Experience with a Free Electronic Journal: *Theory and Applications of Categories*

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The word "free" in the title intentionally has two meanings: free of cost and in a state of liberty. The thesis of this note is that mathematics journals should be free and that this can be achieved much more easily than might be supposed. After describing how one free journal began and thrived, we make some observations about our thesis.

For me, the "serials crisis" began in earnest when I was hired at a small undergraduate university (Mount Allison) in 1981. A commitment to research was complicated by a university library containing none of the journals needed to keep up with my field. In 1981 much communication of new work was done through circulation of preprints and conference talks, but to access journals for archival material required a 125-mile journey to Dalhousie University in Halifax, Nova Scotia—a journey made many times. During the 1980s advocating improvements to library holdings was ineffective because of the severe cost pressure from the soaring prices of serials. Soon the Dalhousie library began to cut journals, and access to the literature became more fragile.

Luckily, in the 1980s many of us began to use email and Knuth's wonderful TEX. Change became possible. In January 1990 I emailed about twenty-five colleagues in category theory, proposing that we set up an electronic journal based on TEX and using email and ftp. The response to my proposal varied from enthusiasm through indifference to scathing. We didn't proceed. In retrospect, the enthusiasts and I were right. There was no technical obstacle then to starting a free electronic journal. The only significant technical difference between then and now is the explosion called the Web. Of course, there is an important nontechnical difference: electronic journals are common and accepted today.

Through the early 1990s the serials crisis became more acute as commercial journal publishers raised prices precipitously. In April 1994 some students showed me a Web browser called Mosaic. It was an unforgettable moment—the time was suddenly right to propose a journal again. At the same time, several other subject area electronic journals were starting up, notably the *Electronic Journal of Combinatorics* (EJC), the

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Electronic Journal of Differential Equations (EJDE), the *Electronic Transactions on Numerical Analysis* (ETNA), and the *New York Journal of Mathematics* (NYJM). Seeing them made me regret not going ahead in 1990. That June I wrote to a dozen colleagues among the leaders in my field. They were invited to become founding editors of a new electronic journal. Everyone agreed immediately. Something had changed. At our international conference in France in July we met and sketched plans for the journal. All of the editors agreed that the highest conventional editorial standards must be met, and all were determined that our venture would be highly respected.

The first dozen editors elected another group, and the journal started with twenty-four editors from twenty-one universities (including Buffalo, Cambridge, McGill, Milan, Paris, Rutgers, and Sydney) in ten countries. Our TEX expert, Michael Barr, soon produced a pleasing LATEX style for the journal that is based on the "article" style: we'd decided to look like a paper journal. Translating the widely varying author submissions to the house style was time intensive at first, but the journal does have a more consistent "look and feel" than many early electronic math journals. It was also decided that the content would be defined by dvi files. Largely, it still is.

In January of 1995 the new journal, *Theory and Applications of Categories* (TAC), was announced. Articles were submitted, and soon one was refereed and accepted. It was entitled "Oriented singular homology". The revised version was received on April 4, 1995, and the article was published on April 6. There were 9 articles and 178 pages that first year—just about right for the limited skills of and time available to the managing editor.

We also had to consider archiving. The National Library of Canada was then investigating storage of electronic serials, and TAC was in the first group it archived. Also, in June of 1995 the European Math Society set up what became the *European Mathematical Information Systems* (EMIS), and TAC joined. EMIS began actively archiving about a dozen journals, some of which were purely electronic. Many journals are now archived by EMIS and mirrored on five continents. The archive is secure.

Early growth in TAC's number of articles and pages was slow. By 2000 TAC was publishing fifteen articles, totalling 338 pages. In 2001 there was stronger growth. That volume had 23 papers of nearly 600 pages, and a special issue was also published. Over the last decade the number of articles published annually has been stable in the mid-twenties. Occasionally several more articles appear in a special issue. The 275 articles TAC has published in the last decade represent about a seventh of the items in the category theory MSC category, and that number is in the same range as the main commercial journal in the subject area.

For several reasons some of the classic papers in category theory were published where they are inaccessible even to those with good library resources. Some of these invaluable articles circulated as dog-eared Xerox copies. In 2002 TAC launched a unique service, a series called Reprints in Theory and Applications of Categories. Criteria for inclusion are strict, and the series now includes about twenty reprints of articles, theses, and out-of-print books.

The editorial board has become slightly larger, and as some editors have left there has been renewal. Happily, several younger colleagues have been elected. The current editors are even more international than the 1995 group. Thanks to the editors' vigilance, the quality goals we started with have always been met. For anyone who simply prints the published articles, TAC is not visibly distinguishable from a paper journal. However, the Web pages provide quick, easy, and free access. The front page remains very simple and elegant: pages load fast, and article content is one click away.

Given its satisfactory growth, editorial renewal, and strong support from the category theory community, future prospects for TAC are excellent.

Other free electronic journals that started at about the same time as TAC have had varying, but successful, experiences: some rapidly began to publish many dozens of articles; others, like TAC, grew more slowly. Over the last decade and a half, a number of other free electronic journals have started up across several mathematics subject areas. Some have even begun to provide low-cost print editions.

The AMS noted the growth of electronic journals through articles published in the *Notices*. Further, the AMS began to disseminate statistics from electronic journals, giving median refereeing and acceptance-to-publication times. Most important was the support for free electronic journals shown by Math Reviews and Zentralblatt in reviewing journals like TAC. It made them visibly respectable. Initiatives like MathSciNet, the online Zentralblatt, and EMIS have been essential to a change in culture among mathematicians: we now look first to high-quality electronic sources for information. Getting the new free journals noticed by commercial abstracting services is considerably harder. For example, TAC began to be covered by Thomson's Web of Science only recently and after considerable pressure. In my opinion such delays arise because free journals help to expose the lack of value added by those companies.

What does experience with TAC suggest about the future of the mathematical literature? If asked in 1995, I would have predicted that by now there would be several hundred electronic math journals and many fewer commercial journals. Instead, there are a few dozen free electronic journals

and some others that provide variations of "open access". Despite occasional outrage from the mathematical and scientific community, there is little sign of commercial journals disappearing. Unfortunately, the publishers harvest more money than ever from taxpayer support for science. Nevertheless, progress over the last decade has led me from pessimism about the slowness of change to cautious optimism that the free journals are making a difference.

So, if your subject area of mathematics doesn't yet have a free electronic journal, *it's time to start!* All that's needed is a strong editorial board and *very little* time from a small team. Colleagues in my field often suppose that managing a subject area electronic journal is a heroic endeavor. The truth is very different. In 1995 a few hours were required to publish the average article in TAC. That was almost entirely due to TEX submissions that varied wildly in quality. Today, authors produce much better source code, and each article published in TAC requires well under an hour of the managing editor's time. Some articles do still go to our TEX experts for improvement, but we seldom see really awful code. Nevertheless, TAC has a visual standard that matches the best of the print journals. TAC's simple publication system might not scale to many hundreds of articles yearly, but most mathematics journals are not of that size. Moreover, the scripting required to automate article handling for much larger numbers is not difficult. Several free journals do it that way.

There is nothing to stop the mathematical community from freeing its literature electronically. *Let's just do it.*