Chapter 2 - The Current Context

From Preprints to E-Prints

The practice of sending out preprints, although common among many fields of science, has long been established among physicists. Many scholars have remarked about this distinctive “preprint culture” in physics (King and Roderer, 1982; Hurd, 1996). In my conversations with six physicists (see Appendix C), all recognized this traditional practice of sending out xeroxed paper preprints. “When I was a graduate student, we would make preprints of an article ready for submission and send them out to five hundred of our closest friends. Then in return, you would get four preprints a day and end up throwing most of them away. It was pretty annoying, inefficient, and slow.” (Thomas D. Cohen, personal communication, December 17, 1998).

Often, after presenting their work at a conference, they would return to their institution with a long list of addresses from those who had asked for a copy of their papers. As Hurd (1996) asserts, use of these preprints, actually “precursors of articles” that might eventually get published, has been a key element in the informal communication process of physicists. Working with their distribution lists, physicists typically shared their papers with those who were potential competitors as well as responding to specific requests. The high costs of printing and mailing naturally limited the numbers of papers that could be sent out. Papers distributed in this way never threatened the economic viability of the formal publication because the dissemination was limited in scope. Publishers viewed the practice as routine informal communication, much as they regarded conversations among scientists at conferences. However, the dynamics of exchanging paper preprints changed dramatically when this activity migrated to an electronic environment. This shift from a hard copy preprint to a digitized e-print has an interesting history.

E-Print Archives

In the last ten years, scientific communication patterns have been changing with the increased usage of electronic networks, electronic mail, and online discussion groups. As electronic dissemination of scholarly research became easier with the growth of the Internet and the increased use of personal computers by researchers, physicists began to send out their preprints electronically through e-mail. Paul Ginsparg, a theoretical physicist working at Los
Alamos, heard several of his colleagues complain that they were afraid to take vacations because upon return, they would find their e-mail accounts swamped with long papers that used up all their allotted disc storage space (Taubes, 1993). Realizing the advantages of storing all the papers in one location, he started an electronic database of research papers in August of 1991. Intended initially for his small community of high energy physicists working on a matrix model approach to string theory, the hep-th (High Energy Physics--Theory) database provided a convenient location where current research could be shared instantly with the 160 scientists on his distribution list, all working on similar problems. Conceived to allow for quick dissemination of cutting-edge research results and a “virtual meeting ground” where communication would be facilitated and accelerated, the popularity of this electronic preprint or e-print server grew rapidly. Within sixteen months, the hep-th database had two thousand users (Taubes, 1993, p.1246).

During the first years of this experimental bulletin board, many scientists and traditional scientific publishers were skeptical about the acceptability of this mass of raw, unreviewed material. Benjamin Bederson, former editor-in-chief of the American Physical Society (APS), commented that because the archives lacked peer review, their usefulness might be limited to small communities of scientists that worked closely together and knew of each other’s reputations. (Taubes, 1993) This “noise issue,” some argued, could open the gates to junk science if anybody could post anything at any time to thousands of readers with the click of a mouse button. Actually, some preliminary filtering was implemented during the first year of the archives, at the point when an author registers during the submission process. For example submissions from aol.com or hotmail.com would get automatically bounced. (Hafner, 1998) “Paul Ginsparg has argued that the widespread distribution of the archive fosters a self-policing check on quality that may serve to limit premature submissions and incorrect results; the potential for global embarrassment is far greater in a networked environment than in a paper-based distribution to a few selected colleagues” (Hurd, 1996, p. 72). Additionally, some questioned whether the sheer volume of manuscripts with no filtering and editing, could be of

2The Internet address is hep-th@xxx.lanl.gov.
any use to scientists.

One of the problems was that the medium itself was suspect. The Internet was perceived by some as unfit for serious scholarship, seeming more like a “global graffiti board for trivial pursuit...misinformation was difficult to distinguish from information; an ethos of egalitarian dilettantism prevailed; and, worst of all, serious scholars and scientists distanced themselves or kept their distance from the Net, concluding that it was much too chaotic and undiscriminating a medium to be entrusted with the communication and preservation of their substantive ideas and findings” (Harnad, 1996, p. 105). In spite of these perceived limitations, the archives increased in popularity. One of the factors that was crucial to the success of the archives was that the authors, readers, editors and consumers of information were all from the same community and intimately involved in the process. They coincided and overlapped in their use of scientific information. In effect, there was less need for a publisher to connect the reader with the author.

In a few years, this database expanded to 3800 users, and, in 1992, Dr. Ginsparg set up separate servers to encourage physicists in other fields of physics to use the archives. Initially, he added databases for the theoretical fields in nuclear physics, condensed matter, astrophysics, general relativity and quantum cosmology. Computational physics, lattice physics and algebraic geometry followed. After three years Ginsparg added experimental physics in all fields, from nonlinear dynamics, to plasma and material physics. In 1995, Ginsparg received one million dollars from the National Science Foundation to consolidate the archives and expand the concept into other areas of science (Hoke, 1995, p.3). He created servers for e-prints in mathematics and astronomy. Ginsparg added improvements featuring links to citations, images, and data. According to Ginsparg (1996), the servers were processing 70,000 transactions per day for about 35,000 researchers worldwide by 1996. Currently, the Los Alamos archives receive nearly 500 submissions per week.³

Accessed through the World Wide Web, anyone can log-on to the site and search the database using the subject directory or keywords to pull up abstracts of e-prints. To actually view and read the full article requires a special software, such as Ghostview for Postscript files or

³Weekly statistics are available at the xxx.lanl.gov website.
Adobe Acrobat, to read the portable document files (pdf). According to Youngen (1998, p. 44), almost twelve thousand preprints are issued annually from the physics community and many of these can be found on the Los Alamos servers. The e-print archives have mirror sites in several other countries improving international access. This world-wide distribution has made the process of disseminating preprints more democratic, overcoming the “old boy” network of previous distribution lists. “The distribution of these preprints, the working documents of the research community, determines whether a scientist is in the loop, and that system has tended to perpetuate the advantages of well-connected senior researchers. The Internet wipes out that advantage” (Brody, 1996). On the other hand, it does presume that the user has a certain amount of computer technology and Internet access that may be lacking in many underdeveloped nations.

Submitting preprints is an automated process on the current e-print archives. Authors must register, providing some personal information and their affiliation. Submissions have to be in some form of the scientific word processing software called TeX. Created by Donald E. Knuth at Stanford University in 1985, TeX has been widely adopted across most subdisciplines of physics (Taubes, 1993). Figures have to be in Post Script. Each entry is archived and indexed for instantaneous retrieval. The e-prints are numbered and tracked as they are received. All versions are dated, and corrections or changes can only be made by the author.

Citing E-Prints and Hyperlinks

The numbering system has standardized the way preprints are cited and recognized in many fields of physics. Previously, traditional paper preprints were assigned a preprint number by the host institution, but now citations to e-prints most often appear in the following format: SMITH:CONDMA9703160 indicating that this manuscript dealing with condensed matter was the 160th paper submitted in March of 1997 to the Los Alamos condensed matter archive (Youngen, 1998, p. 45). Hyperlinks permit full-text access to cited works that are on the database. The Stanford Linear Accelerator Laboratory (SLAC) has a library database called the Stanford Public Information Retrieval System (SPIRES) that indexes preprints for the high energy community. They have cooperated with Ginsparg’s e-print archives to allow the high energy servers to link both to cited preprints and to referenced preprints for any given preprint in both databases. (See Attachment A)
The new electronic version of this well-established paper network has automated production and dissemination of research reports, two functions that were previously under the primary purview of scientific publishers. In addition, this “electronic preprint archive and distribution system” intentionally includes the word archive in its title. Ginsparg (1996) intends to store the papers permanently, concluding that, with a gigabyte of hard disk storage costing less than five hundred dollars, the economics are favorable. Roughly 25,000 papers including figures can be stored for an average of less than two cents apiece.

This fundamental shift, by at least some communities of physicists, of looking to the e-print servers for their main source of information has forced scientific publishers into a defensive position. With the archives threatening to usurp several key functions of the scholarly scientific journal, publishers have begun to take notice. The idea of having access to such a rich source of current information at no cost has caused some users to question the value or the actual need for the traditional journals.

Peer Review and E-Prints

The lynchpin holding up the importance of formal publication is the validation of the quality of research which peer review contributes in the creation of the archive of published knowledge (Ziman, 1968; Chubb and Hackett, 1990; Schaffner, 1994). Recognizing this, Ginsparg has proposed a modified review process that would split the e-print archives into several tiers. The highest level would contain e-prints that were rated as significant by a chosen body of reviewers. The lowest level would be open to all e-prints (Taubes, 1993). The mechanics of this review process have not been clearly worked out. Elsewhere, Ginsparg has proposed using some software that would allow any interested scientist to add comments to any preprint; “...comments would be appended to the article for subsequent readers to view...an even simpler version of such ‘open peer commentary’ could consist of readers assigning stars, as in a Michelin restaurant guide, to articles.” (Re-engineering peer review, 1996, p. 78)

Ginsparg has also been grappling with the possibilities of implementing some kind of electronic review; “For example the archive could be effectively partitioned into sectors, gradated according to overall importance, quality of research, or other useful criteria, and papers could be shifted retroactively as dictated by additional information or follow-up research. And
rather than face only an undifferentiated bitstream, the average reader could benefit from an interface that recommended a set of ‘essential reads’ for a given subject from any given time period” (Ginsparg, 1996, p. 96) He has hinted at the possibility of some third party that could take over some of this maintenance. Clearly there is some recognition here of a need to make the e-print servers more like a formal journal publication.

Stevan Harnad, who edits an electronic, peer reviewed journal called *Psycoloquy*, has experimented with open peer commentary. He publishes peer commentary on articles as well as authors’ responses to those commentaries.

But the Net does offer the possibility of distributing the burdens of peer review more equitably, selecting referees on a broader and more systematic basis (electronic surveys of the literature, citation analysis, even posting ‘Calls for Reviewers’ to pertinent professional experts’ bulletin boards and allowing those who happen to have the time to volunteer themselves). The speed with which a manuscript can be circulated electronically is also an advantage, as is the convenience that many are discovering in reading and commenting on manuscripts exclusively on-screen. All in all, implementing the traditional peer review system purely electronically is not only eminently possible, but is likely to turn out to be optimal, with even paper journal editors preferring to conduct refereeing in the electronic medium. (Harnad, 1996, p. 107)

Whether the e-print archives will take the next step to implement some kind of peer review remains to be seen. The fact that the archives have evolved into something that closely resembles a traditional journal has made publishers sit up and take notice. It would not be an exaggeration to say that the success of e-print bulletin boards has shaken the foundations of traditional print-based scientific journal publishing.

**Economic Impact for Scientific Publishers**

What lies at the crux of this matter is money. Since scientific publishers depend upon subscriptions, especially those from libraries of major institutions, any change in communication patterns necessarily portends changes in traditional ways of doing business. Publishers depend upon authors to sign over copyright to them upon submission of a manuscript. The act of simultaneously submitting the work to the e-print archives can be considered a breach of copyright, because the work is being disseminated to the world (Okerson, 1994). An exponential growth in the number of scientific articles and the rising concomitant costs all factor into the
equation. Reactions from publishers is varied, reflecting the different roles of the many scientific publishers, from those who are in the business for-profit, to non-profit societies like the APS. Guernsey and Kiernan (1998), have highlighted some of the disagreements among editors of scholarly journals in their acceptance or rejection of material considered to be pre-published by the author. Some publishers fear the loss of revenue if they publish information that has already been widely disseminated. They argue that readers could become confused by multiple versions of a paper with the possibility of errors in previous unreferred drafts. An associate editor of Physical Review E commented on these concerns: “The original panic involved the fear of loss of dollars. Then the publishers became concerned about losing their position of importance. They did not want to relinquish this venue where significant findings are first shared in the community (Dr. Neal Abraham, personal communication, February 16, 1999).

Some journals like Science and the Journal of the American Medical Association forbid publication of any article that has been previously disseminated on the World Wide Web. These recent decisions are related to the Ingelfinger rule, implemented by the New England Journal of Medicine in 1969. This rule attempted to avoid competition from the news media and being “scooped” (Marshall, 1998, p. 861). Journals that pride themselves in publishing “newsworthy” content have adopted advance release embargo policies that amount to agreements between the media and the publishers. The media get to see the information about a week before its scheduled publication date to allow time for background research, and, in turn, they agree to wait for a specified date and hour to publish it to coincide with a journal’s publication date. The editor-in-chief of Science, Floyd Bloom, (1998, p. 877) argues that the publicity generated by the embargoes helps science; “Wide coverage of scientific discoveries is good for the public and the scientific community because it illustrates the intellectual and practical value of publicly funded investments in scientific research.” Ginsparg’s archives “...signaled that the Web was about to change the rules of scientific publishing, providing a way to circulate papers widely outside the formal embargo system and potentially undermining conventional journals.” (Marshall, 1998, p. 865). But not all journals that use embargoes take the same position about the e-print servers. Philip Campbell, Nature’s editor-in-chief, has taken a more tolerant stance: “E-print servers to my mind are an extension of an idea. It’s just a form of intra-scientific communication” (Hafner,
The American Chemical Society’s (ACS) journals forbid the use of e-print archives. Their publication policy statement clearly states:

As stated in the Notice to Authors of Papers, submission of a manuscript to the ACS journals implies that the work reported therein has not received prior publication and is not under consideration for publication elsewhere in any medium, including electronic journals and computer databases of a public nature. The editors and the advisory board have established a policy that any material that is posted in electronic conferences or on WWW pages or in newsgroups will be considered as published in that form, in the same way as if that work had been submitted or published in a print medium. (ACS Publication Policy, 1998)

This intransigent position reflects the dependence by the ACS on subscription fees to fund their operation. Well over half their costs come from subscriptions and licensing fees, and their policy statements point to this need to retain the value of the traditional journal (Beyer, 1978). In a recent paper, the ACS attempted to counter the notion that electronic publishing was less costly and simple. “The publishing process, during which an article is accepted, revised, corrected and repeatedly proofed for errors, is necessarily labor intensive. Even the growing trend toward electronic submission of original manuscripts, eliminating the cost and time needed to keyboard hard copy, does not address the burden of preventing errors from being introduced during each stage of revision.” (Will science publishing perish? p. 4) They argue that it costs between seventy and eighty percent of the operating costs of a publication just to produce the first copy of any journal.

In 1998 the ACS put all of its twenty-six journals online. The main goal has been to cut the lag time from submission to publication. In addition, they post articles as soon as they have completed the peer-review, copy editing and any other quality control steps needed. “By eliminating the production, printing, and mailing steps, electronic publication can cut several weeks from the process, but that can still leave a lag of months between a paper’s submission
and its appearance. Journal publishers are striving to shrink that gap, and reader and author expectations aren’t the only spur. There’s also the prospect of competition from electronic preprint archives...” (Taubes, 1996b, p. 767) The time required for review still slows the process down. Publishers are concerned that the preprint servers are infringing on copyright, but their response to this type of communication varies considerably.

**The Stance of the APS**

Physicists have been more open to the e-print phenomenon. Benjamin Bederson (1998, pp. 863, 865), former editor-in-chief of the APS, argues that the difference is related to the bottom line: “It could boil down to an ingrained openness that helped erode the embargo system from the inside, and the reality that few physics discoveries have an immediate impact on a company’s stock price or a patient’s questions. Physicists have not only been free in spreading their results—-they’re eager.” In any event, the APS has decided to cooperate with the archives. For example, physicists who wish to submit an e-print for publication in one of the APS’s journals do not need to submit a separate file. Electronic submission has become commonplace among physicists, and all they need to supply is the e-print’s identifying number on the archive. The APS can retrieve the files from the archives to send out to reviewers. The elimination of typesetting fees is further reward for those who submit properly formatted electronic texts due to the reduction in editing costs.

The APS has accepted the challenge from the archive administrators to explore and reflect on the implications for publishing in the electronic environment. All their journals began going online in 1996. Perhaps the APS feels less threatened by Ginsparg’s archives because journal licensing fees and profits do not make up a major source of income for the society as they do for the ACS. Since Samuel Goudsmit pioneered the use of page charges for authors in the 1940's, the journals have been under decreased pressure for space. “Page charges in the journals of the American Physical Society are based on actual publication costs, and calculated to cover all publication costs” (Beyer, 1978, p. 82). Usually paid for by grants, these fees have relieved the need for advertising. The ACS has made page charges voluntary--in effect eliminating them due to competition from a proliferation of commercial journals that do not impose charges (Will science publishing perish? p. 5). The masthead of the journals reveals the following different
costs to the authors of the two societies:

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<th>American Physical Society Journals</th>
<th>American Chemical Society Journals</th>
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<tr>
<td>$80 dollars per page. No charges if properly formatted in RevTeX</td>
<td>$25 dollars per page (voluntary)</td>
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The APS has been quick to recognize that the e-print phenomenon has the potential to transform the relationship among producers, publishers, consumers, and archivers of scientific information. In a recent APS online newsletter, “e-prints” were defined in the following way: “originally coined as shorthand for an electronically circulated preprint. Now, more generally, used to signify any electronic work freely circulated by the author (as opposed to a publisher)” (Smith and Doyle, 1996). It is interesting that the definition does not condemn this free circulation or equate it with publication.

**The APS E-Print Workshop**

In October, 1994, the APS hosted the “E-print archive workshop” at the Los Alamos National Laboratory to investigate the phenomenon and the ramifications for their publications. In addition to the executive officers of the APS, the senior editors of all the APS journals, the head of the Journal Information Systems office of the APS, and several editors from American Institute of Physics were also present. Representatives from the German Physical Society, the UK Institute of Physics, the American Astronomical Society, IEEE and librarians from large research universities, and a copyright lawyer were also in attendance. Discussions included intellectual property issues, electronic journals, peer review, tracking of e-prints, current thinking and overall strategies for scholarly scientific publishing. Some of the debates reflected the adversarial challenges posed by those who run the archives. Ginsparg and Stevan Harnad, director of the Cognitive Sciences Center at the University of Southampton in England, who also runs an e-print archive, have both claimed that their distribution systems are quicker and far
more cost-efficient than traditional publication. With the cost of scientific journal subscriptions doubling since 1986, Ginsparg claims the e-print archives have countered “this bizarre misconception that the publishers add so much essential ‘added-value’ that we should be willing to pay big bucks for it.” (Taubes, 1996b, p. 767) This type of brazen claim that the archives do all the typesetting, printing and distributing instantaneously and at no cost to the reader has publishers on the defensive.

Copyright Issues

Bill Hagen (1994) from IEEE admitted that initially publishers wanted to avoid the archives, “When reports of such uses began reaching us, I think that most publishers felt that if we closed our eyes hard enough, the e-print scenario would just go away for another couple of years.” Those who call for the demise of traditional scholarly publishers and the jettisoning of copyright transferral in this environment should exercise caution, he argued. “For example, if some publishers were replaced by author-based servers, wouldn’t the successful e-print server require so much management after a point that this new management itself would need to take on the roles and aspects of publisher?” (Hagen, 1994) Database security, guaranteeing editorial integrity, providing peer review, and archiving all require lots of personnel, organization and investments. Ultimately, Hagen’s argument goes, someone has to pay for the product or distribution will suffer. The IEEE publication policies have evolved gradually in relation to e-print prepublication, and they now accept e-prints for review. “We do depend on the author’s willingness to transfer copyright to the IEEE. In addition, we ask that the author attach appropriate notices of the posted material indicating that the paper has been submitted to, accepted by, or published by the IEEE and we ask that an IEEE copyright statement or notice be attached.” (Hagen, 1994)

Copyright is so crucial to commercial publishers because it is required in order to distribute and sell the information. Paul Berman, a lawyer from Covington and Burling stated at the workshop that putting manuscripts on the e-print constitutes publication. “Conversely, there is also little question...that the people who operate, Dr. Ginsparg and others who operate
electronic preprint servers, are in fact functioning as publishers” (Berman, 1994). Ann Okerson (1994) from the Association of Research Libraries, raised some interesting questions; “How is copyright affected when editorial or copy editing or revision changes are made to an article? What is a different version? How significant do the changes have to be between a preprint and a final article for them to be considered distinct works?”

Answers to many of these questions have yet to be worked out. The APS has decided to informally grant back wide rights to scientists to use their own work, by allowing the e-prints to co-exist on the servers, even though authors are required to formally sign over copyright when submitting manuscripts to their journals. It is contradictory, but unavoidable. This decision reflects an understanding and recognition on the part of editors and administrators at APS that they could not swim against an overwhelming tide of acceptance and use of e-print archives among physicists around the world. Accepting this practice, the APS has been willing to experiment and learn about the opportunities that electronic dissemination has to offer.

In 1996 the APS started their own electronic preprint server, avowedly not to compete with the Los Alamos archives, but to create a place where the phenomenon of e-prints could be studied from the publisher’s point of view. By providing a space where authors, wishing to publish in an APS journal, could start the process of submitting a manuscript, they wanted to learn how the process could work. They wanted to experiment with the process of managing the servers, including creating navigational help, database security, editorial comment, and authentication. In particular, they were interested in innovations for web-based submissions (Smith, 1996). The APS is encouraging that electronic mail be used to transfer all manuscripts within the review process. They are thinking about shipping out interactive software to all referees. “Not only would on-screen refereeing speed up the mechanical steps of receiving, marking up, and returning a manuscript, but it might also have a psychological effect. Some

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5The APS e-print server is available on the web at http://publish.aps.org/eprint.
studies have shown that some referees are responding more quickly because they’re receiving a manuscript electronically: “It’s there, they look at it, and get rid of it as opposed to having it disappear into a pile of paper on the desk” (Taubes, 1996b, p. 766). All of the APS journals have been online since 1996. With the experience of their own e-print server, the APS is migrating the entire process of scholarly publication into an electronic environment. The APS has also argued that the physics community would be better served if the e-print servers were run and maintained by a society rather than Ginsparg’s one-man operation (Taubes, 1996a).

In conjunction with their goal of promoting “the advancement and diffusion of the knowledge of physics,” the APS is the one of the first publishers to take the step of experimenting with electronic pre-publication mechanisms. Unlike the Los Alamos archives that requires TeX and PostScript, the APS server accepts manuscripts in many kinds of word processing formats such as WordPerfect and Microsoft Word. The APS hopes to entice physicists from subdisciplines other than particle, nuclear or condensed physics who may have avoided using Ginsparg’s archives because of the technical difficulty of working with unpacking, compiling and compressing files. The APS site does not have any limits on file size, and it does not restrict submitters from certain e-mail addresses. Recognizing the desire for an inclusive index that would cover all electronic e-prints, the APS has loaded the Los Alamos index on its site, providing cross listing. According to Arthur Smith, who runs the site, about half of those who use the APS site, also post their papers on Ginsparg’s archives. (Arthur Smith, personal communication, November 11, 1998). More than half of the submissions come from other countries.

When authors submit a manuscript to the APS server, they must register and assign copyright to the APS. The list of disclaimers is interesting: “The e-print system is NOT a publication of the American Physical Society, and therefore no editorial control is extended to the content. That means you use the material at your own risk...all the information provided here is exactly what the authors posted. However, incoming materials are now screened to ensure they have some relationship to physics.” 6 This is clearly not the same as journal peer review. In

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comparison to the xxx.lanl.gov site, the APS server is very small with only about 900 submissions over a two-year period. In a given month, the site may get close to 20,000 hits (occasions when someone accesses the site). Because it has not been used much, when its usefulness as a proving-ground is complete, the APS may just fold the operation over to the Los Alamos site (Arthur P. Smith, personal communication, November 11, 1998).

As of December, 1998, most of the submissions to the APS site have been in the field of condensed matter (285) as compared to only 14 for plasma physics or 8 in physics of beams. When asked why certain physicists use the e-print servers, while other physicists ignore them, Mr. Smith proffered this theory: he believes that physicists working in fields like particle physics, where research is concentrated and focused on a few problems, are more likely to use the archives than those working in subdisciplines like plasma physics, where researchers can spread out their attention on a myriad of problems. Clearly this theory would support the proposition that subject content plays a part in the popularity of the archives.

In this current situation, the blurring that occurs between pre-publication media and formal publication creates the potential for quite a tangled web. Referees who read the e-print servers are finding that they sometimes have to make a judgement call on who should get priority for a finding. “Referees find that either the content and findings of a paper that they are reviewing are subsumed by a preprint, or they contradict a preprint, or in one way or another, a preprint NOT cited by the authors of the paper has a major impact on the way we judge whether the paper should be published. Sometimes we go with the paper as submitted, even with the pre-existing preprint, if the author can demonstrate some kind of priority” (Arthur P. Smith, personal communication, November 11, 1998). Lacking some firm consensus about the status of the servers by the entire community of users, problems like this are sure to proliferate.

This chapter has provided only a brief overview of the current state and context of the electronic preprint scenario. Some of the problems that have surfaced in this current period of migration to electronic publishing will be fleshed out in the analysis of the final chapter.

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7Statistics on usage are available under the advanced search mode, sorting by section at http://www.aps.org/eprint.