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Bioline Publications: how its evolution has mirrored the growth of the internet

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ABSTRACT: We describe the progress of Bioline Publications from birth to the present time and draw some conclusions from our experience.

Introduction

Why we set it up; what we knew; what we didn't know

Bioline was set up in 1993 as a result of an increasingly loud rumble of dissatisfaction among scientists about the way research information was (or was not) distributed. The rumble reached a crescendo at a biotechnology/bioinformatics conference in Trieste, Italy at which Professor Joshua Lederberg (winner of the 1958 Nobel Prize in Medicine) deplored the growing gap between the cost of learned journals and the budgets of libraries to purchase them.[1] This problem was recognized as being particularly pronounced for research institutions in developing countries.[2] At the same time, the appearance of a possible means of using information technology and communications (ICT) set the research community thinking that there might, just possibly, be a low-cost solution in sight.

Some of us had been collaborating as working scientists on online databases and had some experience in the use of electronic communication. We had skills in database development, in software development and in serving on editorial boards of various biological journals during the normal course of our academic careers. We had contacts in the international scientific community and in the publishing world. As scientists, we also knew what scientists wanted. Perhaps we had enough collective knowledge to do something constructive to test the electronic publishing water.

On the negative side, we had little experience of the likely impact of the new technologies on the distribution of scientific research; we knew little about the likely response from the scientific community to a novel method of accessing research information. We also had no idea of the consequences of e-publishing on the economics

of journal publishing. Would we become millionaires or debtors? Using the direct resources of the founders, Bioline/UK and Bioline/Brazil, we decided to test the water.

As scientists, we also knew what scientists wanted

In the beginning

In the beginning, in 1993, there was email. This was the limit of our understanding about the new communications developments that were showing on the horizon. Therefore the first launch of Bioline was as an online system accessible only by email. In spite of the limitations this imposed on the transmission of scientific documents (text only in ASCII), it was nevertheless a viable technology and many scientists were already using it as a means of communication. Graphics transmission was established and the good quality was of some surprise to traditional scientists.

A number of commercial and non-commercial publishers were approached with a view to collaboration. We met a variety of responses – more positive from the commercial sector than from the scientific societies. After visits, demonstrations, and discussions, several publishers agreed to provide their journals for electronic transmission through Bioline. They agreed to reduce the cost of the online version of their journals since we all considered the exercise to be experimental. Additionally, a number of bioscience reports and newsletters were made available on the system. The system was launched discreetly, with no fanfares, and we waited to see what would happen.

Over the next three or four years more journals were provided for distribution and at the beginning of 1997 some 25 journals were online, together with a valuable collection of reports and newsletters. However, although there was a steadily increasing interest in the free material (abstracts and some free journals), subscription levels to the full text/graphics were poor and it became clear that we would not become overnight millionaires. By this time, the system could also be accessed through the gopher software and we began to add a number of other services to the Bioline system (suppliers' database, news, mail, free demonstration papers).

A listserv (bioline-l) was set up in 1994 to serve as a means of communication and discussion between Bioline, the users, and publishers. The use of the list was a surprise to us. We had hoped to see discussions on the future of e-publishing, comments on improving the system, constructive criticisms – but the listserv developed solely into an announcement board or 'alert service' whereby Bioline informs users about new material of special interest, new developments in e-publishing, and new developments in Bioline. Over the last six years the number of messages posted to bioline-l from people other than ourselves has been about four. Since hardly any subscribers have unsubscribed, we interpret this as an indication that the user community is not interested in yet another discussion group, but welcomes the low level of messages received that are focused solely on the Bioline material and system.

Enter the World Wide Web

The global availability of the World Wide Web offered new and very exciting possibilities for the exchange of scientific information, and in 1996/7 Bioline migrated to the new technology, while retaining email access in parallel. A number of the commercial publishers set up their own websites and no longer wished to distribute through Bioline. Their journals were withdrawn, although material already online remained available through Bioline.

We began to develop the system in a number of ways. All documents were now made available in HTML format. Hyperlinks were included in the text to established public domain databases such as Genbank, EMBL, EXPASY enzyme database, or the databases of the World Data Center of Microorganisms. Additionally, links were made to the image files and to references to other papers available on the Bioline system. At the same time, the delivery of papers as single documents was introduced.

A policy decision was made to use public domain software and to retain maximum flexibility in the use of the system. PDF files were not introduced because of the

Table 1 Development of Bioline

Date	Material	Provided as	Access	New options
1993	6 journals, reports and newsletter	mostly as hard copy for scanning	email only	annual subscriptions only
1994–5	15 journals, reports and newsletters	hard copy and on disk	email and gopher	annual subscriptions only; accessed by ~20,000 unique sites per annum
1995–6	25 journals, reports and newsletters	mostly on disk; some by email	email, gopher or WWW	suppliers' database; Bioline-list; news; free demonstration papers; software option; hyperlinks added to databases, references, etc.
1996–7	24 journals (commercial publications decreasing; developing country and smaller publishers' journals increasing); reports and newsletters	mostly on disk and increasingly by email and in HTML format	WWW only	single document purchase introduced; online-only journals begun; discussion fora; video clips; lists of researchers; Electronic Publishing Trust for Development established
1998–2000	as above	mostly HTML format	WWW only	accessed by ~60,000 unique sites per annum; new partnerships established

proprietary format and because of the significantly larger size and increased download times of such files. For the same reasons, image files were not embedded in the text, but were linked and so available to readers by clicking on the figure legends, as required.

As the use of the web around the world grew, access by email and gopher was discontinued, although delivery of documents by email is retained as an option if users prefer this to direct on-screen retrieval. Our aim remains to develop Bioline as a flexible, interactive information resource that is constantly looking for ways to reduce costs and provide equitable access (Table 1).

Experiences with online-only journals

One possible route towards reducing costs is to abandon printed material and exchange research information solely electronically, thus saving printing and distribution costs. To test the hypothesis, Bioline set up three such journals: *Biofilm*, *BioSafety*, and *Biopolicy*. After consultation, international editorial boards were established and papers were solicited. Peer review was conducted electronically. A modest charge was made for the journals to help meet editorial costs.

Initially, papers of high quality were submitted and interest grew. The journals were enhanced by the provision of an online discussion forum for each journal, and links to researchers and related information resources on the web. As well as the submission of photographs and line drawings, video clips were also made possible. However, after two years it was clear that subscriptions were not forthcoming and we abandoned charging for access. Immediately, 'subscriptions' began to increase and interest grew once more, particularly for the very focused journal, *Biofilm*.

we abandoned charging for access

The lessons we have learned from this are that the internet community is quite

certainly interested in the idea of online access to research information, but is currently unwilling – or unable to persuade their cost centres – to pay for access. Additionally, the discussion fora are hardly used by the biopolicy and biosafety communities, although the biofilm community has shown some interest in its use. It seems that specific groups are potentially interested in retaining the electronic journal, as a recent questionnaire seemed to indicate, but further electronic discussions are a low priority at present. The biopolicy and biosafety journals, although very 'hot' subjects, suffer from the wealth of free online information now available on the web from a large number of academic institutions and government organizations.

We are aware that other initiatives have met with similar responses. We have been told by some scientists that this is 'before its time'. However, we believe that the concept is the right one and we are currently considering relaunching these initiatives, perhaps in collaboration with other like-minded organizations or societies. The structure is in place and ready for taking forward.

Working with publishers in developing countries

In late 1996 a UNESCO/ICSU conference on science publishing and the electronic age was held in Paris.[3] Bioline was invited to make a presentation on the value of the new technology to publishers in developing countries.[4] It had been clear to us that the greatly increased visibility of research papers distributed through the web was of enormous benefit to such publishers, since their high print and distribution costs[5,6] kept print runs of journals in developing countries small and meant that the research was little known. Scientists were reluctant to publish in local journals and at the same time had difficulties publishing in mainstream, already oversubscribed journals. Scientists felt isolated and much of their research was 'invisible'.[7,8] This had a negative impact on national research progress with the additional consequence that the international science knowledge base was incomplete – a particularly serious situation in such areas as emerging new diseases, epidemiology, tropical medicine, taxonomy, biosafety, or biodiversity, where a global picture is essential.[9]

increased visibility will have a positive effect on the future of the journals

At the Paris conference (http://associnst.ox.ac.uk/~icsuinfo/confproc.htm), Bioline met a number of publishers from the developing world, who showed much enthusiasm for the potential benefits of electronic publishing and a willingness to collaborate. Accordingly, in 1997, Bioline established a UK-registered charitable trust, the Electronic Publishing Trust for Development (EPT) to seek funding to support electronic publishing initiatives (http://dspace.dial.pipex.com/bioline/).[10]

Bioline/UK and Bioline/Brazil additionally provided free host computer facilities, formatting, and training support. Since this time, and with the help of start-up grants from the Southern Africa Book Development Education Trust (SABDET) and the International Network for the Availability of Scientific Publications (INASP, http://www.inasp.org/), the full text and graphics of 15 bioscience journals published in Brazil, Cuba, India, Indonesia, Kenya, South Africa, Uganda, and Zimbabwe have been published electronically, and the technology of e-publishing is being transferred. Accessions to the abstracts of these journals has steadily increased as the amount of online material grows (Figure 1), and it is clear that the increased visibility will have a positive effect on the future of the journals and is playing a part in the closure of the South–North knowledge gap. Already, in Zimbabwe, discussions are taking place about establishing a national electronic publishing system.

This experience has demonstrated the feasibility of the electronic publication of journals from developing countries, but has also demonstrated that there is a great deal to be done in this area. The ability of publishers to publish online does not require web access, since material can be formatted offline for the web and put online by such organizations as Bioline. However, this is not an ideal situation and it is very encouraging that access to the web throughout the developing world is becoming increasingly

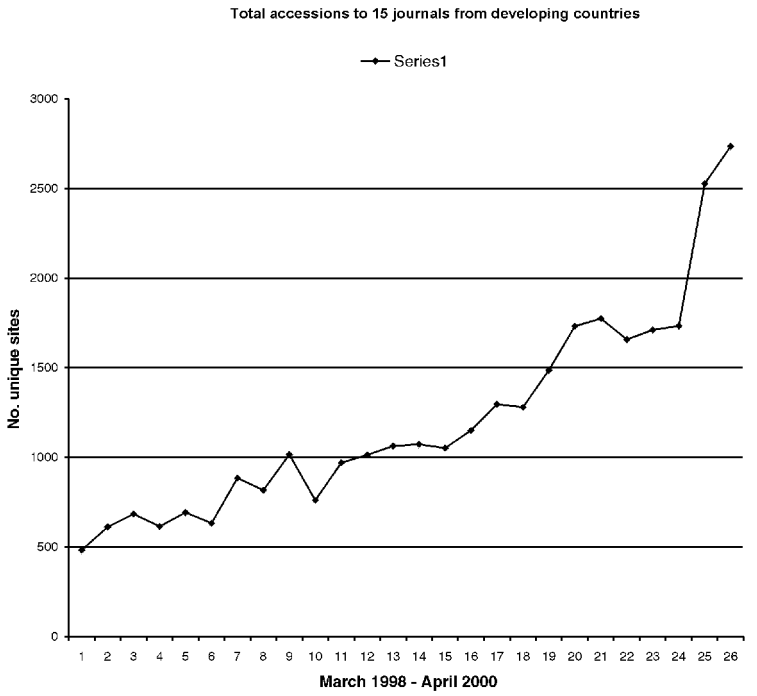

Figure 1 Chart of usage of journals from developing countries

Journal names included in the total usage figures shown in the figure: *Biotecnologia Aplicada*, Cuba; *Central African Journal of Medicine*, Zimbabwe; *African Crop Science*, Uganda; *East African Medical Journal*, Kenya; *Ichthyology Bulletin*, South Africa; *Ichthyology Special Publications*, South Africa; *Indian Journal of Biochemistry and Biophysics*, India; *Indian Journal of Experimental Biology*, India; *Indian Journal of Marine Sciences*, India; *African Journal of Neurological Sciences*, Kenya; *Memorias do Instituto Oswaldo Cruz*, Brazil; *Tropical Biodiversity*, Indonesia; *Insect Science and its Application*, Kenya; *Zimbabwe Science News*, Zimbabwe; *Transactions of the Zimbabwe Scientific Association*, Zimbabwe.

possible.[11] Organizations such as the World Bank and many funding organizations clearly recognize the fundamental importance of communication and information technology for development (http://worldbank.org). It remains true that only a few organizations within a country may currently have access, but the picture is changing rapidly. Discussions are under way for the establishment of information waystations to pass information from the reception point to the end-users (http://www.iwsp.org).

The internet's growth is impacting on commerce, education, technology, and society throughout the world.[12,13] Results from the latest survey of internet growth have identified more than 72 million hosts (http://www.isc.org/). As the internet grows, there are increasing strains related to the participation of developing countries, and some fear that the slow pace in making access possible may lead to a 'digital divide'. The expected arrival of millions of wireless devices and expansion to the very populous regions of the world will bring new challenges, but also immense opportunities. The World Wide Web must not lead to the World Wide Wait.

The EPT will continue to provide support and encouragement and will endeavour to expand these first initiatives. Bioline will continue to provide distribution and technological support.

there are increasing strains related to the participation of developing countries

The pace of change continues

As the web is rapidly adopted as a resource for accessing the global repository of knowledge and a medium for scientific exchange, it also becomes clear that better technology

for document management and content retrieval are necessary. The hypertext mark-up language (HTML) for web formatting is hugely popular because it is simple to learn and implement. HTML was, and still is, excellent for marking up and linking documents. It reflects structure (i.e. Heading 1, Heading 2, etc.) and presentation (i.e. bold, italicized), but there are many inherent limitations. The main difficulty is that HTML is essentially a page description language that tells a web browser how a document should look, but it lacks structural elements that describe the content of a document. Consequently there is an immense problem when it comes to cataloguing and searching for relevant materials or contents on the web. The other problem is also related to display, so that different browsers or versions of the same browsers on different platforms often display the same file differently. These limitations seriously hamper scientific exchange.

non-English speakers will have vastly increased access to material written in their native languages

The solution to these problems, as well as to the problem of long-term archiving and accessibility, is to implement the new XML (eXtensible Markup Language) standard recently approved by the W3 Consortium (see http://www.w3.org/MarkUp/Activity.html). Like HTML, XML is an open standard and information marked up is stored as plain text, not computer code. XML is well suited to the scientific requirement to exchange data that are structured and unambiguous because it is concerned with the type of contents contained in documents (i.e. authors, publication, date, research institution, methods, data, etc.), and it allows authors to express the hierarchical relationship of data values, similar to that represented by database records and object hierarchies, thus turning documents into a form of database record, as well as increasing the venues for access, possibly beyond the confine of the web.

The implementation of XML means that contents within documents can be processed and reused in different ways and be displayed by different hardware and software that recognize XML. Because documents formatted using XML can be repackaged in different contexts and formats, they will have less risk of information loss and require less human intervention when it comes to storage and archiving. This will have long-term implications for knowledge management, as well as increasing the venues for access, possibly beyond the confines of the web.

Another important feature of XML is its reliance on a new standard called Unicode, a character-encoding system that supports multilingual documents with ease and speed. This will allow the exchange of information not only between different computer platforms and devices, but also across linguistic boundaries. The implications for global exchange and sharing of knowledge should be enormous, and non-English speakers will have vastly increased access to material written in their native languages.

XML and the next generation of the web are going to make scientific publishing quite different from today. The Bioline team recognizes that Bioline Publications will need to reflect on the next generation of documents that are going online and plans are under way to begin tagging all incoming documents with XML. This will ensure that publications in the Bioline system are ready to migrate to the new web and take advantage of new software and data exchange processes, thereby enhancing the values of the documents and their contents in the system.

In addition, the Bioline team will continue to explore new multimedia developments and see how they offer potential for adding value to research publications as well as allowing presentation of results in new ways. It is no longer necessary to present research in the linear form appropriate for printing, but modules may be linked to enable readers to migrate around the different elements of research result, methodology, and citations.[14–16]

An increasingly distributed system

In the highly complex world we inhabit, it is becoming increasingly recognized by industry and academia alike that solutions to complexity will lie in distributed mechanisms. In the future, centralized mechanisms are bound to lead to inefficient solutions. Bioline believes that using the different skills

and experience of like-minded partners can best achieve progress in the distribution of scientific knowledge. In publishing, this involves authors, publishers, editors and their boards, referees, document managers, software developers, website managers, distributor managers, and libraries, each contributing different skills to the process.

For seven years, Bioline has operated as a long-distance teleworking operation between Brazil and the UK, with Brazil providing host computer and software skills and the UK providing the management and document handling skills. As from 1 May 2000, a further group of partners will be added. These are the Centre for Instructional Technology Development (CITD) at the University of Toronto at Scarborough and the University of Toronto libraries. The CITD will contribute advanced document management and multimedia enhancement where appropriate, and the libraries will provide web formatting, system management, and marketing. These partners, together with many publishers from different countries around the world, are moving into the next century as a distributed consortium of individuals and organizations all concerned with the more efficient and more equitable distribution of scientific knowledge. The system has been renamed Bioline International to reflect the international management team and the global content. Core funding continues to be provided by the partners as grants are sought for development aspects and new pricing mechanisms are considered for the future.

Conclusions

Someone has said that 'Bioline is part of the process' and charting the evolution of this service it would seem to be true. There are still many uncertainties in scientific publishing, especially regarding the economics, but it seems inevitable now that the traditional print-on-paper ways of the past will be supplanted by electronic mechanisms. The new public-archiving initiatives, such as that of the NIH in the USA (PubMedCentral, http://www.ncbi.nlm.nih.gov/PubMed) and EMBO in Europe (E-biosci, http://www.embo.org/El_Pub.html) are greatly welcomed and will surely have a major impact on science publishing – perhaps making research publications part of the public domain, as are the sequence databases (GENBANK and EMBL). Bioline will watch these and other developments with much interest and will adopt the recent Santa Fe Open Archive Initiatives (http://www.openarchives.org) by tagging the documents in the Bioline system with the Metadata Set. Bioline will continue to contribute in whatever way is appropriate, ensuring that developing country scientists, societies, and publishers are informed and made a part of the evolutionary process.

Bioline was unsure what it started and is still unsure what it will finish. It is evolving strongly and will inevitably continue to be 'part of the process', working in collaboration with others to achieve global access to the world's scientific inheritance.

solutions to complexity will lie in distributed mechanisms

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References

1. Branin, J. and Case, M. Reforming scholarly publishing in the sciences: a librarian perspective. *Notices of the American Mathematical Society* 1998:45(4), 475–86.
2. Ginsparg, Paul. Winners and losers in the global village. 1996. (http://xxx.lanl.gov/blurb/pg96unesco.html).
3. Shaw, D. and Moore , H. (eds), *Electronic Publishing in Science*. UNESCO Expert Conference. Paris: ICSU Press, February 1996.
4. Canhos, V. P., Canhos, D. A. L., Souza, S. and Kirsop, B. Electronic publishing in developing countries: trends, potential and problems. In Shaw, D. and Moore , H. (eds), *Electronic Publishing in Science*. UNESCO Expert Conference. Paris: ICSU Press, February 1996, pp. 48–52.
5. Butler, D. The Net can help close the gap. *Nature* 1999:397(10). (http://helix.nature.com/wcs/b05.html)
6. Electronic Publishing Trust for Development. Closing the South–North knowledge gap. *Nature* 1999:397, 201.
7. Gibbs, W. Lost science in the Third World. *Scientific American* 1995:Aug., 92–9.
8. Hassan, M. North–South disparities in the production and use of knowledge. *Nature, World Conference on Science* 1999 (http://helix.nature.com/ wcs/c00.html).

9. Acosta-Cazares, *et. al*. Scientific colonialism and safari research. NetPrints Archive 2000. (http://clinmed.netprints.org/cgi/content/full/2000010008v1).
10. Kirsop, B. and Canhos, V. The Electronic Publishing Trust for Development: putting developing country journals online. *Scientific Communication and Publishing in the Information Age. Proceedings of the INASP/British Council Workshop*, Oxford, 1999.
11. Adam, L. Connectivity and access for scientific communication and publishing in Africa. In *Scientific Communication and Publishing in the Information Age. Proceedings of the INASP/British Council Workshop*, Oxford, 1999.
12. Petrazinni, B. and Kibati, M. The Internet in developing countries. *Communications of the Association for Computing Machinery* 1999:42(6), 60–6.
13. Kibati, M. and Krairit, D. The wireless local loop in developing regions. *Communications of the Association for Computing Machinery* 1999:42(6), 60–6.
14. Holoviak, J. and Seitter, K. Earth interactions: transcending the limitations of the printed page. *Journal of Electronic Publishing* 1997:3(1) (http://www.press.umich.edu/jep/03–01/EI.htm)
15. Kircz, J. G. Modularity: the next form of scientific presentation? 1997 (http.science.uva.nl/projects/commphys/papers/jkmodulm.htm).
16. Rosenzweig, R. The riches of hypertext for scholarly journals. *Chronicle of Higher Education* 2000: Mar. 17.

Websites

Bioline Publications (now Bioline International): http://bioline.bdt.org.br/
Base de Dados Tropical (BDT): http://bioline.bdt.org.br/
Centre for Instructional Technology Development (CITD): http://citd.scar.utoronto.ca/
Electronic Publishing Trust for Development (EPT): http://dspace.dial.pipex.com/bioline/
International Network for the Availability of Scientific Publications (INASP): http://www.oneworld.online/inasp/
Internet Software Consortium (providing web statistics since 1987): http://www.isc.org/
Santa Fe Convention for Open Archiving: http://www.openarchives.org

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