

The Slow Revolution of the Free Electronic Journal

Allyn Jackson

It was supposed to be here by now, that glorious electronic future of scholarly communication. In the 1990s there was talk of the collapse of publishing empires, of packing all of human knowledge onto a few huge hard disks, and of everything being clickable from everything else. Well, it has not quite happened that way. The publishing empires are still there, most of human knowledge is still stored on paper, and the average number of clicks it takes to go from one Web page to another is holding steady at nineteen.

Nevertheless, there is a revolution taking place in electronic publishing of mathematics, even if it is occurring more slowly than some of the prophets thought. The past seven or eight years have seen the birth of around thirty-five mathematics journals that are available free of charge and published on the Web. These are journals run independently by mathematicians, without the support that publishers have traditionally provided. Though it is becoming more commonplace and more accepted in the mathematical community, this mode of journal publishing does not seem poised to take over traditional publishing, at least not immediately. However, it does provide a flexible alternative that has some distinct advantages over conventional publishing.

Publishing a free electronic journal is both hard and easy, as the following four brief portraits indicate. These portraits bring out many of the challenges that these journals face in establishing themselves in the already crowded world of mathematical publishing.

Allyn Jackson is senior writer and deputy editor of the Notices. Her e-mail address is axj@ams.org.

Electronic Journal of Combinatorics

At a conference in 1994 Neil Calkin, now of Clemson University, and Herbert Wilf, of the University of Pennsylvania, discussed the possibility of starting a free electronic journal in the field of combinatorics. The time seemed right, and “it was easy to do,” Calkin remarked. In that same year the *Electronic Journal of Combinatorics* published its first papers. It is now one of the most successful free electronic journals, with a reputation that attracts some of the best papers in combinatorics and competes well with traditional print journals in that area.

As with many electronic journals, two things in particular made the startup simple: the wide availability of e-mail and the pervasiveness of \TeX . The journal might not have prospered had the technical implementation proved onerous. However, the key to its success lies, as with any new journal, whether print or electronic, with the makeup of the editorial board. “Herb Wilf knew all the right people,” Calkin noted. “He persuaded good people to serve on the editorial board and to submit good papers.” Early on they announced the founding of the journal at a couple of major meetings in combinatorics and made a point of mentioning it to colleagues. For the last few years about one thousand people have subscribed to the journal’s e-mail notification service, which sends out abstracts of new papers being posted. The journal publishes about fifty papers per year and has a rejection rate of around 50 percent.

Authors submit manuscripts in various dialects of \TeX by e-mail or by FTP (File Transfer Protocol). Communication with authors and referees and

Notices Coverage Concerning Electronic Journals

Below is a selected list of articles concerning, directly or indirectly, electronic journals in mathematics that have appeared in the Notices within the last six years.

“Tragic Loss or Good Riddance? The Impending Demise of Traditional Scholarly Journals”, by Andrew M. Odlyzko, January 1995

“Roadkill on the Electronic Highway: The Threat to the Mathematical Literature”, by Frank Quinn, January 1995

“Whose Article Is It Anyway? Copyright and Intellectual Property Issues for Researchers in the 90s”, by Ann Okerson, January 1996

“Electronic Mathematics Journals”, by Mark Steinberger, January 1996

“Mathematical Journals: Past, Present, and Future—A Personal View”, by Donald Babbitt, January 1997

“Mathematics Journals Should Be Electronic and Free”, by Steven G. Krantz, September 1997

“Toward a Mathematical Markup Language”, by Ralph Youngen, October 1997

“Mathematics Research Libraries at the End of the Twentieth Century”, by N. D. Anderson, K. Dilcher, and J. Rovnyak, December 1997

“Reforming Scholarly Publishing in the Sciences: A Librarian Perspective”, by Joseph J. Branin and Mary Case, April 1998

“Mathematics Journals Should Be Electronic and Free(ly Accessible)”, by Greg Kuperberg, David Morrison, and Richard Palais, August 1998

“Pricing of Scientific Publications: A Commercial Publisher’s Point of View”, by Edwin F. Beschler, November 1998

“Scientific Publishing: A Mathematician’s Viewpoint”, by Joan S. Birman, August 2000

—A. J.

within the editorial board is also carried out in e-mail. Once a manuscript is accepted, the author is asked to add a few lines of \TeX code that adjusts things like the page size and identifies the paper as appearing in the *Electronic Journal of Combinatorics*. Once that step is done, the paper is posted on the journal’s Web site right away. At first papers were available only in \TeX source and dvi (device independent) formats; today PostScript and PDF (Portable Document Format) are available also.

All papers go through the hands of one of the three editors in chief, of whom Wilf is one. These editors keep all of the records about the status of submissions and refereeing. Calkin is one of the two managing editors, who take over once papers are accepted: they communicate with the author on the final version to be posted, they update the journal files, and they maintain the Web site. In this regard, Calkin explained, the role of the managing editors is to do “what a publisher would do.” However, the amount of work is less because the

managing editors do no copyediting of the papers, and they do not insist that all papers be put into a uniform format. Indeed, glancing at some of the papers on the journal’s Web site, one can easily see variations in the style of the papers’ titles, the way the authors’ names are presented, and so forth. Another task for the managing editors is to fix papers that do not compile properly in \TeX ; Calkin said that difficult cases arise three or four times a year.

One concern many have raised about electronic journals is the durability of the electronic formats in which they are stored. A canonical example is the loss of Internal Revenue Service data from the 1950s, which was stored on Univac tapes. The only Univac machines around today are museum pieces. Something similar happened to one mathematician who can no longer open the electronic file containing his 1989 doctoral thesis because it was written using software that is obsolete today. Calkin agreed that durability of storage formats is a legitimate concern, but, precisely because people are worried about it, he believes it will be adequately addressed. “It will be an ongoing problem,” he said, “but there will be incentives to have ongoing solutions.” When PDF became available, he noted, the *Electronic Journal of Combinatorics* converted all of its papers into that format, and “it was relatively painless.” He believes that creators of new electronic formats will have an incentive to make conversion from old formats just as easy.

Documenta Mathematica

Documenta Mathematica was founded in 1995 by the Deutsche Mathematiker Vereinigung (DMV, German Mathematical Society) on the initiative of Ina Kersten of Universität Göttingen, who was DMV president at the time. “She was and still is very much convinced that mathematicians should take publishing into their own hands, at least to some extent,” explained Peter Schneider of Universität Münster, who now serves as one of the three managing editors for the journal. The other two are A. K. Louis of Universität des Saarlandes and Ulf Rehmann of Universität Bielefeld, who serves as the technical managing editor.

Documenta Mathematica became especially well known in the international mathematical community after the journal published as a special issue the proceedings of the International Congress of Mathematicians (ICM) that was held in Berlin in August 1998. The first two volumes of the proceedings, containing writeups of the section lectures, were handed out to ICM participants as they registered; previously it had taken months for ICM proceedings to appear. This feat was achieved largely through the efforts of Rehmann, who had about two weeks to generate the 2,200 pages containing the 160 papers presented at the Congress. He said the process went smoothly thanks

journals, has mirror sites in several places around the world. These sites update themselves automatically by communicating with the central site at Technion on a daily basis. In addition, the journal files are stored electronically (and will soon be stored on CD-ROM) at the Library of Congress and at the library of Temple University. Sometimes reversion to paper also provides an additional backup: The first four volumes of the *Electronic Journal of Linear Algebra* were produced in a paper version that was sent to a number of libraries for archiving.

Hershkowitz noted that paper provides a sense of permanence and security for those who worry that someday the electronic files might disappear or become inaccessible. These worries are largely misplaced, he believes, as many far more critical things, such as programs for nuclear weapons, are computerized today. "The immediate fate of the world depends on computers," he said, "and the systems have been reliable."

New York Journal of Mathematics

The *New York Journal of Mathematics*, published at the State University of New York at Albany, was launched in 1994 as the first free electronic journal covering all areas of mathematics. It received two small three-year grants from the university to support the purchase of computers to run the journal. The journal differs from many other free electronic journals in the sophistication of its Web site and the amount of care devoted to individual papers. The journal's home page strikes a high-tech note with an animated logo showing Boy's surface rotating above and reflecting onto the acronym for the journal, NYJM (for those with slow Web browsers there is also a "no frills interface").

One can download a paper in a variety of formats, including PDF and hypertext dvi, and these two versions contain embedded links. There are internal links, from the authors' names to their affiliations given at the end of the paper, from a mention of a theorem to the statement of the theorem, from references in the paper to the bibliography, and so forth. There are also external links, which lead from

references in the bibliography to their entries in the online versions of *Mathematical Reviews* or *Zentralblatt* and sometimes to the papers themselves when those papers are available on the Web. Each paper also has a "links page", which connects readers to reviews of the paper or related works that were published after the paper appeared. The links page also provides access to computer programs or other resources related to the paper.

Most free electronic journals do not provide such elaborate linking because the links are quite time consuming to add. The editor in chief of the *New York Journal of Mathematics*, Mark Steinberger, said that much of the work of embedding links into papers has been automated and takes about sixty to ninety minutes per paper. In fact, he noted, this task actually takes much less time than copyediting and fixing TeX or PostScript files that do not work properly. John Randall of Rutgers University, who serves as consulting editor for the journal, worked with Steinberger on the software development and Web design and troubleshoots many of the technical problems that arise. The assistant managing editor, Timothy Kohl, who is the computer consultant for the mathematics department at Boston University, created and manages the journal's search engine.

Since 1997 Steinberger has also produced the electronic version of the *Pacific Journal of Mathematics*, an independent journal published on a nonprofit basis. The journal's producer, International Press, pays Steinberger for this work and also pays for the *Pacific Journal* to share Web space with the *New York Journal* and to use the latter's full-text indexer. Steinberger's work led to a change in the publication process of the *Pacific Journal*. At first the electronic version and the print version were produced using separate files. In adding internal links to the papers, Steinberger caught many errors in cross-references and labels, but the corrections could only be made in the electronic version. Today the files Steinberger generates are also used to produce the print version.

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Discontent over High Journal Prices

Inseparable from the phenomenon of free electronic journals is an issue familiar to mathemati-



cians everywhere: rising journal subscription prices. For more than a decade the increasing cost of scholarly journals has put mounting pressure on journal budgets for academic and institute libraries all over the world, leading to cancellation of subscriptions and threats to the quality of many collections. A May 2000 report of the Association of Research Libraries stated bluntly: "The increasing volume and costs of scholarly publications, particularly in science, technology, and medicine, are making it impossible for libraries and their institutions to support the collection needs of their current and future faculty and students." The report goes on to encourage academic faculty to avoid submitting their work to high-priced publications when lower-priced alternatives are available.

While mathematicians have long been aware of the increasing prices of many mathematics journals, data about those prices have not always been easy to obtain. One survey that was widely circulated in the mathematical community and beyond was carried out by Robion Kirby of the University of California, Berkeley; the survey first appeared in 1997 and was updated in 2000.¹ The *Notices* has in the past carried journal price surveys, but dropped the practice after threats of legal action that claimed the surveys amounted to unfair advertising. Recently the AMS published a journal price survey on its Web site.² Glancing through these surveys, one can easily see where the discontent over journal prices comes from.

Nowadays nearly all mathematicians type their papers in a dialect of \TeX . Much of their communication about research is carried out electronically: papers are circulated in e-mail, posted on Web sites, or placed in preprint archives. Communication among journal editors, authors, and referees is nearly always carried out electronically, even in the case of traditional print journals, and many journals are produced using author-prepared \TeX files, at least as a starting point. As the use of electronic communications became more widespread among mathematicians and as journal prices continued to rise, many began to question the necessity of the services traditional publishers provide, such as copyediting and formatting of papers. In fact, some felt that by setting journal prices so high, some publishers were actually inhibiting scholarly communication rather than enabling it. These are the kinds of concerns that motivated many who started free electronic journals.

¹Kirby's survey is available at <http://www.math.berkeley.edu/~kirby/journals.html>.

²The Web address for the survey is <http://www.ams.org/membership/journal-survey.html>.

Web Addresses of Journals

Listed below are the addresses for the main Web sites of the free electronic journals mentioned in this article. The journals typically have one or more mirror sites linked to the main sites.

Documenta Mathematica:
<http://www.mathematik.uni-bielefeld.de/documenta/>
Electronic Journal of Combinatorics:
<http://www.combinatorics.org/>
Electronic Journal of Linear Algebra:
<http://www.math.technion.ac.il/iic/ela/>
Electronic Transactions in Numerical Analysis:
<http://etna.mcs.kent.edu/>
Geometry & Topology:
<http://www.maths.warwick.ac.uk/gt/>
New York Journal of Mathematics:
<http://nyjm.albany.edu:8000/nyjm.html>

The Web site Math-Net (<http://www.math-net.de/>) contains a list of free electronic journals and also provides links to other similar lists available on the Web. Two of the main ones are the list on the European Mathematics Information Server (<http://www.emis.de/journals/index.html>) and the list on the AMS Web site (<http://www.ams.org/mathweb/mi-journals2.html>).

—A. J.

Why So Few?

There are around 675 mathematics journals in all, and only about 35 of these are free electronic journals. Computing power is generally not an obstacle to starting electronic journals, which can easily be run on computer systems typically found in academic mathematics departments. What is more, many of the established electronic journals are willing to share the software they have developed, making startup of a new electronic journal easier. So why aren't there more free electronic journals in mathematics? There are a number of reasons. One is simple: There are already a great many journals. New journals, whether print or electronic, face stiff competition for good papers and for good people for their editorial boards. Kirby was a driving force behind *Geometry & Topology*, a free electronic journal launched in 1997 (with a print version sold at cost). From the start the journal aimed to have standards equal to those of the best print journals, he said, but it is a struggle. "If we reject too many papers and have too high a standard, then we may not get enough papers to get over the threshold," he explained. "If we have a somewhat lower standard, then we label ourselves, by our demonstrated standards, as not quite at the top. So we have to keep hustling." In this regard, *Geometry & Topology* faces the same kinds of growing pains as does any other new journal.

Another reason there are not more free electronic journals is that they require a good deal of work to run. Computers have streamlined many

journal operations, such as communication with authors and referees, and have automated tasks like preparing indexes and tables of contents. However, much of the work that needs to be done after papers are accepted cannot be automated, such as fixing \TeX files that do not work or redrawing figures that do not display properly. While some journals forego copyediting because it is too time consuming, some editors believe copyediting is important, especially if they receive many papers from authors whose native language is not English. Indeed, in examining the editorial structures of free electronic journals, one nearly always finds mathematicians or sometimes mathematics graduate students who handle only postacceptance processing of papers; in other words, they perform the tasks that publishers traditionally have performed. Kirby wryly noted that, just as \TeX “converted mathematicians into typists,” so electronic journals are converting them into publishers.

By keeping the entire operation in the hands of mathematicians, free electronic journals offer unprecedented freedom, control, and independence. But there are also some concerns. One is whether the model of free electronic journals would scale up well. In a letter to the editor in this issue of the *Notices*, Hans Schneider discusses the print journal for which he has served as an editor in chief for almost thirty years, *Linear Algebra and its Applications*, published by Elsevier. In 1999 this journal handled around 500 submissions and published around 300 papers, for a total of 5,000 pages. By contrast, the *Electronic Journal of Linear Algebra*, also mentioned in Schneider’s letter, had in 1999 about 40 submissions and published about 12 papers, for a total of 150 pages. A journal the size of *Linear Algebra and its Applications* “requires a professional technical support staff and a trained secretarial staff,” Schneider writes. “It would be quite unrealistic to attempt to produce a journal of this size by voluntary labor, even if supplemented by some paid part-time help.”

While the realities of large-scale journal production may mean that free electronic journals will remain small, there seem to be no barriers when it comes to quality. At first electronic journals suffered from perceptions that they were of lower quality than print journals. However, this perception has mostly disappeared and is probably not hindering the establishment of more free electronic journals. To the extent that the perception remains, it is probably based on the fact that all electronic journals are less than ten years old and thus have not had enough time to work their way up to the level of the very top journals. There are various considerations a mathematician might take into account when deciding where to submit a paper, and selecting a journal of maximal quality is always an important one. By contrast, journal price has not been a consideration, though this

may be changing. For example, Kirby noted that in the competition for good papers *Geometry & Topology* does better against high-priced journals than against lower-priced ones. In addition to journal quality, authors also think about visibility. Many would likely agree with a remark of Andrew Granville of the University of Georgia: “I would not submit my very best work to an e-journal, as I don’t think it would receive the same wide general readership as the best paper journals.” On the other hand, he noted that he would not hesitate to send a good paper to a journal like the *Electronic Journal of Combinatorics*, which has high standards and is widely read among those working in that area.

A final reason for the relatively low number of free electronic journals comes back to the theme of rising journal costs. Establishing a free electronic journal has no direct effect on the prices of high-cost journals (though in the long run there may be an influence). Some might dream of converting high-priced print journals into free electronic ones, but this is not as easy as it sounds, given the complications of editors’ contracts and publishers’ ownership of journal names. However, in the past few years there were two cases, one in computer science and one in ecology, in which the editors and editorial boards of high-priced journals resigned and started up new journals produced by less-expensive publishers. Nothing similar has yet happened in mathematics, but there are cases in which editorial boards of mathematics journals have discussed opting for less-costly publishers.

Communicating Mathematics on the Web

It is a little surprising to find that papers in electronic mathematics journals usually look just like papers in print journals. Indeed, the expectation is clearly that readers will download papers and print them out rather than read them on-screen. So although electronic journals take advantage of efficient storage and accessibility, most do not offer many capabilities, beyond simple search functions, that the electronic environment offers—and authors are not demanding these capabilities. For example, *Electronic Transactions on Numerical Analysis*, published at Kent State University, has encouraged authors to include interactive supplements to their papers. However, only a couple of papers have included such supplements, and one of these papers had as a coauthor the journal’s founder and one of its editors in chief, Richard S. Varga. Because it gets some financial support from the university, the journal is able to offer authors technical assistance in developing these supplements. Though there have been few takers to date, Varga said he expects interest in interactive supplements to grow, because they provide useful enhancements to articles.

One development that could help electronic journals better exploit the potential of Web publishing is MathML, a new language for presenting mathematical documents on the Web. Nowadays electronic journals are confined to offering papers in $\text{T}_\text{E}\text{X}$, dvi, PDF, and PostScript formats. Ordinarily, users download these files and open them with a piece of software separate from the Web browser. The usual language for creating Web documents, HTML (Hypertext Markup Language), has very limited capacity for displaying mathematics, and most mathematical expressions and symbols must be imported as graphics. MathML, which has been under development by an international committee for around five years, aims to solve this problem by providing a way of presenting the full range of mathematical expressions and symbols directly on the Web. In addition, MathML can capture mathematical content so that, for example, one can encode x^2 as a mathematical expression and not simply as "x superscript 2". Mathematical expressions are therefore searchable in MathML and can be cut and pasted into mathematical calculation software.

The fact that MathML is an application in the XML (eXtensible Markup Language) family means that MathML adheres to the developing standards of the Web. This also means that MathML is too verbose to be used directly for writing mathematics papers in the way that mathematicians use $\text{T}_\text{E}\text{X}$. Authors would either have to use a program to convert $\text{T}_\text{E}\text{X}$ files into MathML, or they would have to use a MathML authoring tool. MathML is not yet usable in the most commonly available commercial Web browsers, though prototype support for MathML is available. For these reasons, plus the fact that MathML is not yet ready for widespread use, most of the electronic journal editors interviewed for this article did not express much interest in using MathML in their journals. Many indicated they would offer MathML should it come into widespread use, but for now seemed content to stick with $\text{T}_\text{E}\text{X}$, PostScript, and PDF.

It seems clear that new technological developments are needed before major changes occur in how mathematics is presented in electronic journals. In 1996 the National Science Foundation awarded a grant to the Mathematical Association of America to launch a new journal called *Communications in Visual Mathematics* (<http://www.geom.umn.edu/~dpvc/CVM/>). The goal was to experiment with the use of interactive computer graphics and hypertext publishing tools to present mathematics on the Web. A prototype issue was created by Thomas Banchoff of Brown University and Davide Cervone of Union College; Cervone is the creator of the logo for the *New York Journal of Mathematics*. The articles are not presented in the traditional "linear" fashion of most mathematical exposition, but instead contain extensive

hypertext links intended to allow readers to pursue what most interests them or best suits their background. In addition, many of the papers include animations or interactive demonstrations. The journal's progress has been stalled by the lack of development of the technological tools necessary to produce easily these kinds of articles. Until such tools are available among mathematicians, Banchoff explained, few authors will put in the time and effort required.

The mathematicians who are creating and running free electronic journals are helping to chart a course for the future of mathematical communication. At the same time, they are pursuing a vision of unfettered access to mathematical research. "One great strength of e-journals is that they reach everyone with access to the Web," noted Herbert Wilf, a founder of the *Electronic Journal of Combinatorics*. Free electronic journals are available to Third World countries, small teacher's colleges, nonelite universities, high schools, industrial and government laboratories, and others. "The number of institutions that can afford to have a large collection of research journals on hand is very small," Wilf noted. "This democratization of information is one of the revolutionary abilities of the Web."