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'Cannot predict now': the role of repositories in the future of the journal

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Repositories, whether institutional or subject-based (disciplinary), typically provide open access to preprints and final manuscripts of accepted journal articles, among other material. While repositories generally do not perform all of the traditional activities of formal publication such as peer review, editing and formatting, and, except for a few exceptions, have struggled to attract researchers to deposit articles, it is fair to ask what impact such repositories have or might evolve to have on the academic journal. A handful of disciplinary repositories have become loci for scholarly dissemination and interaction. Academic libraries and other institutional-based hosts of repositories are slowly gaining experience in building and maintaining the infrastructure necessary for participation in the scholarly publishing sphere. While a few libraries have begun to use this experience to offer support for publishing, others have developed programmes to raise awareness of 'author rights' and to encourage faculty advocacy within the scholarly publishing arena. This chapter provides an overview of the repository landscape and outlines some of the ways in which repositories may have an impact on the future of the academic journal. The title of this chapter refers to one of the responses given by Mattel's Magic Eight Ball when asked to answer a yes or no question. With two rather momentous events in early 2008 – the mandate that research funded through the National Institutes of Health be deposited into PubMed Central and the unexpected mandate from Harvard's Faculty of Arts and Sciences that published articles be deposited into the institutional repository – it is clear that this rapidly changing landscape is subject to upheavals, reversals, and sudden surges forward.

I should also make the disclaimer that I manage an institutional repository and thus have certain prejudices and hopes. I have tried to minimize these in the presentation of this discussion.

The current repository landscape

What is a repository? For the purposes of this discussion, a repository is a digital assets management system of some kind or a network of systems that allows for the deposit and subsequent distribution of digital files over the internet. The type of content contained in repositories can vary widely: published articles, conference papers and book chapters, as well as unpublished papers, technical reports, working papers, presentations, data sets, scholarly websites, dissertations and theses, digitized material from library holdings, audio, video, and other materials. Most of the discussion in this chapter will focus on repositories that contain preprints (papers not yet accepted for publication in a peer-reviewed journal) and postprints (papers accepted for publication in a peer reviewed journal). These are sometimes collectively called e-prints (Bailey, 2006). Postprints may be the author's final manuscript version (post peer review but before final formatting and editing) or the published version (with the formatting, pagination, and headers and footers of the journal).

In most cases, the content of these repositories is available freely to anyone with access to the internet. Repositories typically collect content and some descriptive information either through direct deposit by researchers or through deposit by another on behalf of the researcher. Repositories thus fit into the 'self-archiving' model of open access, which is sometimes referred to as the 'green' road to open access (as opposed to the 'gold' road which is publishing in an open access journal) (Harnad et al, 2004). (Another form of self-archiving is to make the content openly available via a personal or departmental

website; this form of self-archiving is not discussed in this chapter.) It is important to note here that repositories typically do not have any formal peer review or editorial process for deposited items; the researcher's institutional or organizational affiliation is usually the authentication needed for deposit. Notably, however, arXiv, the well-established disciplinary repository for physics, now requires the endorsement of a would-be depositor by a current contributor (Ginsparg, 2006: 9607).

Repositories expect that researchers have the right or have secured the right to deposit content. This expectation is most problematic for postprints or other content that has been published. If a publisher requires the transfer of copyright from the author(s) and does not have a policy that allows the deposit of the article (in either the final manuscript form or the published form) into a repository, or if the author has not explicitly secured the right to do so, the author does not have the right to deposit. However, many publishers *do* allow some form of an article to be self-archived. The SHERPA/RoMEO database of publisher copyright policies and self-archiving policies indicates that as of February 2009 of the 539 publishers surveyed, 63 per cent allow some form of self-archiving (i.e. either the preprint or postprint or both) and that 51 per cent allow the postprint to be deposited (see *http://www.sherpa.ac.uk/romeo.php?stats=yes*). While this nominally would allow a large percentage of articles published each year to be deposited, the publisher's conditions on these policies are often quite confusing. For example, Elsevier allows authors to deposit a preprint into a disciplinary repository, but a postprint may only be made available on the author's personal or institutional website or server (note that Elsevier does not specifically rule out institutional repositories). The published PDF version of the article may never be made available publicly. In addition, authors must ensure that they include the complete citation with a link to the digital object identifier. (These conditions are set out on Elsevier's website, see: *http://www.elsevier.com/wps/find/authorsview.authors/copyright*). Negotiating the confusing and often conflicting publisher policies on self-archiving is a barrier to deposit not only for authors but for repository managers as well (Salo, 2008).

Repositories are generally optimized for crawling by search engine web spiders, and most make their metadata (i.e. the descriptive information describing the contents) harvestable via the Open Archives Initiative Protocol for Metadata Harvesting in order to help services such as OAIster (*http://www.oaister.org/*) perform integrated searches with content from other repositories. Both efforts serve the purpose of maximizing the distribution of the content contained in the repository. In addition, many, but not all, repositories make some level of commitment to the long-term preservation and persistent access to the material contained within them.

Two useful resources for exploring the range of repositories are the Directory of Open Access Repositories (OpenDOAR; see *http://www.opendoar.org/*) and the Registry of Open Access Registries (ROAR; see *http://roar.eprints.org/*).

Repositories can be organized according to any number of principles; this discussion will focus on two: subject or disciplinary repositories and institutional repositories. According to the OpenDOAR service, these two types of repositories represent 93.5 per cent of all repositories as of February 2009.

A *subject-based* or *disciplinary repository* collects, manages and disseminates scholarship in a broad or specific area of research. This means, of course, that the research represented comes from individuals based in a wide variety of institutions and organizations. These repositories are sometimes called e-print servers or e-print archives. The type of

content tends to be preprints and postprints. In both cases, the emphasis of disciplinary repositories is on the rapid, open dissemination of research; in the case of a preprint, the role may also be to offer the author an opportunity to get feedback on an article before it is submitted for publication (Harnad, 2003). Disciplinary repositories can be supported by a specific institution or scholarly society or by a network of institutions. As of February 2009, the OpenDOAR service reports 179 disciplinary repositories around the world. The most prominent examples of a disciplinary repository is arXiv (*http://arXiv.org/*) for preprints and postprints in physics, mathematics, computer science, quantitative biology and statistics. arXiv was established in 1991 at the Los Alamos National Library by Paul Ginsparg. It is now supported by the Cornell University Library, and contains over 526,000 papers deposited by researchers as of February 2009.

An *institutional repository* collects, manages and disseminates materials produced at an institution. Most institutional repositories are based at colleges and universities, although they also exist in governmental agencies, museums, corporations and other organizations, and began to become prevalent in the early part of this decade. Lynch (2003) describes institutional repositories as: 'essentially an organizational commitment to the stewardship of … digital materials, including long-term preservation where appropriate, as well as organization and access or distribution'. An institutional repository can contain a range of materials, but tends to focus on the research and scholarship of faculty, students and staff, as well as other materials that reflect the intellectual environment of a campus. Examples of institutional repositories include Ohio State University's KnowledgeBank (*http://kb.osu.edu/*), the Queensland University of Technology QUT Eprints (*http://www.qut.edu.au/*), and the University of California's eScholarship Repository (*http://repositories.cdlib.org/escholarship/*).

Departmental repositories are also worth mentioning here. These are similar to institutional repositories except that they are organized around a specific academic department or research centre. Departmental repositories tend to focus on the rapid dissemination of content produced by their researchers as well as promotion of the department itself. An example of a departmental repository is the University of Southampton's School of Electronics and Computer Science ECS EPrints Repository (*http://eprints.ecs.soton.ac.uk/*). As of February 2009, OpenDOAR lists 1082 institutional or departmental repositories from around the world.

The current impact of repositories on academic journals

Crow (2002) describes scholarly communication as having four specific parts: 'registration' of new ideas and research, 'certification' of the quality and validity of the research, 'awareness' of the research through dissemination and access, and 'archiving' research and scholarship for future access and use. The academic journal inherently performs three of these roles; archiving or preservation has traditionally been dependent on the libraries collecting the journal in paper form, but is now performed by services like Portico (*http://www.portico.org/*). Repositories also inherently perform three of these roles to greater or lesser degrees; the certification or peer-review process, however, has generally been left to journals. Open access advocates like Stevan Harnad generally stress that the most important role that repositories, especially institutional repositories, can play is to provide immediate open access to the published research and that peer review should rightly live with journals (for a typical example of Harnad's argument, see Harnad, 2008). Only a handful of researchers suggest that the review function should live within or perhaps overlay the repository sphere (see Ginsparg, 2007; Guédon, 2004).

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The other relevant piece of the environment is, of course, the business of journals. The serials crisis – the tension between the ever-increasing price of journals, particularly in the science, technology and medical (STM) fields, large scholarly societies' reliance on journal subscriptions to underwrite their activities, and the ever-tightening budgets of academic libraries – has been written about extensively (for a good overview, see Panitch and Michalak, 2005). The 2008 *Library Journal* Periodicals Price Survey reports that in 2006 the top ten STM publishers took in 53 per cent of the revenue in the $16.1 billion periodicals market (Van Orsdel and Born, 2008). From 2004 to 2008, the average price of US journals included in the Institute of Scientific Information's (ISI) Science Citation Index has increased 40 per cent; non-US journals in the same database have increased 34.3 per cent. The social sciences and arts and humanities have not fared much better (though the actual costs of the journals are lower). US social science journals have increased 37.8 per cent over those same four years and non-US journals have increased 40.9 per cent. US arts and humanities journals have increased 29.7 per cent while the non-US journals have increased 36.9 per cent (Van Orsdel and Born, 2008). In contrast, the serials budgets of members of the Association of Research Libraries only increased 11.5 per cent from 2004 to 2006 (Krillidou and Young, 2008: 12). It is no wonder that libraries have been actively looking for alternative models, and certainly the early rhetoric around institutional repositories in particular suggested that they could perhaps be an active part of a shift (for examples, see Crow, 2002; Prosser, 2003).

So could repositories supplant or change the journal as we know it? Could repositories help change the economics of the current environment? Yes and no – and the answer is even more muddied depending on who one talks to and whether one is talking about institutional or disciplinary repositories. The biggest reason why one might answer no is simply that researchers are not depositing their published peer-reviewed articles into repositories except for a few disciplinary repositories (to be discussed below). In her study to evaluate the deployment of institutional repositories, McDowell (2007) found that from 2005 to 2006, the median annual increase was 366 items, or essentially one new deposit a day. She writes, 'At a median growth rate of one item a day, IRs [institutional repositories] in America will likely not achieve the critical mass to significantly impact open access or change modes of scholarly communication for some time to come'.

The single deposit a day average is depressingly low, though not a surprise for any repository manager. Reasons for this slow deposit rate are diverse and include lack of awareness; uncertainty about open access and a desire not to disrupt relationships with publishers; a lack of time; the effort required to deposit; or that faculty are already self-archiving on their own or departmental website and do not see the advantage in depositing into a repository (Markey et al., 2007: 73). Fundamentally, institutional repositories have not been designed with services that faculty want and with benefits that they can easily see (Foster and Gibbons, 2005; Salo, 2008). Interest is also highly dependent on discipline; in my own experience as a repository manager, faculty in disciplines that do not have an active preprint or working paper culture are suspicious of sharing the non-authoritative version of an article (i.e. their final manuscript version post peer review).

Institutional repositories also include a mass of non-peer reviewed, published material. McDowell (2007) estimates that only 13 per cent of the material in institutional repositories is peer reviewed. Institutional repositories often contain presentations, historical research conducted at the university that has been converted into digital form, working papers, technical reports, electronic theses and dissertations, and data sets.[1] For most institutional repositories, these materials fit well into their collection policy and are entirely appropriate, but this has brought them under attack by some open access

advocates for diverting the focus from the goals of the open access movement (Poynder, 2006). Salo (2008) does an admirable job analysing the dilemma of institutional repository managers and getting beyond the rhetoric of some open access advocates. The point to make for this argument is that the very low rate of author self-archiving makes it difficult to imagine that institutional repositories – unless a large number of institutions follow the Harvard mandate (discussed further below) – will themselves be much of a threat to either the role that journals play in certifying research and scholarship or to the business model itself.

There are exceptions to the low deposit rate, but these are in the disciplinary arena, rather than institutional. arXiv is probably the most cited example of how a community can actively engage with a repository and come to rely on it to register and date stamp an idea or concept, to solicit feedback and review from the community, and to raise awareness of the community's own work. arXiv has its roots in the paper preprint physics community; preprints of papers were sent to colleagues as an expected part of the scholarly communication process. Moving this community into the online environment accelerated the process and made a more explicit date stamp of when a new concept was first discussed (Pinfield, 2001). These roles should sound familiar, so the question of whether arXiv has affected the journals in its area has been raised. By all accounts, it has not. Sally Morris, writing when she was the Chief Executive of the Association of the Learned and Professional Society Publishers (ALPSP), says that 'In the realm of physics, where the arXiv preprint repository has been in operation since 1991, publishers do not report any unusual drop either in submissions or in subscriptions' (Morris, 2004: 305). In listserv discussions, Morris has also stated that arXiv has had an effect on the usage of articles on publishers' websites (e.g. see *http://www.library.yale.edu/~llicense/ListArchives/0703/msg00189.html*), though there does not seem to be evidence of journal cancellations. A recent study of the interplay between astrophysics journals and the e-prints in arXiv shows that use of the e-print in arXiv falls dramatically once the journal article is published. The authors speculate that the astrophysics community still values the peer review and the authority that journal publication confers on an article (Henneken et al., 2007). However, the future does not rule out a role for arXiv; According to arXiv's founder, 'The arXiv repository functions are flexible enough either to coexist with the preexisting publication system or to help it evolve into something better optimized for researcher needs' (Ginsparg, 2006: 9606).

arXiv already has some cursory review in place; a network of volunteers quickly scans deposits to ensure they fit the scope of the subject area where they have been deposited. It is not too hard to imagine a more formalized review process being put in place. The question is not whether or not this could be done with the infrastructure arXiv has in place, but whether the review process would have buy-in from the participating researchers and the committees responsible for the promotion and tenure process.

The economics domain is another in which there exists a culture of sharing papers prior to publication. These have traditionally been shared through working paper or discussion paper series that are distributed by economic departments or research centres. For example, the Harvard Institute of Economic Research distributes a working paper series with the goal 'to make this early research available to fellow economists, scholars and institutions all over the world' (*http://www.economics.harvard.edu/journals/hier*). Economic preprints, whether or not in working paper series, tend to be distributed through the Social Science Research Network (SSRN) or through the Research Papers in Economics (RePEc) network of distributed repositories. But, again, there is little evidence that these practices have had a significant impact on

the primacy of journals for validating and certifying work. Ellison (2007) studied the publication patterns of economists in top departments and found that few publish papers in the so-called field journals (journals that represent the subfields of economics), and that Harvard's economics faculty are publishing fewer papers overall in peer-reviewed journals. He posits that:

> The 'decline of peer review' theory … is that the necessity of going through the peer-review process has lessened for high status authors: in the old days peer-reviewed journals were by far the most effective means of reaching readers, whereas with the growth of the internet high-status authors can now post papers online and exploit their reputation to attract readers. (Ellison, 2007: 1)

He points to the extraordinarily slow publication process in economics as a deterrent (see also Ellison, 2002) and notes that technology has made it possible to make research instantly accessible. He ends the paper:

> One could imagine that new institutions may arise and perform many of the same functions as the current peer-review system more efficiently. Given how central peer-review has been to academic research over the past century, however, the thought that the current system might collapse before any successor is clearly established is troubling. (Ellison, 2007: 36)

Ellison does not explicitly mention repositories as one of these new institutions, but clearly this is a potential role for discipline-based repositories. But caution should be taken in assuming that these models (which both have roots in a print tradition) will hold true for other disciplines. While these are not the only examples of disciplines with strong e-print practices, there are relatively few.

Emerging trends

Based on the analysis of the current landscape, it is pretty clear that most repositories will probably not change the role of journals or the business of journals in the near to mid-term future. However, institutional and disciplinary repositories have prompted or played an important part in some emerging trends that may in the long term affect the future of the journal. Three are highlighted below.

Education and advocacy around scholarly communication issues and author rights

While libraries have long tried to educate their faculty about the serials crisis (often when informing faculty of impending journal cancellations), education and advocacy around broader issues of scholarly communication is relatively new. Issues covered vary by library but usually include retaining rights when publishing (usually referred to as author rights), open access through self-archiving, publishing in open access journals, reuse of materials and associated copyright issues, and the future of scholarly societies, among other topics. There is strong support among national library associations for this new role for librarians. The Association of Research Libraries (ARL) and the Association of College and Research Libraries of the American Library Association jointly sponsor a workshop on scholarly communication education. The Scholarly Publishing and Academic Resources Consortium (SPARC) has developed a large number of resources to support education and advocacy around author rights, open access, and other issues (see *http://www.arl.org/sparc/advocacy/index.shtml*). In a recent survey of members of ARL, 75 per cent of respondents have conducted scholarly communication education; and 32

per cent have a librarian with explicit responsibility for education and outreach around scholarly communication issues (Newman et al., 2007).

Education and advocacy around author rights have been especially visible in the last two years, partly because of the low deposit rate in institutional repositories. The adoption by institutions such as MIT and the members of the Consortium for Institutional Cooperation of addenda for authors to attach to copyright transfer agreement forms in order to retain certain rights has meant that librarians have needed to talk to faculty about actually *reading* copyright transfer agreements.[2] Libraries are also engaging with graduate students – the future faculty – regarding these issues. All of these efforts have in turn forced publishers to be more explicit about the copyright transfer process and to specify what rights may be retained by authors. Long term, as the current undergraduate generation and their juniors – who are so used to open, free access and the ability to reuse and remix material – move into academe, publishers will need to adopt different models for copyright transfer and the licensing of articles.

Development of infrastructure and services

As libraries build out repositories and digital library services, they are building a robust and stable technical infrastructure, expertise in a range of scholarly communication and publishing topics, and connections with their faculty regarding a new set of issues. For some libraries this has meant a readiness to participate directly in the scholarly publishing sphere through providing the technical infrastructure for their faculty to publish and edit journals. Hahn writes:

> expectations are rising that research libraries will take responsibility for current scholarship as well as legacy scholarship, especially for a wide range of locally produced works of scholarship. Evolving repository services, which house and disseminate institutional records, theses and dissertations, preprints, postprints, learning objects, and research data, can inspire a range of inquiries about potential publishing services. It could be a short step to managing publication of works like journals and monographs, and faculty are approaching research libraries seeking publishing services. (Hahn, 2008: 10)

Jean-Gabriel Bankier, the president of the Berkeley Electronic Press, and Irene Perciali, the Director of Journals for BePress, ask 'What if, in addition to an archive, an institutional repository were a place for authors to create and publish scholarly content in the first place?' (Bankier and Perciali, 2008: 22). Accordingly, the Berkeley Electronic Press now provides a software suite that includes both repository and journal publishing software. At a presentation at the Digital Library Federation 2008 Spring Forum, Randall Floyd described Indiana University Library's effort to move from a repository-centric viewpoint to a services-centric viewpoint; one of the key pieces of this was supporting a faculty member in publishing an open access journal (Floyd, 2008). Libraries, realizing the initial investment in institutional repositories has not produced the desired changes (particularly if one of the reasons for the repository was to prompt change in the scholarly publishing arena), may find that leveraging investment in the technical infrastructure through the support of journal publishing makes financial sense and meets their service missions to support faculty research.

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Mandates for open access

In October 2005 the Wellcome Trust, the largest private funder of medical research in the UK, made it a condition of funding that published research be made publicly available through deposit into UK PubMed Central. In 2006, several other UK and European funders followed suit by requiring that funded research be made publicly available through deposit into an open access repository and/or publishing in an open access journal. In January 2008, the European Research Council announced that grant recipients must make funded research openly available within six months of publication. And in December 2007, an appropriations bill was signed into law that required grantees of the US National Institutes of Health (NIH) to make published articles available in PubMed Central a year after publication.

PubMed Central is a repository for biomedical and life sciences journal literature and is supported by the NIH and managed by the National Center for Biotechnology Information in the National Library of Medicine. Strictly speaking, PubMed Central does not share many of the characteristics of repositories as described in the first part of this discussion; the majority of its content has been contributed directly by publishers rather than by authors. In the three years prior to the 2008 mandate, there had been a strong recommendation that researchers deposit their work into PubMed Central; this resulted in the deposit of about 5 per cent of funded research.

The argument for open access mandates by funders is closely tied to increasing the impact of funded research through open access and, in the case of government-sponsored research, giving taxpayers access to the research they have funded. In 2006, the Federal Research Public Access Act was introduced to the US Senate. This legislation would have mandated all federal agencies expending funds above a certain threshold to require their grantees to make their research publicly available. This was vigorously opposed by many publishers; the Association of American Publishers issued a strong statement denouncing the legislation and made many of the same arguments that would be made in response to the NIH mandate.[3]

There have also been a few departmental and institutional mandates, but none made the noise that was heard in February 2008 when Harvard University's Faculty of Arts and Sciences voted unanimously to grant the university permission to deposit their published articles (in the form of a final manuscript postprint) into Harvard's institutional repository (for the text of the resolution, see *http://www.fas.harvard.edu/~secfas/February_2008_Agenda.pdf*). This mandate will require faculty to publish in journals whose publishers allow self-archiving, although faculty can get a waiver to opt out on a case-by-case basis. Among other reasons, this development is remarkable because it originated with the faculty and not with the library or the administration. This development is so new that, as of February 2009, Harvard had yet to make public its institutional repository (although a preliminary version is available to the Harvard community); it is hard to say how this mandate will play out in the long term. Certainly it is too soon to say how the Harvard faculty and publishers will respond as the mandate is implemented. Nevertheless, libraries and some faculty have certainly taken notice. SPARC and Science Commons have recently published guidelines for faculty who are interested in pursuing an open access mandate at their institution (Nguyen, 2008).

So what role will repositories play in the future of the journal? If more funders and institutions mandate that research be made available through open access repositories, then the business model of journals will be affected even if the research is embargoed for a period of 6–12 months (for an up-to-date list of funders that mandate some form of open access, see

http://www.sherpa.ac.uk/juliet/index.php). If disciplinary repositories begin to experiment with peer-review structures, particularly in communities with a strong preprint culture, journals will face another entity that provides registration, certification, awareness and archiving.

This chapter has attempted to lay out the current environment and interactions between repositories and journals as well as guess at a handful of emerging trends. While this is a complicated landscape with many interdependencies, it is clear that both institutional and disciplinary repositories will likely play some kind of role in the long-term evolution of the journal.

Notes

1 As a side note, data sets are themselves an interesting case to consider, as most journals articles do not include an entire data set but an analysed subset of the data. In some cases, the data set is deposited into a disciplinary data repository and the journal article links to the data set. In other cases, the data set is never made accessible or curated. This is perhaps a role that institutional repositories could play particularly for small to mid-size data sets.

2 For the MIT author addendum, see *http://info-libraries.mit.edu/scholarly/mit-copyright-amendment-form/*.

3 For the AAP press release and a response by an open access advocate, see *http://www.earlham.edu/~peters/fos/2006_05_07_fosblogarchive.html#114726726169346460.*

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