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Guest editorial

Non-profit alternatives to commercial academic journals: Success stories from mathematics

In 'Scientific communication, open access, and the publishing industry,' Andrew Kirby asserts that proponents of open access underestimate the importance and complexity of scientific communication, and that this mistaken view arises mainly in "isolated" fields such as mathematics. He holds that journals perform necessary functions which cannot be performed in other ways. I will respond as a mathematician who supports open access.

First, I want to underline the key point that Kirby does not address, namely, that many for-profit publishers charge exorbitant prices for their journals. Much of the work of publishing these journals (writing, refereeing, editing) is done for free by the academics themselves, and in many cases the research itself is funded by taxpayers, so it would seem the journals should be low cost and publicly available. Instead, many publishers charge high prices, force institutions to purchase journals they do not want through the so-called bundling process, and restrict public access to research results. If journals are to earn their privileged position within the academic world, their practices should advance rather than impede the missions of higher education and research.

Let us consider Kirby's points in order. Kirby begins by claiming that communication is more vitally important to the process of science than is often thought. He argues that in fields where communications among researchers are "simple", there is greater opposition to the current practices of journals than in fields where communications are "complex." It is not clear why lower communicative complexity should increase a field's opposition to the current practices of some journals. Kirby suggests that newer interdisciplinary fields are most in need of journals as they are still establishing their identity, but we are not told why that identity-creation could not happen in open access or non-profit journals.

Mathematics is selected as a representative field with strong opposition. Kirby argues that mathematics is isolated ("marginal") with an antiquated and simplistic communication structure, and this leads mathematicians to undervalue the role of the modern publisher. These claims are not supported by the evidence he offers.

Kirby draws the conclusion that math is insular from the bibliometric analyses of Bollen et al. (2009) and Leydesdorff and Rafols (2009). However, these analyses are misleading. One reason is that mathematics and mathematicians often appear with different disciplinary affiliations. Many universities have multiple mathematics-related departments: applied mathematics, computational mathematics, statistics, and operations research are a few examples. Leydesdorff and Bollen (in part) rely on the Thomson Scientific ISI classifications. In the ISI, various branches of mathematics are listed under computer science, engineering, biomedical sciences, and physics; thus the true reach of mathematics is underrepresented by their analysis.

A second reason these analyses are misleading is that they fail to capture most mathematical activity. The ISI indexes fewer than half of the math journals found at Math Reviews (MR) and Zentralblatt MATH (Adler, Ewing, & Taylor, 2008). There are fewer mathematicians, fewer articles per mathematician, and fewer citations per article in math, resulting in math appearing less active and less connected in this analysis than in reality. As Adler et al. (2008, p. 5) point out, "The special citation culture of mathematics, with low citation counts for journals, papers, and authors, makes it especially vulnerable to the abuse of citation statistics."

Further, Kirby's conclusion that "mathematics journals tend to be connected only to other math journals" is not supported by Bollen. The only mention of math in the entire article (including diagrams) is the following: the *Annals of Mathematics* (one of the premier general mathematics journals) is cited as having a particularly high correspondence with not only the *American Journal of Mathematics* and *American Mathematical Monthly*, but also with the *Proceedings of the National Academy of Sciences of the United States of America* and *Econometrica*. This suggests connectivity, not isolation.

In fact, of six disciplines studied, Porter and Rafols (2009) have shown (using the ISI as well) that the connectivity of math is increasing fastest. One way this can be seen is in the increase in multiple-author papers. Connectedness is also evident in the structure of modern mathematics departments. The Department of Mathematics at Florida State University, my home department, has researchers in pure mathematics, mathematical biology, mathematical finance, and actuarial mathematics along with several other branches of applied mathematics. Even pure mathematics has strong interdisciplinary connections to current research in philosophy, computer science, physics, astronomy, biology and, increasingly, geography (e.g. Abrahamsson, 2012). I am a pure mathematician and have a paper in the *Journal of Physical Chemistry A*. As Lovász (1999, p. 2) states, the view of mathematics as insular is dated: "mathematics has outgrown the small and close-knit community of nerds that it used to be. And with increasing size, the profession is becoming more diverse, more structured and more complex."

Kirby makes the puzzling assertion that "communication [in mathematics] can be thought of as representative of a previous scientific era – pre-Enlightenment rather than pre-digital – where the norm is to pass around proofs and vote upon their elegance." He says this "medieval guild" mentality makes mathematicians undervalue the services of contemporary publishers and the effort

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involved in digitizing past publications and in providing electronic search methods. Even if his picture of mathematical scholarship were accurate, the connection he implies here is mysterious – why should a field with this mentality have less need or appreciation for the distribution of new results, archives of past publications, or useful search functions, than other fields? Mathematicians need these things just as other fields do, and have created new ways to get them outside of the for-profit system.

Academic journals serve five main purposes – dissemination, registration (establishing precedence), review, filtration (organizing), and designation (Clarke, 2010). The mathematical community has already begun to use new tools for several of these functions; let me introduce a few.

For dissemination and registration, the arXiv is the key tool. It is free to use and is supported by many institutions (see http://arxiv.org/help/support for funding details). In fact, "the arXiv [is] by far the dominant preprint repository and it is the first place many mathematicians in certain areas of the discipline look for new research" (Crowley, Hezlet, Kirby, & McClure, 2011, p. 2). Most mathematicians post pre-prints of their work to the arXiv or on their personal web pages.

For review and filtration, MathSciNet and the associated Math Reviews are superb services run by the American Mathematical Society (AMS), a non-profit professional organization. MathSciNet is a comprehensive searchable database of mathematics papers; it is offered to institutions on a subscription basis. Math Reviews are associated to each paper; these summarize the results of the paper and the paper's merit. They are written for free by other mathematicians (much like referee reports for traditional journals).

The service of designation or branding is trickier, although as new journals and online repositories become more established, their prestige rankings will be sorted out. Even established prestige rankings can shift quickly. In 2006 the entire editorial board of the Elsevier journal *Topology* resigned. The journal *Geometry & Topology* was created with the aim "to run a journal of top quality essentially free, using authors' labor for the typesetting and the Internet for distribution of its electronic version" (Birman, 2000, p. 773). In 2009 *Topology* ran its last issue, and now *Geometry & Topology* has taken its place as the foremost journal in the subject. As one mathematician has noted, "from the economic point of view, prestigious journals are like colas: the importance is in the brand" (Walt, 2007). The move away from for-profit publishers in recent years arises because mathematicians do not think the brand name is worth such a high premium.

How high is the premium? Table 1 reveals a startling discrepancy in prices (see also, American Mathematical Society, n.d.; Birman, 2000; Kirby, 1997; Rehmann, n.d.). As The prices of representative Elsevier journals are significantly greater than those of representative non-profit journals, even when the non-profit journals are rated more highly on scholarly impact.

Far from being uninterested in modern communication methods, mathematicians rely on them heavily. Indeed, the fundamental role of communication in research is a major reason behind the protest against journal pricing and copyright practices. Mathematicians are unsatisfied with a system whose high price point and draconian copyright regulations are an effective barrier to communication.

What about other functions of publishers? Kirby says that mathematicians fail to appreciate the expense of digitization projects. Having digital access to archives of journals is useful, for mathematicians as for others, and such archives do represent an initial cost to create. However digital archiving too can be conducted by non-profit organizations, and it need not be bundled with the price of new journals. In mathematics, many historical texts have been digitized and are freely available through such projects are Project Euclid, Numdam, and the archiving projects of the American Mathematical Society. In comparison, the digitization fees charged by many for-profit journals seem excessive.

Table 1
Comparative prices of mathematics journals, reproduced with permission from Arnold and Cohn (2012, p. 3).

Journal	Publisher	Metrics[a]	Price[b]	$/art.[c]	$/page	$/cite
Annals of Mathematics	Princeton	3.7/A*	$447	5.39	0.12	0.06
SIAM J. Appl. Math	SIAM	1.8/A*	$642	5.95	0.27	0.13
Journal of the AMS	AMS	3.6/A*	$300	9.09	0.24	0.13
Advances in Mathematics	Elsevier	1.6/A*	$3899	11.53	0.35	0.90
Journal of Algebra	Elsevier	0.7/A*	$6944	13.89	0.75	1.22
Journal of Number Theory	Elsevier	0.6/B	$2745	17.49	1.12	1.91

[a] Metrics are the 2010 5-year impact factor from Journal Citation Reports and the 2010 rating by the Australian Research Council (based on expert opinion). A* = top-rated, B = "solid, though not outstanding."

[b] Elsevier prices are the amounts actually paid by the University of Minnesota for electronic-only institutional subscriptions in 2012. The lowest prices Arnold and Cohn could find on the Elsevier web site as of February 29 were $3555.20, $5203, and $2226.40. The Annals price is again the actual amount paid by UMN, which is slightly greater than the $435 list price. The SIAM and AMS prices are the list prices, although UMN paid less because of institutional membership.

[c] Columns 5–7 normalize by the most recent data available: the numbers of articles and pages published in 2011 and the number of citations to the journal made in 2010 (as reported in Journal Citation Reports).

Data storage costs for such an archive are small. As early as 1995, it was realized that "the electronic storage capacity needed for dissemination of research results in mathematics is trivial with today's technology" (Odlyzko, 1995, p. 50). Current open access mathematics projects like the *Open Journal of Discrete Mathematics* and the *New York Journal of Mathematics* (*NYJM*) are able to meet their costs, including data storage costs, with grant money or by charging minimal fees.

Outside of the traditional functions of journals, Kirby identifies other important roles publishers can play amid increasing academic specialization: "developing different types of research support," which includes offering "proprietary search platforms," and "creating meta-journals." These are valuable services that publishers could charge for separately, but their value fails to address the original debate about open access and low- or no-cost scholarly journals.

Kirby's final sentiments are perhaps his most misguided, when he compares for-profit journals to newspapers and worries that if we move to low cost or free journals there will be no way to make sense of the ensuing flood of articles. His concern here is the curatorial and vetting function that editors and reviewers serve – but those important functions can be performed equally well for a low cost open access journal.

Newspapers require money to pay for their reporters, editors, and fact checkers, but this is not the case with scholarly journals. With the exception of some editors who are paid a small stipend, these services are all done for free already. The salaries of the authors, reviewers and editors are paid either by their parent institutions or by grants, most often from public research foundations. In Kirby's analogy, the reporter (the mathematician) is paid not by the newspaper (the journal) but by the taxpayers.

Despite Kirby's assertion that "it is not clear that we have thought through the implications of setting the price point closer to zero," mathematicians have been discussing alternatives, strategies and pitfalls for decades, and alternative systems are already thriving. They are not limited to open access; many successful low cost journals are now available (see Louis, Schneider, & Rehmann, 1999 for a cost analysis of the online journal *Documenta Mathematica*, as well as Steinberger, 1996 for a history of the online *New York Journal of Mathematics*).

Kirby's evidence does not show that math is isolated from other disciplines, nor that it relies on outmoded communication structures. Far from oversimplifying the problems of new publishing models, mathematicians have already implemented alternatives to for-profit publishing. Many services now performed by for-profit publishers rely on the free labor of academics and can be had at low cost outside the for-profit system.

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