

MSRI Workshop

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All of us—the publishers, the librarians, the mathematicians—we're all monks inscribing manuscripts, and we see on the horizon this thing called a printing press. We know it's going to have an impact, and we're sitting around trying to predict what a newspaper will look like."

—John Franks, Northwestern University

Predicting the future is a dicey business. This has never been so true as when applied to today's electronic media, which are transforming mathematical communication at a dizzying pace. A workshop held late last year at the Mathematical Sciences Research Institute (MSRI) underscored the futility of trying to predict where the next electronic wave will take us. One of the speakers, Van Jacobson of Lawrence Berkeley Laboratory, put it this way: "Roll your mind back to 1880. I am Alexander Graham Bell, and I am waving an ugly black thing, saying, 'This is going to change your life.'" Following in Bell's footsteps, Jacobson was "waving" not a telephone but something called the MBone, which transmits live voice, video, and graphics over the Internet so that people can "attend" conferences while sitting at their office workstations. Indeed, previous prognostications for the future of communication devices have not been terribly accurate. UC Berkeley library dean Peter Lyman said there were predictions that the telephone would never become an instrument of mass communication because "there were not enough women in the U.S. to run the switchboards."

After repeated pronouncements that we cannot predict what our electronic future will be, 150 workshop attendees happily went on to do just that, discussing the latest technological tools and the implications they hold for mathematical communication. The attendees included mathematicians with an interest in things electronic, librarians concerned about their role in an online future, and publishers watching warily as the information superhighway cuts a swath through their backyard. A few economists, some software developers, a newspaper magnate, and a few others rounded out the group. Tuning into the workshop on the MBone at a given time were anywhere from a handful to a couple of hundred sites ranging from Japan to the United Kingdom to Australia.

The workshop spanned a daunting array of topics, from the latest software, to copyright issues, to the economics of the Internet, to data formats. Given the rapid changes on all of these fronts, it was not surprising to find that there was disagreement not only about future directions in electronic communications, but also about which issues will prove problematic. And although the consensus seemed to be that publishing com-

Is the network provider liable when its users flout copyright laws?



panies, professional societies, and libraries face an uncertain future, there was little agreement on who the major players will be in the changing landscape of scholarly communication. As Franks put it, "While everyone agrees there's a revolution in the offing, we haven't asked or answered the question, Who are the revolutionaries, and who are going to be the victims?"

Will Publishers Survive the Electronic Era?

One of the central questions explored at the workshop was, Can publishers compete with electronic journals prepared by scholars and distributed for free? Consider, for example, the *Electronic Journal of Combinatorics*. Launched in 1994 by Neil Calkin of the Georgia Institute of Technology and Herb Wilf of the University of Pennsylvania, this journal has an editorial board and standards for acceptance that are on a par with print journals. It currently has 500 subscribers who receive via e-mail abstracts of the articles. Of course, one need not be a subscriber to read the journal: it is open to anyone who has access to the Internet. One can browse through the papers using a World Wide Web browser such as Mosaic, and one can download various kinds of source files (TeX, Postscript, .dvi, etc.) in order to print out paper copies of the articles.¹

Wilf pointed out that, as more and more scholarship is transmitted through e-journals, papers will be read only if they are "clickable", mean-

With the invention of moveable type, the need for hand transcription eventually diminished. Will the rise of electronic publications do the same to the printed word?

ing that they are available electronically with hypertext coding that allows links to them. "If a work exists *only* on paper, then it will not be hypertext-clickable by researchers of the future, unless special steps are taken to convert it to electronic form," he noted. Works that appear on paper might eventually be converted to electronic form, but it is likely that they would simply be stored as images of pages, not as hypertext-encoded documents. This means that, as scholarly communication relies less and less on print and more and more on electronic media, those papers appearing only in print are likely to be read less frequently than those available electronically. The moral, says Wilf, is: "Keep your papers clickable."

The *Electronic Journal of Combinatorics* is hardly a lone wolf; last year the *Directory of Electronic Journals, Newsletters, and Academic Discussion Lists*, published by the Association of Research Libraries (ARL), carried 440 entries. Ann Okerson of ARL noted that there are in excess of one hundred peer-reviewed online journals available for free and produced by scholars. Electronic availability of journals has been announced by the AMS, the American Physical Society, the Society for Industrial and Applied Mathematics, the Association for Computing Machinery, and others. Journals published by Elsevier are slated to go electronic in 1995. There is a project, which Okerson said is still in the discussion phase, that would make available online the approximately 1,300 journals that form part of *Current Contents*.

Andrew Odlyzko of AT&T Bell Laboratories added to the debate with his article "The Demise of Traditional Scholarly Publishing".² During the workshop, he pointed out that although traditional publishers provide such services as copyediting and proofreading, those may be things the mathematical sciences community is willing to forego in return for the low cost and accessibility of electronic publications. In response to publishers' insistence on the "value added" that they contribute to scholarly publications, Franks had this to say: "I would encourage them to

¹For those who would like a peek at the *Electronic Journal of Combinatorics*, the URL is <http://ejc.math.gatech.edu:8080/Journal/journalhome.html/>.

²A version of Odlyzko's article appeared in the *Notices*, January 1995, pages 49-53.

keep in mind those monks illuminating manuscripts—they thought they were adding a lot of value to those manuscripts,” he declared. “Sometimes even valuable things change because of the change in technology.”

Today, it is easier for many mathematicians to typeset their own papers rather than have a typist do it. “And once you reach that stage when you typeset the papers yourself, then the question is, Why not eliminate the publisher, the middleman, and distribute the information directly?” Odlyzko asked. In fact, publishers today often insist on author-prepared manuscripts. At the same time, authors are increasingly viewing the price of journal subscriptions as a barrier to the wide dissemination of their work.

These trends underscore the idiosyncratic nature of scholarly publishing. Universities pay faculty to produce research, the research is turned over to publishers, and the universities repurchase that research in the form of journal subscriptions. Free electronic journals cut publishers out of that loop, posing the risk of huge revenue losses. Professional societies like the AMS are particularly vulnerable, since most of their activities rely on income from publishing to remain afloat. Many services that members value, and perhaps the societies themselves, could go by the boards if their publishing operations do not survive.

Just how strong this threat is has not yet become clear. For one thing, publishers will probably be able to hold onto the market for books and monographs longer than that for journals. The reason seems to be pattern of use: the fact that bound, typeset books are more pleasant and convenient to use becomes important when one wants to absorb a large amount of material, while most scholars will study journal articles that have simply been photocopied and stapled. In addition, authors make royalties on books, while they rarely do on journal articles, so they have some incentive to stick to the existing system when it comes to books. Publishers are also making some attempts, generally cautious ones, to forestall the threat. For example, the AMS has carried out several projects, from establishing e-

MATH, to putting the *Bulletin* and the *Notices* online, to the current project to make the *Mathematical Reviews* database available in hypertext-clickable format. Nevertheless, the Society’s future depends in large part on what niche, if any, scholarly publishers can carve out for themselves in the electronic world. With many envisioning a future in which scholars communicate directly with each other, without publishers as go-betweens, just what that niche might be is a big unknown.

Part of the pressure to move to electronic publishing comes from the financial squeeze on universities and on the scientific community generally. But part of it also comes from the exponential growth of scientific literature. Odlyzko provided these snapshots: In 1870, 840 mathematics papers were published; in 1960, it was 7,800; in 1990 it was 50,000. The only way to reasonably manage this information is with computers. And the technology is there: The growth rate in mathematical literature has been about 7% per year, while the growth in the speed of microprocessors has been about 70% per year. Indeed, Odlyzko noted that the idea of electronic journals has been around for several decades, but the technology is only now maturing to the point where they are feasible.

With such technological advances, the archival function of libraries might become less important. “If you can call up any paper on your screen and, after deciding that it looks interesting, print it out on the laser printer on your desktop, will you need your university’s library?” Odlyzko asks in his *Notices* article. He predicted that in the not-too-distant future a desktop storage device will have the capacity to store the whole of mathematical literature. The day could come when it is cheaper for mathematics departments to have such devices on hand than to run traditional libraries. Organizations like *Mathematical Reviews* and *Zentralblatt für Mathematik* already archive much of the mathematical literature, and they are moving steadily toward electronic means. Rather than having thousands of librarians the world over receiving shipments of journals, handling invoices, sending issues to the

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bindery, shelving copies, etc., “a much smaller, much leaner organization like *Mathematical Reviews* or *Zentralblatt* could do it for a tiny fraction of the cost,” Odlyzko declared.

As if all this were not heady enough, Lyman cautioned listeners: “We have to realize that our visions are very likely to be too timid.” He pointed

ideas built on results produced by geographically disparate scholars, and this change required a shift in how science was organized as a social endeavor. In the same way, when it comes to technological innovation today, says Lyman, “we need to think about our social communication as a variable as well.”

Problems in Paradise

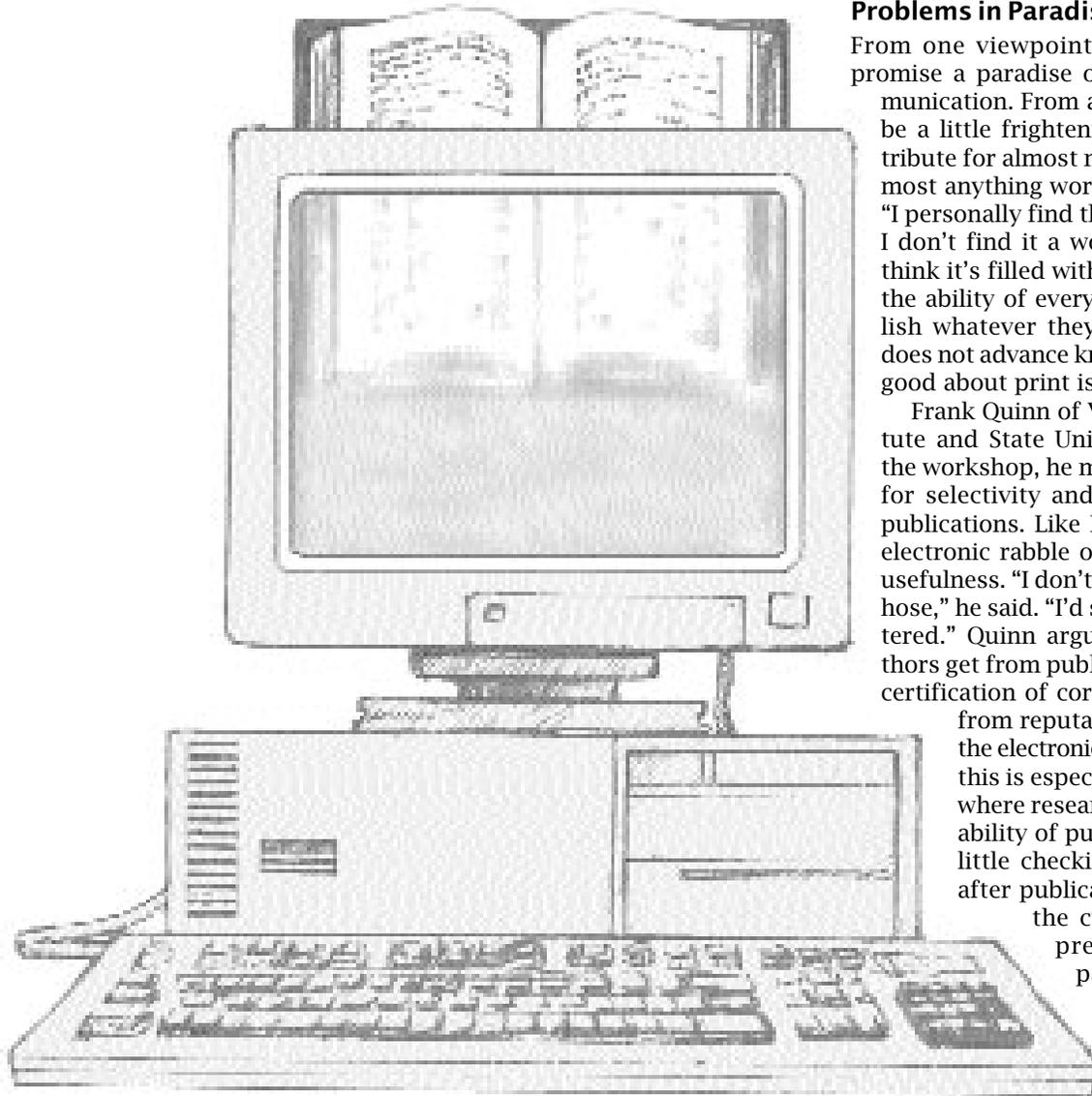
From one viewpoint, the Internet seems to promise a paradise of open, egalitarian communication. From another, this promise can be a little frightening. “Each of us can distribute for almost nothing our opinion on almost anything worldwide,” Lyman declared. “I personally find that the Internet is a mess. I don’t find it a wonderful, rich resource. I think it’s filled with junk. And in that sense, the ability of everyone in the world to publish whatever they want on a global basis does not advance knowledge. The thing that’s good about print is selectivity, standards.”

Frank Quinn of Virginia Polytechnic Institute and State University concurs.³ During the workshop, he made an impassioned plea for selectivity and standards in electronic publications. Like Lyman, he finds that the electronic rabble on the Internet dilutes its usefulness. “I don’t want to drink from a firehose,” he said. “I’d still like to have things filtered.” Quinn argued that the prestige authors get from publishing their work and the certification of correctness that readers get from reputable journals are at risk in the electronic environment. He believes this is especially true in mathematics, where researchers depend on the reliability of published works and where little checking and filtering goes on after publication. He sees dangers in the current practice whereby preprints, which have not passed muster by editors and referees, are distributed as widely as the published journal articles.

Right now, he said, the mathematical literature is like a large “country” with one border, patrolled by editors and referees. The patrolling of the border has assured that a goodly part of the mathematical literature is correct and reliable. If in the electronic era, the mathematical community abandons defense of this border, Quinn said, it would be like opening the gates to the “barbarians”. New quality

out that the first couple of centuries after the invention of the printing press were devoted to imitating hand-lettered illuminated manuscripts. Initially, all people could think of was producing traditional forms of communication more efficiently; they couldn’t conceive of new forms. “This is the state we’re in when we talk about ‘document delivery,’” he noted. “We’re thinking about knowledge in terms of the printed article and how to distribute it more efficiently.” The printing press facilitated the development of science as a cumulative endeavor, in which new

³ Quinn wrote “Roadkill on the Electronic Highway: The Threat to Mathematical Literature”, which appeared in the January 1995 Notices, pages 53-56.



control mechanisms would evolve, and Quinn predicted that the community might see, instead of a single country, the establishment of small “city-states” protected by individuals or small groups. For example, an individual could send forth a deluge of papers on algebraic geometry, but unless the “Lord Mayor” of the algebraic geometry city-state becomes convinced of their worth, those papers will not become part of the knowledge accepted by the top algebraic geometers. “The barbarians are at the gates,” Quinn warned. “Are we going to open the gates? That’s the question.”

MSRI director William P. Thurston doesn’t like the “gatekeeper” metaphor. “We have to leap forward from the time when it was expensive to distribute to now, when it’s cheap,” he noted. Rather than gatekeepers, who put up barriers to information transmission, he envisions endorsers or enhancers who find and assemble things that interest specific audiences. Some at the workshop even suggested a model in which network servers that allow access to scholarly works could keep track of how often each work is read, allowing for a “democratic” measure of which works are the most important.

These new modes of scholarly communication have potential problems. “The article is going to be treated as an entire work, it will be unbundled from the journal, and it will be sold as a separate piece,” said Okerson. “And of course you would expect payment to be made for that.” But just how payments should be calculated, and what those calculations should be based on, is a complicated question that those in the publishing world have yet to resolve. The fact that ownership and copyright laws vary from one country to the next poses additional complications in the international environment of the Internet. Another legal conundrum: Okerson mentioned a recent lawsuit brought by *Playboy* magazine against a carrier of bulletin boards, alleging that one of the users posted some *Playboy* material on one of the boards. Is the network provider liable when its users flout copyright laws?

Today, authors are increasingly segmenting their rights, transferring the written rights to one party, the video rights to another, and the translation rights to a third. “There are more choices available to authors, they are making different choices, they are segmenting their rights, which makes for a much more complicated world,” Okerson noted. “And knowing who owns what is very tricky.” Such complications notwithstanding, Okerson says that authors are enjoying the additional control they have over their work, though publishers like the changes a lot less. “I don’t think we will ever go back to the more monolithic ownership of copyright by publishers,” she declared.



Ann Okerson of the Association of Research Libraries (ARL) speaking at the conference.

When it comes to scholarly articles, mathematicians place a higher value on wide dissemination of their works than on the economic benefits. And when they have at their fingertips the tools for wide dissemination, they will want to protect their rights to distribute their works as they like. In fact, Franks predicted that the copyright issue will eventually become unimportant for mathematicians. “Mathematicians will publish in journals that allow them to keep the copyright,” he stated. They will turn over to publishers the right to copy and distribute, but at the same time keep those rights themselves. “If a journal doesn’t permit me to do that, I’ll go to one that does, and there are some now that do.”

Thurston spoke of the mathematical sciences community paddling along a placid river and suddenly coming to a spot where many other streams are joining in. “We’re paddling along in our little canoe, and we’re now seeing much bigger boats coming along from the side,” he said. “We have to get prepared to paddle our little canoe, and back-paddle if necessary. But I think we have to not take the attitude of attempting to dam the river...The only future for publication is to enhance communication, not to block communication or limit communication.”

