Crossing the Divide

JONATHAN GRUDIN, EDITOR (1997–2003)
Microsoft Research

This essay summarizes the editor's views of publication in the field of human-computer interaction. Digital technologies have begun changing the way journal articles and conference papers are produced, reviewed, published, accessed, and used. This period of profound change presents challenges and opportunities for both new and existing channels of scientific and technical communication.

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Additional Key Words and Phrases: Journals, conference proceedings, human-computer interaction

1. INTRODUCTION

This issue marks the tenth anniversary of *Transactions on Computer-Human Interaction* and the end of my six years as Editor. My view of the journal's role has evolved as I have observed digital technologies change the ecosystem of scientific and technical communication.

Digital or electronic access to information will radically transform not only communication but scholarship itself. This will take time. Publication addresses a range of goals held by diverse stakeholders. Critical needs must be met even as new ways of working are established. Boundaries will be redrawn. Organizations will find new roles. Journals, conferences, and other forms of information exchange will evolve.

Some fields, professions, and media will react before others. Our embrace of technology, emphasis on rapid dissemination of results, and relatively short paper-based history put human-computer interaction at the forefront. Publishers reacted early. Book sales may be affected. An identity crisis is building for journals as their monopolies on broad communication and archiving are undermined by conferences and online access.

Data on download patterns and surveys of other fields have led me to conclude that shifting boundaries will leave journals with a different role and an incentive to look for new opportunities to serve the community.

My principal focus is HCI, with other fields providing contrasts. My perspective is no doubt North American, albeit affected by five years working in Europe and Asia. Historical notes are based on Zuckerman and Merton [1971] and Kronick [1976].

2. THE DIGITAL ERA

The Web is transforming the use of information as radically as did the printing press. Prior to writing and print, most learning was listening, memorizing, and speaking. Scholarship then became reading, analyzing, and writing. It is now becoming searching, synthesizing, and constructing. These are still early days. The impact is only starting to be felt, even in fields where everyone has Internet access.

Less visible than the growing ease of constructing and accessing online information repositories is their increased life expectancy. Five years ago, relying on digital archives was risky. This may surprise anyone with a drawer of unreadable tapes, disks, or punch cards, but such reliance is reasonable now. Soon it will be assumed, heralding a new era.

Consider the ACM Digital Library. All back issues of journals, proceedings, newsletters, and magazines are available. ACM could disappear; the archive will not. It is backed up to two distant sites and a mirror site in China, and ACM is negotiating with organizations whose mission is long-term archiving. The entire corpus is less than 100G—the capacity of a $100 hard drive. It doubles in about five years, growing more slowly than storage capacity at a fixed price.

Storage media deteriorate, but copying gets easier. If with each new computer purchase, files are transferred to the larger hard disk and a backup created, digital records are safer than paper, which is rarely backed up.

The once serious problem of format obsolescence is disappearing. If the world abandons PDF, viewers written for the new format would also view PDF—no reason not to, and much to be gained. Software conversion of a PDF archive to the new format would be inexpensive. Conversion programs would be as easy to find as, for example, MacWrite conversion programs are today: Type "MacWrite conversion" into the search engine of your choice.

In the past there were many formats. Each had few users. An author of conversion software could not find customers. Today we have fewer formats, each is widely used, and the Web is a marketplace.

If you have an automobile built before 1910 and need spare parts, you may be out of luck. But a Model T Ford owner can find them by typing "Model T spare parts" into a search engine. For a wide range of digital objects, we have moved into the Model T Ford era of computing. Some objects are not yet safe: Online video is relatively sparse and not standardized, for example. Once more video is online, standards and converters will grant it the longevity that digital text already has.

2.1 Implications of Immortality

As we come to appreciate that digital information can outlive paper, change may be rapid. But not instantaneous. Many of us are comfortable with paper.

We are practiced at filing and retrieving it. We own annotated documents, and find paper easier to browse.

Well, it *was* easier to browse, but not that easy. I spent entire days in the library with citation indices, looking up papers that cited an article of interest, tracking them down in the stacks, checking out other articles that they referenced. Now I can do this in minutes. Hundreds of thousands of references in ACM Digital Library articles are live links to cited articles. An article is accompanied by links to subsequently published work that cites it. Publishers are cooperating in adopting common metadata formats and unique digital object identifiers (DOIs), URLS of the form http://dx.doi.org/[DOI]. References and citations can link to a work that is copyrighted by another publisher (to then obtain full text requires dealing with that publisher). Eight million DOIs are now resolved (accessed) each month.

ACM also provides access to article reviews, "downloaders of this article also downloaded..." lists, and 'online only appendices' provided by authors. Publishers (including ACM) provide online errata links to corrections made after print publication. Many send tables of contents notifications when new issues appear online. The major private journal publishers provide online access to proofed articles a month or two prior to printing and distribution.

Paper can't compete. As we step through the looking glass, paper becomes the ephemeral medium: quickly recycled post-it notes in a digital world. I print out a document and carry it to a meeting; afterwards I throw away the paper and count on the subsequent availability of the digital version.

The ACM Digital Library is available to millions of students and researchers through site license at 1300 institutions on every continent (including Antarctica). There are also 30,000 individual subscriptions and 21 corporate licenses. Some publishers provide free online access to articles six months or a year after publication, or to readers in developing countries.

Confidence in future accessibility alters the cost/benefit balance for putting information online. All else equal, authors will favor journals and conference proceedings that are in widely-subscribed digital or electronic libraries. This will pressure publishers to make material accessible at a reasonable price. For example, several non-ACM journals have made their contents accessible to Digital Library subscribers, and recently the board of the Elsevier Journal of Algorithms resigned to start a lower-priced journal, ACM Transactions on Algorithms.

To return to the printing press analogy, when a previously isolated oral culture made contact with the outside world, its language was likely to disappear if it did not rapidly develop a written form with dictionaries and grammars. Today, if a paper culture within a field finds itself with digital competitors, it is likely to disappear if it does not rapidly develop an accessible digital form. Some conference series and journals are at risk.

3. GOALS OF TECHNICAL PUBLICATION

Journals and conferences address multiple concerns:
1. Establishing scope.
2. Defining quality or soundness.

 3. Defining originality.
 4. Measuring the value of submissions.
 5. Helping authors improve submissions.
 6. Communicating results broadly.
 7. Archiving and providing access to results.
 8. Timely dissemination of results.
 9. Staying within page count constraints.
10. Publishing on schedule / maintaining content flow.
11. Helping individual community members succeed.
12. Formation or maintenance of a research community.

The first three are key to establishing a periodical, and are occasionally revisited. The next two address the review process, followed by five focused on publication. The final two deal with the human context, the field supporting and being supported by a publication. All are significant. Some may be considered central and others peripheral or operational, but such distinctions are not clear-cut and can change over time.

Shifts in the nature of journals and conferences over the centuries illuminate the forces acting on them. Technical correspondence arose to communicate results, methods, and opinions. As journals took form in the 18th century, archiving became another mission. Kronick [1976] quotes from an 1896 address to the British Library Association: "Periodicals exist to disseminate information; but they also exist to record it."

Only a century later did journals acquire other values and practices now taken for granted. For example, assessing originality and soundness were minor concerns at first—plagiarism was widespread, reviewing was not.

Conferences have also evolved. Until the 20th century, most meetings were local gatherings. In the 1890s, the approaching centennial motivated scientific congresses that drew people to Europe from around the world. A century later the millennial transition produced no comparable events: Air travel had made international conferences routine.

Pre-printed proceedings are a recent development. Even early computer science conferences and workshops distributed papers after the event if at all. That changed in the 1980s; proceedings have been distributed at all major human-computer interaction conferences.

The 1896 address continued by noting a possible conflict between conferences and journals: "When we find that the momentary dissemination of knowledge is obtained at the cost of permanent record of it, we may well pause and ask ourselves whether there is not a danger of a blessing being changed into a curse, unless we take measures to prevent it." Goals frequently conflict. Even within one field, different journals prioritize differently, as do different conferences and workshops. A healthy field needs a range of venues that emphasize diverse goals. It is a complex whole. And each activity, and the interactions among them, is affected by transition to digital information.

4. SCOPE, SOUNDNESS, AND ORIGINALITY

For journals, the original goals of communication and archiving are now assumed; the definition and assessment of scope, quality, and originality get more attention today.

4.1 Scope

When a journal or conference series is planned, a set of topics and methods is identified. The somewhat Darwinian intention is to define a unique niche or to compete with others occupying a niche. A new specialization competes with the general field that motivated its formation by not publishing enough in the area. CHI and the journal *HCI* in the mid-80s had a fresh cognitive focus; if they competed at all it was with general computer science conferences and broad journals such as *Communications of the ACM* and *Human Factors* that had published work in the area.

Competition arises in several ways: a different publisher wants an offering in an area, authors chafe at the amount or orientation of what is being published, new specializations appear, or researchers rebel against a publisher or professional organization. Travel and language barriers motivate new conferences. We end up with multiple journals (*HCI, TOCHI, Interacting with Computers*), general conferences (CHI, INTERACT, HCI International), and specialized conferences and tracks (DUX, HICSS, etc.). Written or unwritten differences of scope address the length and quality of acceptable articles.

Ultimately, the real scope of a journal or conference is negotiated between the organizers and researchers based on the overall ecology. Placing a topic in the scope statement may not lead to submissions. Novel topics may be added later. Drift in scope is not uncommon in our rapidly changing field, as when *ACM Transactions on Office Information Systems* dropped 'Office.'

4.2 Defining Quality in a Multidisciplinary Field

Hard sciences generally concur on quality criteria, the humanities agree less, and multi-disciplinary fields least of all.

Human-computer interaction is now a core component of computer science. But only a few computer scientists attended the first CHI conference in 1983. Experimental psychology and cognitive science dominated, followed by human factors and industrial engineering.

Most academic psychology departments soon lost interest, but a generation of psychologists remained. They worked in industry labs, shifted to computer science departments, and more recently have been populating schools of information. Social psychologists and ethnographers became involved. 'Usability Engineering' became a profession. Information systems departments in management schools focused on computer use from a different perspective. Over time it was recognized that Design with a capital D and Marketing contribute to understanding human-computer interaction.

Multidisciplinarity brings benefits—and challenges. A central challenge is to identify a standard or process for determining the quality of contributions.

Quality spans importance (to theory or practice), originality, and method-ological soundness. These are independent; for example, work can be sound and original but not of much import, or original and interesting but not sound.

Importance is related to scope. Research that is out of scope is not important to a field. Work that makes too fine or too weak a distinction is also unimportant, though it might be significant to a specialized sub-discipline. Judgments of importance are where political, institutional, and other biases slip in. These biases incontrovertibly affect journal and conference acceptances even in the sciences and argue for the imperfect remedy of blind reviewing, which has gained popularity in our field.

Originality is also viewed differently across disciplinary boundaries: That which seems startlingly original to a fellow specialist can appear to be a minor incremental step to an outside viewer. Again, this creates particular challenges in multi-disciplinary fields.

Differing views of methodological rigor can be more subtle. Consider the laboratory study, not the only form of contribution to human-computer interaction but an important one. In Moby Dick, Ahab nails a gold doubloon to the mast as a reward for the first sailor to spot the white whale, and Melville describes the different thoughts of each sailor as he gazes at the coin. As editor of *TOCHI*, I have observed a similar range of impressions as different members of our community gaze upon the laboratory study.

To most perceptual and cognitive psychologists, lab studies provide insight into the fundamental nature of human behavior. Despite 'ecological validity' caveats, perceptual and low-level cognitive findings are considered to be broadly applicable. Psychologists brought into HCI the norm of asserting a scientific advance when the probability of a type one error is less than 5% ("$p < .05$").

Social psychologists also strive to uncover fundamental truths, but lab studies of groups are best seen as identifying phenomena to look for in real world settings. Such indicators must be strong enough to motivate more costly, less tidy observations, but there is no logical reason that this should be $p < .05$. A researcher might be happy with $p < .15$ for a finding that is subject to replication.

To a practitioner who must decide between two designs, any evidence is better than flipping a coin. A lab study that favors one alternative by a 60–40 margin ($p < .40$) might be welcomed.

A computer scientist building a new form of interactive system may feel that its novelty alone merits publication. A proof of concept study might please such researchers even if their unpolished user interface performs somewhat less well than an existing refined alternative ($p > .50$).

And some qualitative researchers consider lab studies to be pointless in principle.

In conclusion, different HCI constituencies might justifiably welcome probabilities of .05, .15, .40, .60, or none of the above. Each group often regards those that follow as unacceptably lax, while the latter consider the former to be overly narrow.

4.3 Originality: Too Little? Too Much?

4.3.1 *Plagiarism and Republication.*   Although some writers complained about "philosophical robbery," plagiarism was widely practiced early in the scientific era. Even the strongest journals relied on reviews, translations, and reports attributed to anonymous or unnamed individuals, and others plagiarized openly. Traces remained of an oral culture in which attribution is not economical. A century of journal publication passed before standards of citation were established. Although cultural attitudes toward unacknowledged borrowing still vary, citation standards are now widely accepted. Reviewers frequently ask for additional citations (often to their own work and that of friends), and authors gripe about such pressures, but it rarely rises to a journal editor's attention and only occasionally leads to rejecting a conference submission.

A lack of originality is relatively easy to police when the prior work was done by someone else: an offended party may notice and lodge a complaint. Online publication and search engines facilitate the detection of plagiarism. The issue is greyer and detection less likely when an author publishes research twice. The permissible boundaries of 'self-plagiarism' are a major source of contention. The ever-increasing pressure to publish is an understandable if indefensible motive. However, two arguments for republication are less easily dismissed.

First, in an emerging or multi-disciplinary field, relevant audiences for a result are often scattered. It may be reasonable to republish a result for a different audience. For example, American Association for Artificial Intelligence conference policy states: "To encourage interdisciplinary contributions, AAAI will consider work which has been submitted or presented in part elsewhere, if it is unlikely to have been seen by more than a few members of the AAAI audience." [AAAI 2004]

In contrast, journals and conferences in a mature discipline such as experimental psychology have distinct niches. It is clear where to publish a particular result and where to look for it. A paper is more likely to reach the relevant audience.

Nevertheless, inherent in the archival role of journals is the idea that publication adds a work to the historical record. Journals in the modern era draw a strong line against publishing material previously archived in a journal or book.

Second, conferences have not been archival. Workshops and some small conferences explicitly permit republication. True, people do not want to hear the same thing twice, duplication complicates evaluation of a researcher's productivity, and burdening multiple sets of reviewers taxes the community. But until recently, computer science journals accepted without modification work presented in major conferences. Digital technology has changed this, as discussed below under archiving.

4.3.2 *Incremental Progress and Radical Innovation.*   A culture that prizes novelty will not label a paper "too original," but a fuzzy line separates being original from being out of scope. In a world in which it can be argued that there

is little new under the sun, novelty in one domain can mean that work belongs elsewhere.

A new field places a premium on originality, its *raison d'être*. As the field matures, consensus develops as to important problems and accepted methods, and originality is less prized. Common to Kuhn's [1962] and Sulloway's [1996] accounts of scientific revolution is a distinction between 'normal science' with established problems and paradigms, and rebellious or revolutionary change. Most scientific work occurs as normal, incremental science. In this context originality is often suspect.

Journals and conferences follow a similar maturation process. Initially, originality helps one differentiate and establish a niche. Once that is in place, originality can threaten its identity and compete with the reporting of important if incremental progress on established topics.

Many an author submitting to *TOCHI* is encouraged to withdraw a submission that seems out of scope, even if it might be sound research. Often the decision is easy—the paper neither cites HCI literature nor explains why it is relevant to an HCI audience despite this. Other cases are not easy; some full reviews produce rejections due to scope of topic or method. As editor one hopes to avoid what C. H. Waddington [1977] called "COWDUNG—the conventional wisdom of the dominant group." Many authors claim that their most original conference papers are rejected and their incremental papers accepted, and reflecting on my experience, work that seems more original was accepted in the early CHI years but not the past decade.

In conclusion, originality competes with other valid goals. We must avoid the sterility of swirling ever deeper into a few narrow paradigms, but recognize the demands of normal science in a mature field.

5. REVIEWING AND REVISION

The British Royal Society's *Philosophical Transactions,* arguably the first journal, did not review submissions. A reader of one published paper wrote that "whatever fine promises are made . . . one ought not to speak of them until the results have been seen; for it is not very urgent to know what charlatans may promise." Such complaints were neither uncommon nor heeded. [Zuckerman and Merton 1971].

Although peer reviewing was not part of early technical correspondence, today, careful review by experts is the distinction of journal publication. Although journals vary in quality, most of the effort in producing one involves assessing and improving quality. Whether submissions begin as original analyses or as extended or merged conference papers, reviewers encourage additional analysis, more thorough literature review, discussions of implications, and suggestions for future directions.

Conferences and workshops vary in selectivity, but even conferences such as CHI that stress quality do not make revision a priority. Matching submissions to reviewers is less careful, reviews are more hurried, and authors have limited time or incentive to revise. Book publishers solicit reviews and press for

revision, but line for line, journal articles get more attention by knowledgeable reviewers.

Some who write systems papers say that reviewing amounts to proofreading and wordsmithing. My experience differs, as author, editor, and observer. Many authors benefit immensely by seeing reviewers consider their work from different angles and by repeated revision. Authors often thank journal reviewers sincerely. I have seen papers so improved that reviewers may have deserved coauthorship credit.

6. COMMUNICATION AND ARCHIVING: THE ORIGINAL GOALS

6.1 Communication

Communicating results, the original goal of technical correspondence, remains central. Efforts to promote readership and library subscription are ongoing. Journals, conferences, repositories, and distribution lists proliferate.

As an author, I occasionally encountered a disheartening claim of the form: "On average, a journal article is read by N people other than reviewers." N was usually 2. Authors could reassure themselves that the work was archived and would some day be appreciated. Still, it increased the appeal of presenting to visible audiences at conferences.

It was probably a myth. In any case, download patterns can be studied. *TOCHI* articles have on average been downloaded over 500 times apiece since October 2001; CHI conference papers almost 100 times. Download frequency has steadily increased, even as conference attendance has dropped. With the powerful digital library features being added, access should continue to climb.

Conferences in our field publish about an order of magnitude more papers than journals publish. The SIGCHI web site lists over 35 relevant conference series, whereas *TOCHI* and *HCI* together publish fewer than 30 *papers* annually. The 7 journals in the HCI Bibliography (http://www.hcibib.org/) publish fewer than 200; over half are in the monthly *IJHCS* and the bi-monthly *Interacting with Computers*.

As conferences abandon paper proceedings, a process well underway, length restrictions can be relaxed, although reviewers and reviewing may suffer.

6.2 Archiving

Archiving is not only easier, with efforts such as Internet Archive it may be difficult to avoid. Many conference proceedings are now routinely archived.

Historically, archiving was a key distinction of journals and books. A member of the CHI publications board recently wrote "proceedings are not archival." But if we use the dictionary definition, proceedings are now archival in our field—and practices are changing as a consequence.

In the past, ACM and IEEE allowed conference papers to be published verbatim in journals because proceedings were not archived—they were rarely held by libraries and thus were difficult or impossible to access. A few years ago, ACM followed IEEE in revising policy to oppose this practice. This is a sign of the narrowing distinction between proceedings and journals.

The placement of published papers on personal web pages is openly allowed by many although not all publishers. Although long-term maintenance of such pages is questionable, search engines can make such sources surprisingly effective for locating papers. Personal web pages could influence the overall pattern of practice.

7. PRODUCING A PERIODICAL

7.1 Timeliness

Delays are a major source of author dissatisfaction, and results can lose currency. Nevertheless, quality takes precedence for most modern journals. Acceptance of a submission can take years, which is helped only slightly by 'prepublishing' articles online. Journals willing to risk quality can obtain material by promising faster turn-around.

The slowness of journal review and revision contributes to the usefulness of conferences. Authors are motivated by conference submission deadlines, increasing the freshness of reports. The pressure on journals to be timely is reduced as conferences grow in number and gain respect.

The importance of timeliness varies across fields and topics. Competitive or rapidly changing areas experience pressure to report quickly. In our field, the rate of technological change leads to rapid shifts of focus. For example, command naming was a major research topic in the early 1980s; with the success of graphical user interfaces, it became about as interesting as new ways to pack information on 80-column punch cards.

Pressure builds for rapid publication even for results with a relatively long shelf life. Sources include 'publish or perish' incentive systems and practitioners facing design decisions who are willing to forego complete literature reviews and polished analysis.

7.2 Meeting a Schedule and a Page Count Budget

Attracting content was of greater concern than soundness or originality to early journals, including the *Philosophical Transactions*. Today, publication schedule and page count limits are operational goals that seem secondary. Issues arrive late and vary in size. Nevertheless, publishers and editors spend considerable time addressing these goals; their effects are easily underestimated.

Authors, publishers, and subscribers including libraries want full issues published regularly. This can create pressure to accept or hurry articles. At the other extreme, although page limits may motivate more careful screening and more concise articles, they can create backlogs that impede timely publication. For an editor or publisher, a backlog ensures publication on schedule, but it disadvantages authors and readers.

To address a chronic backlog, a journal can shift to more frequent publication. If quality is perceived to be constant, this can benefit publishers who increase subscription prices with publication frequency. This appeals more to

commercial publishers whose income is primarily institutional than to society publications that aim for member subscriptions and accept backlogs to hold down production cost and journal price.

Special issues help journals attract papers and control content flow. They benefit authors by providing a deadline to work toward and a more visible platform. However, the expectation that an issue will be filled and the need to publish a set of articles simultaneously can lead to pressure on quality and timing. The selection of topics can influence the perceived scope of the journal. Too many special issues may undercut the willingness to submit papers for general issues. Like many editors, I came to favor special issues, but it is important to make sure that operational convenience is not the tail wagging the dog.

8. NURTURING THE PROFESSIONAL COMMUNITY

The final two goals address the health of the field, employing McGrath's [1991] distinction between activities that support the well-being of the community as a whole and those that address needs of individual members. Group well-being and individual prosperity are entwined, but a group can become dysfunctional even as individual members prosper (e.g., the 1968 Beatles), and an organization can function well yet dissolve if members do not benefit (e.g., distribution lists that are useful until eventually participation withers). Activities and decisions often address one purpose or the other, and tensions can arise between the two goals.

8.1 Helping Individuals Succeed

From the perspective of publications, a professional community comprises six principal groups: i) authors; ii) readers; iii) reviewers and editors; iv) publishers; v) librarians; and vi) supporters (conference committees, research staff, funding agencies, volunteer and paid members of professional organizations, services, and so on). Most researchers serve as reviewers and as members of professional organizations, and some consult with publishers. One person can at different times fill all roles.

8.1.1 *Authors.* There is unequivocal good news for authors. Journals are an extraordinary resource available at very low cost: consulting volunteered by experts. Authors get credit for the paper and benefit from the deeper understanding they take back to their work.

Authoring a journal article can be intrinsically rewarding, as can presenting to live conference audiences. However, authors do not live on food for thought and personal satisfaction alone. Academics need appointments and promotions, industry researchers need good performance reviews. Publications are central to attaining these individual goals.

In fact, I often hear concern that journals have become little more than an academic accreditation system. In industry research laboratories, conferences are more highly prized for their breadth of coverage, rapidity of dissemination, networking, and even press attention.

Prior to the Internet and proliferation of conferences, academics had to invest in educating departmental colleagues about their research in order to get feedback. Now researchers interact effectively with specialists at other universities. With less local discourse, external letters and publications are more relied upon in appointment, tenure and promotion cases.

Some fields emphasize book authorship, with journal articles secondary. In other fields journal publication is most highly regarded. Academic committees recognize that urgency of publication varies. For example, historians are not in a hurry; a thorough monograph is worth the wait.

Given a choice of book-centric or journal-centric assessment, our academic field selected the journal model, but especially in North America it has chafed. Computer science emerged amid plentiful conferences. Many HCI academics worked or interned in industry labs, adopted values dominant there, and would prefer a conference-centric approach. But universities change slowly, wary of anything that smacks of lowering standards.

HCI faculty educate colleagues on the selective nature of certain conferences and report acceptance rates. Some departments equate two conference papers to a journal article, or even award journal stature to papers in conferences that accept fewer than 25% of submissions.

There are broader efforts to blur the distinction between conferences and journals. In 2002, SIGGRAPH added a brief review cycle and turned its conference proceedings into the July issues of *ACM Transactions on Graphics*. Conference papers of 6–10 pages are thus comparable to longer journal articles. The long-term effect on the motivation to write longer articles remains to be seen.

Starting in 1999, some conference proceedings have been designated sequential issues of "CHI Letters," a quasi-journal mark of distinction. Intended to increase library subscriptions to conference proceedings, it was ill-fated to coincide with the launching of the more versatile and less bulky, digital library. The value of the CHI Letters distinction is debatable; not debatable is the resulting confusion, with some academics using it to list conference papers as journal articles and the writers of letters of reference left to tread carefully around the matter.

8.1.2 *Readers.* Readers are the direct beneficiaries of publishing. They benefit from the work of authors, reviewers, publishers, and conference organizers. They benefit from deep analyses in journals and rapid reports at conferences or on the Web. And they benefit tremendously from online access.

Downloads can be measured, but what happens to the downloaded paper? Is it read? Skimmed? Changes in media and availability lead to changes in use. What will tomorrow's readers want?

Journals offer depth of analysis. Valuable as this is, future readers will probably profit more from focusing on conference publication for its breadth and currency. The skill of deep analysis is losing its value as the opportunity cost of time spent in extended concentration mounts. Analysis has been the principal focus of scholarship since the invention of writing, but future scholars will need the ability to rapidly retrieve, browse, and synthesize vast amounts of information.

This seems as inevitable as the shift from memorization to analysis that accompanied the invention of writing. As information scarcity gives way to information abundance, optimal strategies shift. Not only do people benefit from devoting more time to searching and browsing, they are more open to criticism for not citing relevant work once finding it is so much easier.

Of course, skimming and synthesis are more effective when higher quality content is available. So a balance may be struck. Journals in some form could be part of the glue that holds together an increasingly fragmented universe of discourse.

8.1.3 *Reviewers and Editors.* "The referee is the lynchpin about which the whole business of science is pivoted." [Ziman 1966]

If referees disappear, so will journals. Although nothing prevents 'free riders,' the system only works if on average people review three or four papers for every one they submit. Inexperienced researchers get fewer invitations to review, so a heavier burden falls on busy, experienced researchers.

However, to the degree authors favor conference publication, they are less motivated to review for journals. Reviewing for conferences is faster and easier; as with reading, it enables one to see more research in a shorter time. Finding editors who have experience publishing in journals becomes more difficult.

Reviewers are volunteers who get modest recognition. This gives editors limited leverage when a reviewer is slow. It is difficult to nag a respected person who is doing you a favor. This works against timely publication of journal submissions, increasing the advantage held by conferences. Pressure for fast turnaround can force reliance on less expert reviewers.

Reviewers benefit from reading and thinking about new research, and by organizing their thoughts in writing. Email makes it easier for editors to send a full set of reviews to each reviewer.

Reviewers are crucial, especially for journals. Care must be taken to insure that reviewers continue to benefit through times of change.

8.1.4 *Publishers.* When I assumed the *TOCHI* editorship in 1997, publishers were already intensely focused on the implications of the Web. Digital technology has affected everyone—*TOCHI* has not used paper for submissions, reviews, or handling since 1997—but publishers responded early.

Historically, publishers were central, interacting with authors, editors, librarians, and readers. They established and marketed journals, monitored and maintained continuity in the editorial and review process, and their role in typesetting, printing, and distribution made them indispensable. In compensation publishers retained copyrights.

Word processing and the Internet reduced the cost of production and distribution. Authors can do it themselves. Also, as with music, the Internet has the potential to undermine the value of copyright, and several publishers prohibited authors from placing their own articles on personal web pages. Unlike the music industry, though, journal publishers are not aligned with content creators, because authors are not paid.

These developments, along with increases in subscription rates, decreases in library budgets, and the emergence through consolidation of a few powerful companies, have led to several efforts such as the Open Archives Initiative. 'Open access journal' efforts have been backed by scholars, funding agencies such as NSF and NIH that are committed to rapid and wide dissemination of research results, and entrepreneurs looking to fund efforts through page charges, advertising, or other means.

An early and uniquely successful example is the unrefereed online pre-print server *arXiv*, supported by annual grants of $300,000 [Butler 2001]. *arXiv* is widely used by physicists, for whom it is well-suited: Pre-publication peer review is relatively unimportant in physics, and rapid communication of results is important for some topics.

Other open access efforts have been much less successful to date. Strong support from NIH has accompanied an astonishing number of efforts in the biomedical field; most are ongoing but have gained limited traction. The most successful shifted to working with rather than against traditional publishers [Kurtz 2002].

Proponents of circumventing publishers may have underestimated the work publishers do in creating and maintaining peer-reviewed journals. Efforts aimed at a few commercial publishers who are viewed as more focused on the bottom line than love of knowledge could also undermine journals published by smaller niche publishers, professional societies, and university presses, which serve scholars in other ways. And the editorial staff of commercial publishers are also genuinely committed to working with authors and contributing to professional communities.

Publishers depend on good relations. They listen to authors, editors, librarians, and readers and want to accommodate them. For example, in a rare mutiny, 75% of the editorial board of Kluwer's *Machine Learning* left to form *Machine Learning Research* with MIT Press because Kluwer did not allow authors to republish work on personal web pages. In response, Kluwer changed its policy, and today both journals are in business with overlapping editorial boards. In other cases, prices have been negotiated down.

A research community might take on publishing, but most researchers would rather do research than handle the bureaucratic and managerial tasks involved. Reviewing is burden enough. They will collectively pay a publisher to do it, just as many conferences outsource registration, conference services, and computer and audio-visual support.

To compete with non-profit societies and university presses, commercial publishers find ways to add value. They may be first with a high-quality journal in a new area, or satisfy demand for a lower-quality journal. They seem better organized than society publishers to select, and especially to market books. In Europe they have taken on conference proceedings. They innovate: For example, *New England Journal of Medicine* provides software so physicians toting wireless PDAs can scan the current table of contents and select articles that are then waiting as email attachments at their desk.

Publishers have business models in which they are confident, but know they must respond to technology change and pressures from other stakeholders.

They continue to provide management support while adding services such as cross-referencing. Tools will improve and enable authors to do more tasks, but as long as human effort can be applied to improve communication, publishers can benefit the field.

8.1.5 *Acquisition Librarians and Collection Managers.* Editors mediate between authors and publisher production staff, librarians mediate between readers and publisher marketing staff. Individuals can acquire books, journals, or proceedings directly, but acquisition librarians have been key players in print publication distribution and through institutional site licenses are key to online access, balancing cost against access. This puts them at the heart of the evolution of the balance of publishing among commercial, society, university, and open access alternatives. University librarians recently made news by canceling subsriptions to some commercial online journals over pricing issues.

The vision of the Web as a direct channel between authors and readers leaves little room for librarians. Digital technology affects the role of librarians, for example through the ease of online literature search. But librarians like publishers will find new ways to benefit researchers and remain significant stakeholders for the foreseeable future.

8.1.6 *Support Groups.* Publication is directly or indirectly dependent on many other groups. These include professional societies, conference organizing committees, research project staff, and funding agencies. Some are paid, some are volunteers, others are in between; for example, rotating NSF program managers or research project programmers who could earn more elsewhere.

Professional societies have had a large role in North America. ACM and IEEE are strong central organizations sponsoring a wide range of publication and recognition activities. In Europe and Asia, senior professors often guide conference organization, and private and university presses publish most journals. Greater centralization has enabled many North American conferences to digitize more rapidly. A first mover advantage is possible: authors may submit work to outlets that are more accessible.

Support activities are recognized in published acknowledgments of funding agency support, in recognition ceremonies at conferences, and other ways.

8.2 Growing and Maintaining a Healthy Community

Successful journals and conferences establish a field; publishing and participating in such journals and conferences helps researchers succeed.

Community formation favors greater inclusiveness. Individual professional recognition can benefit from discrimination based on consensus judgments of quality. Regional and second tier journals and conferences enable more researchers to establish a presence. In different contexts, quality bars are set at different levels, and quantity can be evidence of personal productivity and a vibrant field.

8.2.1 *Conference Types.* Social activity is a feature of all conferences. Networking is universally acknowledged to be a major benefit. Conferences hum

with job interviews. They generate a sense of shared purpose. Professional organizations hold business meetings and recruit volunteers. Yet conferences differ markedly, reflecting different responses to the pressures for community and individual support.

Consider three types of recurring conference:

(a) Established, workshop-like conferences that attract on the order of 100 people.
(b) Larger research conferences that range in size to 2000 or more.
(c) Annual umbrella conferences that attract 5000 to 10,000 or more.

Many IFIP conferences fit (a) and CHI conferences fit (b). American Anthropological Association and Academy of Management annual conferences are examples of (c).

An (a) conference supports a small group of researchers, most of whom attend each meeting. Community maintenance is central. Paper quality varies. Several years ago someone explained the dynamics: Regular members are not expected to write a great paper every time, but they need to present to get funding to attend and contribute to discussions, so lesser quality papers are accepted. Still, at least every third paper should be excellent—some of your good work should go to the conference. Newcomers are judged differently—they should demonstrate seriousness and ability with a strong paper.

Only that one time did I hear it stated so explicitly, but this dynamic is evident in many small conferences and tracks that focus on work in progress. In contrast, category (b) research conferences stress paper quality first and foremost and reject most submissions, although some program committee members quietly acknowledge favoring interesting speakers. Quality is ultimately a partially subjective mix of soundness, importance, originality, and lack of obvious flaws (with no revision cycle, even easily corrected flaws are a problem).

Academic appointment, tenure, and promotion committees respect high rejection rates, supporting the category (b) approach. The risk is that rejecting 80% to 90% of submissions can anger veterans, exclude younger researchers or those from related disciplines, and reduce the impulse to volunteer to attend.

Umbrella conferences (c) attract thousands of people by accepting thousands of papers. Acceptance rates can be 50% or higher. Quality is highly variable by any measure. In compensation, attendees get a more complete picture of what is happening in any given specialization, good and bad. And networking is supported on a large scale.

A format that stresses one goal can also address others. Small conferences provide strong discussion that progresses work toward journal or book publication. This is valuable in journal- or book-oriented fields, where conference paper quality is less of a concern. Conferences prioritizing paper quality provide venues such as posters for other work. Umbrella conferences include invited lectures and best paper awards that attract notice on CVs.

Quality-focused and large conferences partially address the small-conference goals with workshops, tracks, and symposia. Like (a) conferences,

these often accept about half of the submissions and consider an author's past record.

Human-computer interaction has many conferences of types (a) and (b). The two largest general conferences, currently each attracting 1500–2000, are CHI, a large type (b) conference with a 15% acceptance rate and fewer than 100 papers, and HCI International, a small type (c) conference with over 80% acceptance and more than 1000 papers.

This typology does not fully capture conference variety. For example, the Hawaii International Conference on Systems Sciences (HICSS) comprises several largely independent (a) conferences that are unusually successful in fostering multi-disciplinarity by virtue of meeting in Hawaii in January. But it may illuminate certain phenomena, such as the challenge of bridging seemingly unrelated groups such as CHI and the more technical Information Systems researchers, as undertaken in the mid-1980s in the Computer Supported Cooperative Work conference series. CHI participants, for whom conference papers are often the final research product, pressed for polished papers; IS participants, seeing them as steps toward journal publication, submitted less polished work. The former dominated, the conference became highly selective in the CHI mold, and IS participants focused on HICSS and other venues.

8.2.2 *Field Maturity.* A new specialization must establish credibility within an existing academic or professional context, amidst competition for material and human resources. Until journals are established, a commitment to standards is demonstrated at conferences. Viewed from the outside, a new field is credited with originality and encounters diverse judgments of importance. It can improve its standing by demonstrating a concern for methodological rigor. Prominent members of the HCI community voiced this argument in pushing for the development of category (b) conferences in the 1980s. Category (a) conferences support relatively low-profile survival within an existing discipline.

A focus on quality contributes to community growth by legitimizing the field, but priorities change as a field matures. A body of knowledge accumulates. Researchers and practitioners specialize. Journals are established and maintain the quality standard. A highly selective general conference is of less interest—it has a shrinking proportion of work in one's area of specialization. The few specialized papers in other areas do not provide comprehensive views of research. High rejection rates drive researchers to form and attend specialized conferences. The category (c) umbrella conference, in contrast, supports community growth by providing parallel, highly focused sessions on all topics. Variable quality and small sessions can be balanced by the enthusiasm of those present and enhanced by knowledgeable discussants addressing sets of highly related papers.

A mature field's focus on incremental advances (at the expense of originality) supports community-building and individual advancement. Graduate students who require publications to get jobs often start by improving prior work. A new professor most easily gets grants, publishes, and attracts students by building on dissertation work. Incremental papers inherit literature reviews and methodology sections and are thus less prone to errors of omission or

commission that sink submissions to selective conferences. Citations legitimate prior work of researchers in the field. In many ways, a shift to normal science strengthens a field and ensures the success of its members.

A mature field has also formed writing conventions and informal networks that share and review work prior to publication, which supports members and creates barriers to entry.

8.2.3 *Journals.* These pressures affect more slowly-evolving journals in similar ways. Regional and second-tier journals address the demand for publication. Journals pay attention to citation counts, which are used in evaluations. Once a journal has a publication history, a radical departure (originality) is more likely to be considered out of scope.

Journals in a maturing field come under the same pressures as quality-oriented conferences. They are eventually publishing only a fraction of the work in subdisciplines and lose readership to specialized journals. To counter this they can increase publication frequency (the quintessential umbrella journals *Science* and *Nature* publish weekly). This is difficult for society-published journals; most specialize (e.g., *Journal of the ACM*) or become magazines (e.g., *Communications of the ACM*). Journals also serve subdisciplines through special issues, a mechanism similar to and sometimes inspired by conference workshops and tracks.

Consider the new specialization of location-aware/pervasive/ubiquitous computing. Three significant conference series have formed (Pervasive Computing, PerCom, and Ubicomp), publishing almost 100 full papers and many short papers annually. Established, broad journals *HCI, TOCHI, IJHCS, IJHCI,* and *CSCW* have initiated special issues on the topic. In a shift of scope, in 2001 *Personal Technologies* became *Personal and Ubiquitous Computing*. A magazine, *IEEE Pervasive Computing,* emerged in 2002. For now, the literature is widely dispersed.

8.2.4 *Two Faces of Human-Computer Interaction.* Our field is the merger of two distinct groups, each with its own history and priorities. This has shaped our conferences and journals.

Workplace studies, now called human factors and ergonomics, originated before World War I. In World War II the use of complex machines became a focus. When computers arrived, this extended to the operators assigned to handle them.

Then in the late 1970s, a new phenomenon emerged: the discretionary use of software by people engaged in tasks typically done without computers. Many human factors issues and concerns were relevant, and a few people worked in both areas, but priorities differed. The two efforts progressed on parallel tracks.

By the 1980s, a mature discipline stood alongside an emerging discipline. Human factors was established in engineering curricula and in industry, with a professional organization, local chapters, conferences and journals. The human factors of computer use was a new subdiscipline. In parallel, cognitive science-oriented HCI was establishing an academic presence outside

engineering, with a society, local chapters, conferences, and then journals. Although "human factors" is in the CHI conference subtitle, CHI researchers rarely cite human factors papers or otherwise share venues.

One result was two major conferences of comparable size and distinct constitutions. HCI International is an umbrella conference of the mature human factors and industrial engineering field. CHI is a selective conference of the kind found in emerging fields.

Journals that began prior to 1983 were strongly influenced by the human factors tradition, though their scope has evolved. Almost one third of HCI publications are in the monthly *IJHCS,* which originated in the human factors tradition in 1968 as *IJMMS* (*International Journal of Man Machine Studies*), then changed its name and scope in 1994. *Behaviour and Information Technology* began publishing in 1981. The *International Journal of HCI* arrived in the late 1980s, founded alongside the HCII conference in the engineering tradition. *HCI, TOCHI, CSCW* and *IwC* were founded later and focus more on issues specific to discretionary computer use, drawing more on research from ACM conferences.

The field also comprises software engineers interested in user interfaces and researchers within schools of management concerned with the management of computing in organizations and the presentation of computer output to managerial users. These efforts predate discretionary hands-on computer use and are often published in the engineering-oriented journals.

European HCI is more traditionally journal-oriented, concerned with indexing and impact analyses. Conferences showcase work in progress toward journal publication. North American HCI spearheaded by SIGCHI is conference-oriented, less concerned with journal impact. Conferences showcase work that is often as polished as it will ever be. This difference can disrupt efforts to work together.

9. DISCUSSION

9.1 Disrupted Equilibria

Although change is a constant, at any moment a workable balance exists among the goals of publication. The complex interdependencies act as constraints; like a 12-legged stool, perhaps, the system is quite stable. Or has been—digital technology is profoundly effecting so many tradeoffs that a major reorganization is inevitable. But it will take time to work out new balances that are acceptable to enough of the stakeholders.

Consider the cost of paper publishing. By limiting page count, it helps control the reviewing burden and forces selectivity and concern for concise prose, all of which enhance quality and assist accreditation processes.

Digital publishing is far less expensive. Online journals can accept more and longer articles, pleasing authors but troubling academic accreditation bodies. Reader response is unclear: Given the online tendency to browse and skim, readers may tolerate higher volume, push for greater concision, or both.

In an interesting experiment, the Association for Information Systems initiated two online journals in 1999. *JAIS* is a traditional double-blind peer-reviewed journal. *CAIS* offers authors a choice of "light" review by the editor or full peer review. In 2003, *JAIS* published 16 articles, *CAIS* published 95. Although 80% of *CAIS* authors requested a light review, it is more highly rated than *JAIS* [Mylonopoulos and Theoharakis 2001].

Conferences that switch to digital proceedings are also less constrained, but some have at least initially held to past paper numbers and lengths. They could increase acceptance and use two-tier quality assessment, such as best paper awards, though an increased reviewing burden must be addressed.

Consider the tensions around online 'preprint' repositories. They are strongly favored by funding agencies but prohibited by some major journals that have a stake in making news and by some professional societies that see a threat to journal solvency. Private publishers have responded with online prepublication, and journals including the respected *New England Journal of Medicine* have introduced commercial advertising online to offset anticipated declines in subscription revenue.

Over time, new balances will be struck as constraints shift.

9.2 The Future of Journals

This essay can be seen as an account of journals under siege, their defenders confined to the threatened, ivory towers of accreditation and scholarship. Conferences proliferate, cover more research, more quickly, and are archived and earning increased respect in the eyes of some academic committees. Proportionally less HCI research reaches journal publication. Length restrictions may be relaxed as conferences shift to digital proceedings. Conference papers may be more useful as browsing, skimming, and synthesizing rival reading and pondering as critical skills.

In addition, the satisfaction of deep analysis and the feeling of contributing to the growth of a science are diminished when Moore's relentless law renders findings irrelevant. Twenty years ago Thomas Green described command-driven text editors as the "white rat of human-computer interaction." Within a few years graphical user interfaces had obviated the prior analyses and curtailed study of text editing.

Nevertheless, the field benefits from the 'iterative design with user testing' of journal articles. As long as reviewers volunteer their efforts, journals are a remarkable service for research. Free educational opportunities are disappearing; take advantage of journals while you can. To preserve this benefit will require a conscious focus on recruiting, training, and rewarding reviewers.

I noted above that *TOCHI* articles are downloaded five times as often as CHI papers on average. However, there are many more CHI papers. Over two years, *TOCHI* articles have been downloaded 75,000 times, CHI papers 365,000 times. Include other online proceedings and the disparity is greater. Only a few years ago, most research libraries carried the journal but not proceedings. The balance has shifted dramatically. Journals must find new ways to contribute.

Experiments such as *CAIS* and *JAIS* show that e-journals can succeed in overcoming quality concerns in journal-oriented fields. Online journals will proliferate, but the conference-oriented CHI community may not embrace them.

9.3 New Roles for Journals

If book sales decline, journals could replace the monograph as the source of extended analysis and reflection. Alternatively, journals can keep pace with quickening times by adopting magazine features while retaining academic respectability, the *Scientific American* model. *Communications of the ACM* reduced its emphasis on peer review and shifted to magazine format.

Elsevier's BioMedNet has launched over a dozen popular "Trends" journals (e.g., *Trends in Cognitive Science, Trends in Neuroscience*) comprising reviews, opinions, and articles of up to seven pages with constraints on format and reference count. The editorial boards consist of well-known researchers. Most articles are solicited, then rigorously peer-reviewed. Upon acceptance professional editors guide production, which typically includes sidebars and a strong aesthetic appeal. In our field, *IEEE Pervasive Computing* has blended peer reviewing and a magazine format.

Journals can find novel forms of content that connect to evolving research communities. For example, increased online access to articles, data, and analysis tools has spawned diverse 'meta-analysis' papers that draw on multiple published studies, giving rise to new methodological opportunities and concerns [Fox et al. 1998]. *MIS Quarterly* has employed a longitudinal twist, soliciting data updates for the online version of a published paper [Te'eni 2001].

Other symbioses with database efforts include *Nature's* plan to publish 'molecule pages,' each containing annually updated information on a protein involved in cell signaling. The value is in the cumulative set of records. "It is essential that the effort should be recognized by faculty committees and granting bodies, in much the same way that they consider the value of authoring a widely cited review article...If large-scale collaborations in biology are going to work, the community will have to change its ways of evaluating effort." [AFCS 2002]. *Nature* subjects molecule pages to full peer review and issues them DOIs (digital object identifiers), and their formal recognition as publications is being considered by the National Library of Medicine.

The converse approach is taken in the case of the NIH-sponsored GenBank genetic sequence database. Journals require that sequence information be submitted to the database for review and assignment of an accession number prior to the publication of an article that mentions it.

Common to these developments are Web access to information repositories and a response to demands for concise, engaging results.

9.4 HCI and Its Publications

Human-computer interaction is in an odd position. Although the human factors/ergonomics engineering and HCI/CHI science factions have much in common, their differences have prevented unification.

After twenty years of growth and specialization, why did CHI become more selective rather than more inclusive? CHI was one of the first conferences to preprint proceedings from the outset—it never established a strong journal culture. Many leading researchers rarely or never publish in journals, hence the reluctance to entrust research quality assessments to journals. Also, HCII occupied the inclusive umbrella conference niche, reducing pressure on CHI to fill this role. Finally, the academic migration of HCI from psychology to computer science and then information science may have extended the period of insecurity, sustaining the focus of the CHI conference on soundness at the expense of community maintenance or outreach. (Two-thirds of today's CHI Academy members were psychologists in 1980, but almost none are in psychology departments or publish in psychology journals today.)

When 85% of submissions are rejected in a mature field, each specialization is represented by only a few papers. Attendance is less compelling. Rejected papers are revised and submitted to specialized conferences, which benefit from the extra review cycle. Over time, experienced reviewers shift their efforts to the specialized conferences. CHI provides alternate venues for researchers whose papers are rejected, but posters have a negative stigma, workshops in a mature field, are often dominated by students, and tutorial attendance is declining. And the feeling of belonging wanes with repeated paper rejections.

HCII is not the comprehensive conference found in many mature fields because many strong CHI researchers do not participate. However, human-computer interaction is diverse enough to need an umbrella conference. HCII will prosper if it finds ways to increase and reward quality.

Multidisciplinarity compounds the challenge. A few HCI programs and departments have formed, but the field is challenged to attract and hold researchers and practitioners. The influx of psychologists in the early 1980s slowed. People trained in computer science, management science, information science, industrial engineering, design, and elsewhere have the option of remaining with or returning to another discipline. This elevates the importance of community maintenance.

CHI peaked around 2850 attendees; CHI 2003 attracted around 1800. AAAI also remained an exclusive multidisciplinary conference as attendance declined from 5000 to under 1000 and smaller AI conferences proliferated.

The two journals with the strongest ties to CHI, *HCI* and *TOCHI*, have maintained a steady publication flow while other journals in the area have increased publication frequency and attract more articles. *TOCHI* has maintained this flow through special issues, which reach out to specialists in a way the conference has not.

9.5 Limits to Generality

Very likely every field will be affected by digital mediation over time, although they vary today in degree of acceptance and use of technology. The effort required to digitize varies; some fields have centuries of print history.

Fields also prioritize publication goals and operate differently. For example, the hard sciences have relatively strong agreement on accepted methods and

shorter papers, leading to higher acceptance rates than the more disputatious humanities. This has enabled the physics online preprint server *arXiv* to succeed without peer review.

The design of metadata descriptors for DOIs revealed disciplinary differences. The initial plan was to create unique digital object identifiers for books and journal articles. Only at the insistence of computer science representatives was it extended to conference papers.

HCI's two-faceted composition creates challenges. Formation through fission may be more common and produce a more orderly division of conferences and journals, as when experimental psychology split into clinical and non-clinical branches in the 1990s.

As noted, publications are shaped by a field's maturity and the relative importance assigned to book, journal, and conference participation. In turn, these are affected by the importance of rapid publication and the shelf life of research results. High-status journals in journal-oriented fields with relatively little online presence can do well even if available only in print. But over time the allure of creating a high-quality competitor that has the advantages of online accessibility will grow.

Because the effects are complex and unpredictable, each field must reassess the nature and venue of its activities at this dawn of a new era of scholarship.

10. CONCLUSION

I am optimistic about the future of scholarship and scientific communication. The sociologist Robert Merton [1988] identified many largely unavoidable inequities that arise in scholarship through the 'Matthew Effect' ("For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath.") Also called accumulation of advantage, it describes ways in which resources flow to those who have prominence, due to an early accomplishment, institutional affiliation, social class, and so forth. He added proximity to information: "Not least is the special resource of being located at strategic nodes in the networks of scientific communication that provide ready access to information at the frontiers of research."

These 'invisible colleges,' formal or informal networks of associations, have always been invaluable to scholars. The networking that many regard as the principal value of conferences is an example. They are advantageous if you are in the network and disadvantageous if you do not have the connections or resources to participate.

Today, there is discussion of network effects and preferential attachment on the web, a rich-get-richer phenomenon whereby sites with links get more links. As information and connections move online, clustering still occurs, the Matthew effect in a different guise, but everyone can follow the links. I can't see how it can avoid having a profoundly democratizing, amplifying, and transforming effect on scholarship.

Each of us must work out how to reposition ourselves, our institutions, our conferences and journals. Which is precisely why change will take time, and

also work, foresight, and willingness to compromise. The opportunities seem limitless.

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