Chapter 1: Overview of scholarly communication

In this chapter, Alma Swan describes Open Access as emerging from a long history of scholarly communication, which has always been closely tied to changes in technology and economics. She describes how journal articles, books and monographs, and data have all been implicated in recent changes, but it is perhaps the recent developments in the dissemination of journal articles that have most exercised the minds of researchers, librarians, publishers and funders.

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Alma Swan

It is almost 350 years since the first scholarly journals entered publication, the year 1665 being a propitious one in this respect with both the Journal de Sçavans and Philosophical Transactions of the Royal Society (of London) launching within a few weeks of one another. The use of the printed word became thereafter the primary, formal, means by which scholars have communicated the results of their work. It became the means, also, by which scholars established their right to the intellectual property reported in their articles, by which they claimed to be the first to conduct such work and present its findings, and by which some system of quality control was imposed upon the reporting of the results of scholarly endeavours through peer review of articles before their acceptance for publication.

A driver for change: digital technology

And so things continued, almost without change, until well into the twentieth century when new developments in the field of electronics placed computing power at the fingertips of scientists for the first time. At first, this was limited to standalone computers but networking brought a profound change and opened up an unlimited array of possibilities. By the 1970s, computer scientists at Bell Laboratories were filing their results on electronic archives that could be accessed by their colleagues using ftp protocols. At this point the stage was set for the most significant revolution in human communication since the development of language itself. Gutenberg's printing press, developed in the mid-fifteenth century, had opened the door to mass communication of a sort but the printed word as a communication mechanism has always been limited in practice, if not in theoretical terms, by economics and the logistics of distribution. Now it became possible for scientists to communicate by permitting access to their own files from remote computers and by accessing those of others in turn. The age of digital communication was born and, necessarily, the rest of this chapter focuses largely upon scholarly communication in the digital age.

The advent of the World Wide Web in the late 80s supplied the most recent major advance in technological capabilities and a set of protocols for computer-to-computer communication. The development of graphical web browsers in the early-to-mid 1990s brought the internet out of the computer-science closet and onto the streets. Anyone with a computer and an online link could communicate with anyone else with a computer. A new communication age was born.

Now, bound only by the technological limits of bandwidth and computer power, scholars, wherever they may be in the world, have ways of communicating that mean that scholarship as a whole can move on in different forms, forms that we are starting to see take shape. No longer constrained to the letter, the monograph, the journal article, or the telephone, scholars can send a one-line email message or transmit a terabyte of data within seconds to another scholar on the other side of the globe. Their communication methods, moreover, are becoming more diverse in form, with systematic, formal mechanisms such as the journal article or the academic monograph being supplemented and complemented by new, informal, self-regulated or community-regulated methods such as online discussion groups, weblogs, webcasts, wikis and podcasts, of which more later. Indeed, the web now really does seem to be facilitating what Tim Berners-Lee, its founder, originally envisaged as its functions - the real-time (or near-to) collaborative interaction of peer-group scholars and the use of hypertext linking systems to minimise data loss or decay (Berners-Lee, 1989).

There is the implication of informality in that concept and indeed informality in scholarly communication is on the rise, with huge potential repercussions for the progress of scholarship and for the scholarly publishing industry as a by-product. That is something to watch for the future. For now, though, the tried-and-tested 'traditional' methods of communication between scholars predominate.

Journals, books and monographs

The most formal and systematic subset within the array of scholarly communication mechanisms encompasses the peer-reviewed journals and conference proceedings, the contents of which form the official information of record in most disciplines. Until the 1990s scholarly journals were published almost exclusively in printed form. Pioneering journals appeared in electronic form as a supplement to the hardcopy form through the nineties and, as resistance to electronic publishing dissipated, electronic-only journals were launched. Initially, the resistance – or perhaps informed wariness is a better expression – was based upon concerns both of librarians, who questioned whether these digital publications would be permanently and accessibly archived, and of the research community which debated whether electronic-only journals represented legitimate avenues for publication and whether they would be taken into account in career and tenure decisions.

The lure of electronic journals was strong, though, and their successful adoption was user-driven. They provide inestimable advantages in being accessible from a computer at any time of day or night, in a convenient way, saving busy scholars the time and effort spent physically visiting the library. What is more, they include additional functionality that is now considered essential to scholars' workflow– links from references to the original article, links from the text to supporting data or additional graphics, and powerful searchability.

As the concerns about electronic journals waned in the light of their advantages to the user digital publishing grew and, although in some disciplines print-only journals still persist, in most areas - and certainly throughout the sciences - digital publishing dominates. Even in the arts and humanities, the disciplines that have moved most slowly towards electronic journals, there are now large numbers of digital titles. *Project Muse*, for example, covers some 250 journals from around 40 different publishers. This is not to say the print format is dead: many librarians consider it is important to hold a print subscription alongside the electronic one for archival reasons.

Following on the heels of journals into the digital age came books and monographs, which remain the main vehicles for scholarly publication in the disciplines of arts and humanities. Acceptance of digital books ('e-books') was slow at first, but in the last few years the rate of e-book publishing has gathered pace, driven particularly by the appropriateness of the medium for text books and learning materials in general, and by demand from younger scholars for texts in digital format. The digital age has provided publishers with new tools for marketing their books, too, though it really took Google's digitising programme (*Google Books Library Project*), which exposes parts of a book's contents to interested searchers, to demonstrate the sales advantage that placing content under the noses of would-be buyers electronically can bring. e-book sales are rising across all sectors, including scholarly disciplines.

Peer review

Behind this type of publication-of-record stands peer review. No journal of repute permits a manuscript to go into publication without it passing a more or less rigorous examination by two or more members of the author's peer group, traditionally remaining anonymous. There are already some new forms of peer review being tried, such as non-anonymous review, where the reviewers' names are made known to the author. The digital age offers yet more variations on the theme (Harnad, 1996). Some journals have already started experimenting with open peer review, where articles are posted on the web for open discussion between peer group and author, are modified in the light of this and are then formally peer-reviewed by selected reviewers in the traditional way. The web also facilitates post-publication peer-review and open commentary and, additionally and importantly in the light of new communication channels, makes easier the objective measurement of the impact of articles in the form of citation analysis (Hitchcock, et al, 2003), which in itself constitutes a form of peer-judgment. We can expect further and far-reaching developments in the peer review system over time.

Data

Alongside the development of electronic publications has come the means for the public provision of types of data that were not possible to disseminate in the print-on-paper world. The early adopters of this facility were mainly scientists, but the humanities scholars and social scientists have not been far behind. In any discipline where large datasets are generated during research work – examples might be remote sensing, epidemiology, social science and education research, astrophysics – researchers can now easily make these available to their peers around the world by depositing them in a digital repository or on sites provided by publishers so that supporting data may accompany journal articles.

As web technologies advance, moreover, new methods of accessing and manipulating data are being developed. For example, *Web services*, interfaces that simplify access to both data and software, can enable scientists to access multiple existing interoperable databases and mesh together relevant data from each to create a new, richer, data collection. The limitation on the potential of such services is not technological but cultural – they can work successfully only with real-time access to the source databases and of course can work only on publicly-available content.

On this latter point, the notion of making publicly available data that support conclusions in published articles is one that is not only popular but may actually be enforced in some cases. The journal *Nature*, for example, has a clause in its conditions of publishing that stipulates that authors must make supporting data available for others to see and use. Many funding agencies now stipulate the same thing, and OECD Ministers have recently adopted a Declaration on Access to Research Data from Public Funding (OECD 2004).

As computer technologies are employed increasingly in academic research across all disciplines, the opportunities they bring for sharing data, mining data, simulation and visualisation will change profoundly the way scholars communicate their findings, make their work known and get it built upon.

Ownership and intellectual property

Traditionally, scholars submitting their work to a learned journal have signed over copyright (actually a bundle of rights) to the publisher. Included in this bundle of rights is the right to publish the work, and getting the work published is an outcome which is, of course, exactly

what the scholar seeks to achieve. Whilst, however, some publisher agreements are very generous to the author and leave the author with a variety of rights and options over how the work may be used, at the other end of the spectrum there are publishing agreements that impose rather severe restrictions on the use of the work, in some cases affecting even the author's own teaching and research use.

The academic community is beginning to respond to this. It is possible to unpick the bundle of rights, so that the scholar retains most of them whilst still handing to the publisher a licence to publish. In other creative areas this is the norm, with the creator retaining ownership of the work. Individual universities, such as the University of California at Berkeley, are actively encouraging faculty to retain intellectual property rights altogether or to use only publishers that 'maintain reasonable business practices' (University of California, 2005a).

Additionally, the *Creative Commons* organisation (and its protégé, *Science Commons*), has developed a set of licences that content creators, including scholarly authors, can use to retain some control over their ownership of their work whilst permitting the sort of public use that they hope their work will be put to, such as copying and distributing for teaching or research. This is a facet of scholarly communication that is likely to see much more change over the next few years.

Research assessment

The past three decades have seen profound changes in the way scholars are assessed for their research performance. Previously, peer opinion formed the subjective measure of a scholar's research ability and the number of reputable books or journal articles he or she published formed the best objective measure. Things began to change when the Institute for Scientific Information (*ISI*) developed a system for measuring the number of citations to journal articles, thus providing a form of comparative, empirically-based measure of the worth of a scholar's output, worth expressed in terms of whether the work had been built upon after its publication. ISI packaged the citation figures for all articles in a journal together, developed a formula for retrospectively calculating the influence of that journal in any given year and called the metric the Journal Impact Factor. Many words have been written about the impact factor over the years and space here does not permit a revisiting of all the arguments for and against it, save to say that as a measure of the impact of *individual scholars* it has only ever been a proxy. Nonetheless, it has been adopted by employers and funders of researchers worldwide as a metric that gives at least some idea of how influential a scholar's research is proving. Now, ISI has made available the 'times cited' metric for each article, showing how many times that particular article has been cited in the literature up to the time the user searches it out. Not a proxy, but a real measure of the influence of a scholar's piece of work, this is just one of a tranche of new bibliometric factors that are being developed by researchers and information scientists, all made possible by digitisation and enhanced by the interoperability of repositories of research results.

With a large database of digital articles to work with, it is possible to develop ways to measure not just citations but lots of other metrics, too. It has already been demonstrated that download counts predict future citations (Harnad & Brody 2004, Adams 2005, Bollen et al 2005). New bibliometric measures will tell us much more about impact, influence and interaction in the scholarly literature, measures such as co-citations, time-series analyses of downloads and citations, citation hubs and citation authorities, peaks, decay patterns and trends (Harnad, 2005a; Hajjem, Harnad and Gingras, 2005; and Kurtz and Brody, this volume). But all this

awaits the database to work on – the database that will be available for analysis once all published articles reside in a worldwide network of interoperable repositories.

The 'Serials Crisis'

An overview of scholarly communication would not be complete without a brief review of the so-called 'serials crisis' that has taken place in scholarly libraries throughout the world over the last 20 years. In recent times it has not been possible for a university or research institute library to purchase subscriptions to every journal and book that would form the ideal collection for users of that institution. Articles required from publications not subscribed to have been sourced through interlibrary loan or document delivery services where available. The situation has been exacerbated over the last twenty years or so by ongoing annual price increases for journals that have exceeded inflation, sometimes by many times. The Library and Information Statistics Unit (LISU) at Loughborough University in the UK monitors journal prices: it found that from 2000 to 2004 the increase in median price of journals from a group of twelve scholarly publishers increased between 27% (Cambridge University Press) and 94% (Sage). Inflation through that period has been on average 2.5% per annum in the UK (LISU, 2004). Similar studies by the Association of Research Libraries (*ARL*) in the US have revealed much the same story (ARL, 2003). Learned society journals are not immune to this, either: Allen Press reports that in the period 1988 to 2004 inflation in the US averaged 3.1% per annum, while the average increase in the subscription price of learned society journals was 7.5% each year (Kean, 2005).

Clearly this could not continue indefinitely and the problem it brings for libraries has been compounded by a concomitant increase in the amount of research being published, resulting in more journals and journals with more content (and the increasing content of journals is one explanation from publishers for their increases in prices). Libraries have adopted various strategies for coping: switching money from their book budgets to serials purchase; cancelling journal subscriptions; signing up to 'Big Deals'; or entering into other kinds of licensing solutions. These are demand-side solutions to a global problem. Unsurprisingly, since the digital age brings the wherewithal, supply-side solutions have also begun to emerge.

New developments in scholarly communication

Early on in this chapter the new, informal mechanisms whereby scholars are now communicating about their work were mentioned. Although still a minority activity, with the technologies in their infancy, they should not be underestimated as communication channels for the future. Already, scientific publishers are taking steps to embed such technologies in their operations (see, for example, Hammond, Hannay & Lund, 2004). True, they present citation and assessment problems, but they now form a part of the spectrum of legitimate, accepted and trusted communication mechanisms that ranges from the formal publication-of-record mechanisms at one end to blogs at the other. Web 2.0 (O'Reilly, 2005) is a social being, a concept rooted in interactivity and cooperation, and its emerging models of interaction are dynamic and real-time (or near to it). Already in some areas of scientific research blogs and wikis are proving to be popular and influential ways of communication between scientists. We can expect to see these and other technologies on the rise over the next few years.

At the same time, in the mainstream, the academy and its supporters including, not least, its funders are changing the thinking on scholarly communication. Two library-led meetings in the US around the turn of the century saw the development of sets of principles relating to the whole process of academic research, academic values, and the communication of these within the academic community and beyond it into the general public domain. Alongside this, they

espoused the twin aims of containing the costs of published research and of using digital capabilities to widen access to its results (Keystone Principles, 1999; Tempe Principles, 2000).

The latter issue gelled with already-existing initiatives from the research community itself where efforts to capitalise upon the opportunities offered by the web had given birth to the Open Access movement, dedicated to freeing up research output from the constraints imposed on its dissemination by publisher restrictions and the non-affordability of journals. The web had arrived, and with it the means, finally, for access to the scholarly literature to be truly available to all. Although there have been other initiatives that have significantly widened access to the scholarly literature, such as the collaboration between the University of Stanford Library and scholarly publishers that resulted in *Highwire Press*[1], none of them have satisfactorily addressed, nor certainly solved, the access problem.

Open Access does address the access problem, though the arguments in its favour work equally well when the whole issue is turned on its head and regarded as a *dissemination* problem. Formal definitions of Open Access are contained in the Budapest Open Access Initiative (Open Society Institute, 2002), the *Bethesda Statement on Open Access Publishing* and, comprehensively, in the *Berlin Declaration on Open Access to Knowledge in the Sciences and the Humanities* (see Bailey, this volume). Essentially, it means the provision of free, immediate (upon publication), permanent access to research results for anyone to use, download, copy, and distribute. Moreover, the definition stipulates that articles are placed in an organised repository (rather than simply on author websites) which is interoperable according to a specific set of standards, the Open Archives Initiative Protocol for Metadata Harvesting (*OAI-PMH*, see Awre, this volume). Search engines, such as *OAIster* and, now, *Google Scholar*, harvest the content of these interoperable repositories, constructing a database of worldwide, freely-available research available to allcomers at no charge.

Articles enter such a repository in one of two ways. They may be published in an Open Access journal (or are Open Access articles within an otherwise closed-access journal) in which case the publisher ensures they are correctly deposited in an OAI-compliant Open Access repository. Alternatively, they are copies of articles published in closed-access journals that are 'self-archived' by their authors, that is, deposited by the author in an Open Access repository. Such articles then form a constituent of the virtual global database, their text and citations available for capture and analysis and their metadata exposed for search engines or service providers to access and present to searchers around the globe.

The philosophical arguments for Open Access are rehearsed elsewhere in this book, along with accounts of its technological base, the business models associated with it and its advantages in terms of increasing the visibility and impact of research. This overview is not the place to pursue those topics further. There *is* one other issue that needs to be laid out here, though, since it is of critical importance to the progress of Open Access and does belong in an overview of scholarly communication. It is the issue of making it happen. Further into this book there is a chapter (Swan) on author responses to Open Access in which the speed of take-up of the concept – which has been slow - is discussed in the light of author attitudes and habits. If left to authors, achieving full Open Access will take a very long while. More is needed than that. And more is coming along

[1] Highwire Press provides a repository of full-text articles from some 900-plus journals, of which approximately 80% are available via pay-per-view access, approximately 20% offer free back issues after variable periods of time, most commonly 12 months after publication, and approximately 3% are true Open Access, i.e. immediately available upon publication.

in the form of institutional or funder requirements for researchers to provide Open Access to their work. So far, moves in this direction have been instituted by a small number of universities and research centres. Research funders, in the form of government-funded bodies in the US and UK and private funders such as charities and trusts, have also already made moves to ensure that the results from the research they support are available on an Open Access basis. There are signs from all around the world that such moves will be followed by similar ones elsewhere. This is significant in scholarly communication terms, for it represents a digital-age counterpart to the 'publish or perish' imperative – implicitly or explicitly applied – that scholars have always acknowledged from their employers or funders. The unchaining of scholarly research is on its way.