



FIRST VIRTUAL CONFERENCE ON INFECTIOUS DISEASES OF ANIMALS

Scientific Publishing on the World Wide Web

The BioMedNet and HMS Beagle Models



BioMedNet



KEYNOTE ADDRESS

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Bioinformatics - where it all started

Biologists who initially used the Internet were mainly bioinformaticists and computational biologists. Back when the Web servers in the world could be found on a single-page listing at [CERN](#), one of the very first biological resources to become available was the University of Geneva's [ExPASy](#) molecular biology server, now home to many important bioinformatics databases and resources such as [SwissProt](#) and [SwissModel](#).

Bioinformaticists realised that the Web was exactly what they needed to make their [sequence- and structure-analysis tools](#) available to the wider community of molecular biologists. Suddenly a researcher didn't need a degree in computer science to analyse biological sequences. Similarity searches that would have taken hours on a local machine could be done in seconds using the supercomputers at the [National Center for Biotechnology Information](#), by filling out a simple query form on the Web.

But bioinformatics, important as it is, cannot completely supplant the wet science experimentation to test hypotheses. As the Web democratized the availability of sequence analysis tools, there were worries that "sequence-gazing" was becoming an addiction, and that graduate students were spending too much time trying to predict the fold of their latest ORF. However, this wariness has largely disappeared and most molecular biologists now seem relatively comfortable with the Web. The question is no longer "Do I need the Web?" but "How can I get Web stuff done as quickly and efficiently as possible?"

As the number of bioinformatics tools on the Web proliferated, a clear need arose for some convenient way of locating appropriate tools for particular tasks. [Pedro's list of BioMolecular Research Tools](#), the Baylor College of Medicine's [Search Launcher](#) pages, and NCSA's

[Molecular Biology Workbench](#) are progressively more sophisticated attempts to do just that. But with the information explosion in biomedical subdisciplines outside of bioinformatics, there grew a niche on the Web for commercial purveyors of information.

BioMedNet - bioinformatics and beyond

BioMedNet has developed a foothold in that niche by attempting to bring together integral biological research information from a variety of sources and specialties. Information included on BioMedNet includes not only sequence, structure and bibliographic databases, but also full-text journal articles, job listings, product information, book catalogs, discussion groups and searchable profiles containing contact information and research interests for tens of thousands of researchers. Under the name of "Meeting Rooms," BioMedNet is also developing collaborative tools that will enable biologists on different continents to work together more effectively than ever before. But it is perhaps the availability of research articles online that has most immediate potential to change the process of science.

Online journals

How can libraries cope financially as the growth of scientific literature continues to outpace their budgets and their shelf space, and when document delivery services charge huge fees for murky photocopies of articles? How can researchers sift through the huge volume of newly appearing literature to find information that is most relevant to them? These are pressing issues for research libraries, and both librarians and publishers are banking on the Web offering at least part of the answer.

The number of electronic journals and newsletters has reportedly increased 15-fold since 1991 - just last year the number doubled. According to the [Association of Research Libraries](#), there are currently about 600 scientific serials available online. In some cases (generally only for a limited test period) the full text is free. In others, online access is allowed only to personal print subscribers or to those who take out separate online subscriptions. [BioMedNet](#) is unusual in that most of the publications in its [library](#) allow articles to be purchased individually.

If this pay-per-view pricing model takes off, it could profoundly change the economics of journal publishing, as well as the way in which libraries cater to the information needs of their users. Currently a librarian is faced with the impossible task of reconciling multiple

| Notable biological and medical journals offering full text online | | |
|--|--|-------------|
| | Available now | Coming soon |
| Science Proceedings of the National Academy of Sciences Current Biology and the Current Opinion series Journal of Biological Chemistry British Medical Journal | Nature Cell | |
| See Online Access is Profoundly Changing Scientific Publishing in the March issue of The Scientist | | |

special interests as they manage the annual subscription budget. But in the future an administrator could have much more flexibility, rewarding the most productive labs with essentially unrestricted access to information, while tightening the belts of underperformers. Indeed, under the pay-per-view model, there will be less need to cut back on more specialized journals in times of budget crisis, because the focus is on quality articles rather than the journals in which they reside. And as online competition develops, a user will be able to make his/her own decisions about which database provider or online library system to use to get best value for money out of their allocated spending quota.

In addition to the move of print journals to the Web, there are some publications for researchers (e.g., [HMS Beagle](#)) which have made their debut in Web-only form, while other new print journals are explicitly designed to take advantage of the Web.

Characteristics of online journals

If the possibilities are fully exploited, Web publishing offers many obvious advantages to the reader.

Advantages

- Searchability of entire full text.
- Instant access - no need to trek to the library to fetch an article.
- Bidirectional citation links, leading back and forth between different publications.
- Links to related resources - including biological databases, unpublished data or other supplementary material too bulky to publish in print, interactive models, movies, and animations to convey ideas that are inherently difficult to express on the 2D printed page.
- Email links to allow feedback from readers to authors and editors, speeding up international scientific communication.
- "Continuous publication" (as in [Folding & Design](#)) - permitting articles to be published as soon as they have been peer reviewed, edited and formatted. It is no longer necessary to wait for a full issue to be compiled.
- Corrections, followups and notes can be linked to an original article (whereas errata in print publications may often go unnoticed).
- Economy of scale - purchasing and obtaining printed copy only for specific articles of interest.

| New journals developed with the Web in mind | |
|---|---|
| Publisher | Title |
| Current Science Ltd | Critical Care Cardiovascular Clinical Trials |
| Current Biology Ltd | Folding & Design |
| Chapman & Hall | Online Journal of Current Clinical Trials |
| Medscape | Medscape Mental Health Medscape Women's Health |

Caveats

- Although in the long term electronic publication may be cheaper and more efficient, in the short term, as publishers scramble to get online, it is costing money to convert data generated using DTP packages designed around paper publication.
- Most users still prefer to browse an original article on paper rather than viewing onscreen. [PDFs](#) are an interim answer: when printed out they are superior to a photocopy, while onscreen they offer the advantage of full-color figures. In the long term, display technology will have to improve.
- Speed, both of the network connection and of the local computer is often still a huge issue, especially in academic environments where internet links are heavily overused. But emerging technologies such as [ATM](#) will make a big difference over the next couple of years.

Online communitites

BioMedNet is working hard to develop the online potential of journals offered in its library. As well as extensive linking (to be greatly extended by the upcoming launch of [Evaluated MEDLINE](#)) and its pioneering development of the pay-per-view payment model, the Current Science Group (of which BioMedNet is a member) is also actively fostering online communities of subscribers to particular journals.

The [Critical Care Forum](#), for example, is centered on a peer-reviewed electronic journal that includes original articles, systematic reviews of the field, a "journals club" focusing on the most recent literature from top publications, a registry of ongoing clinical trials and equipment reviews. Members can also use BioMedNet's meeting room facilities, which include private chat areas, an internal BioMedNet email system (useful for email retrieval on-the-road), access to other full-text periodicals online, a database of published clinical trials, and the CritLink database of evaluated links to Web resources relevant to the community.

The dark side: bad science, authenticity, copyright abuse

Stepping back for a moment we might ask, "what will be the disadvantages of online proliferation of scientific articles?" How can it be argued that there is a dark side to the ready accessibility of scientific information - a world library of biomedical journals on every researcher's desk? Well, first, it has been suggested that the cheap democracy of Web publishing will make it possible for anybody to publish their data, peer-reviewing be damned. Bad science will abound. Second, there are security concerns: authors and readers will worry about the authenticity of the electronic article being accessed, and publishers will worry about copyright violation. Finally, everybody remains jittery about pricing policies - will the "new order" reap benefits to scientists or to publishers? (See ["Scientific Publishers Increasing Electronic Information Offerings"](#) in the August 1996 issue of *The Scientist*.)

Most of the concerns are easily addressed. First, scientists swimming in a sea of bad data will simply seek islands of peer-reviewed journals, as is currently the practice. Peer reviews will not disappear, they will in fact be rendered simpler by intranet solutions of posted drafts and review templates. A bigger concern is that the public might drown in misinformation, although the proliferation and easy accessibility of good information might counterbalance that effect. One can hope for an outcome of 0% increase in the number of cults and fringe groups built on bad data.

Second, changes to files and illicit modifications of data will be tracked meticulously by top publishers, whose reputations ride on authenticity. Scare stories of hacker manipulations and theft of scientific data make good fodder for movies of the "The Net" genre - but should these emerge as realities it will bring the world to a halt, not just science. The copyright battle will similarly be solved pragmatically, as it is now in software publishing - not by fancy technological solutions, but by making it easier and more convenient for users to pay the publisher the correct price. Ask most researchers what is more important, time or money. Time will emerge the winner: scientists will pay \$4 for an article of interest rather than plot their way past payment screens or scheme to obtain a bootleg version.

A financial interlude

It is more difficult to speculate on financial winners and losers in the business of Web publishing. Publishers are now clearly the losers as they gamble millions to convert data, build Web sites, struggle with billing and revamp their marketing departments. Addressing markets as vastly different as libraries and individual scientists is complex. Scientists are the short-term winners as publishers offer free full text on their newly launched Web sites - to assess browsing habits and determine policies that will not outrage their readership but will be profitable in the long run. It is not yet clear whether the subscription model or the pay-per-view model, or a combination thereof, will emerge as the dominant financial transaction. There is a tidy economy in equating high accession rates of individual articles with financial reward. But this underlying premise of pay-per-view will clearly benefit a certain profile of readers and publishers while proving detrimental to another. In the long run, there should be an overall economy enjoyed by all, with greatly diminished paper, print and distribution costs. (See "[Wired Science](#)" by Herb Brody in MIT's Technology Review, and links therein, for a comprehensive and thoughtful analysis of Web publishing for scientists.)

The fox knows many things, the hedgehog knows one big thing

Up until now, we have discussed how conventional scientific publishing can take advantage of the Web. But finally we would like to briefly discuss how the Web has the potential to change the role of scientific publishing. Will the lateral connections and soundbite science facilitated by the Web simply be a distraction and a time-drain? Or will easy access to scientific information encourage reaching outside of compartmentalized disciplines, a phenomenon that has arguably restricted big-time

discoveries in our day? Here the metaphor of the World Wide Web represents not only physical connections between Kansas, South Africa, and Japan, but connections between branches of science. Publishers and editors will be responsible for facilitating those connections, by reaching beyond the primary data and material at hand - assessing, filtering, summarizing and hyperlinking information that resides on other - even their "competitors" - sites.

This is the mission of [HMS Beagle](#), the online magazine for biological and medical researchers published by [BioMedNet Ltd.](#)

With original articles ranging from book and software reviews, opinion pieces, debate forums, and profiles of laboratories and researchers, combined with headlines and summaries of top stories in journals, *Beagle* has been compared to *Nature's* News and Views section. However, designed specifically for the Web, it makes far more effective use of direct links to online full text and other sites of interest. Thus, a biweekly issue will include a single [book review](#), but will also contain links to Web sites related to the book's topic, and to dozens of science book reviews on its [Web Book Reviews](#) page. Similarly there are pages of links to biomedical information such as Web Opinions, Web Software Reviews, and Web Conference Sites. In this sense, it is similar to the tremendously useful [ScienceNow](#) from AAAS, an interdisciplinary publication also developed specifically for the Web, with a multitude of links to online resources.

Time will tell whether scientists wish to be drawn from their hedgehog dens to browse these generalist sites in addition to gobbling data from BioMednet-type resources. And in the higher reckoning, time will tell whether the new era of scientific publishing on the Web will give researchers a better shot at curing cancer and the common cold.
