are not open access, HighWire does host the largest repository of free full-text life science articles in the world at a staggering count of over 600,000 articles. Within the same year, Johns Hopkins University launched its library press division, Project Muse. By expanding to become partners with other non-profit publishers, through the Project Muse division nearly 250 journal titles from 40 different scholarly publishers are offered. Such a model of looking beyond the idea of the library publisher and editor links the experience of the non-profit publishers with the technical expertise of library staff to fully maximize the potential of electronic journal.

In considering open access journals, library press partnerships with non-profit, open access journals could be conducted in the same manner. Along with the technical publication of the journal articles, the library would be able to generate social network frameworks around their

entire run of journals, in a sense placing them all within the same social network. For example, consider for a moment Project Muse's 250 journal titles to all be open access, peer-reviewed journals. In a similar framework of PLoS, a scholar, student, professional, artist, et cetera, would enter the Project Muse web page (i.e., http://www.projectmuse.org), where they would log into their personal account. Within the account might be listed their professional information, but also a list of the journals they have selected to 'receive' from the over 250 journals, or perhaps this list could be automated based on their research interests. Each journal would have similar capabilities to PLoS' post-publication review and commenting, but for scholars they would also be able to participate in a wider, moderated pre-publication peer-review of their colleagues' articles. Additionally, mirroring the networking capabilities of Facebook, scholars might be able to connect to others with shared research interests, similar geographic locations, or similar educational backgrounds. Perhaps more ambitious, yet truly revolutionary, would be to apply this type of piecemeal framework to the Directory of Open Access Journals (http://doaj.org), which currently hold listings to 3,336 open access journals. While this may not be the task of a library electronic publisher, large scale partnerships in the academic library community may be able to actually bring forth this type of digital commons of knowledge.

CONCLUSION

While it does not appear that open access journals will overturn the for-profit publishing industry, open access journal publishers do stand a chance to compete in the digital environment by harnessing the talents of their greatest ally and supporter, the library. In the past, the research library emerged in a brick and mortar sense to provide a knowledge commons for scholars, housing and preserving print journals. Today, similar type of action needs to be taken by

libraries to ensure the growth of a new type of knowledge commons. This paper has looked at the rise of journals in the scholarly environment, their privatization, and how open access can help restore the open system that benefitted scholars of a distant past. It also has discussed the links between human modes of producing knowledge, and how revolutions to production of knowledge can stand to change humans. In today's digital environment, where social networks increasingly become an integral part of life for many, such an application to scholarly communication seems rather necessary and increasingly fitting. Yet it is only through the continued support, advocacy and technical research into open access publishing, coupled with the conceptual thinking of scholars like Harnad that scholarly skywriting—or the fourth revolution of the production of knowledge—can truly be actualized.

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