A Successful Electronic Scholarly Journal  
From a Small Society

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1. Introduction

The ability to self-publish is now with us. Tools and capabilities are changing at a record pace. Publishers must move into the electronic arena. But, as we move to electronic distribution, we must pause to consider what our purpose is and what the present system is providing. Only then can we make responsible decisions about how best to use the new technological tools to further our quest for knowledge. Our experience with a successful electronic journal has demonstrated two critical items: 1) the importance of being able to link to and operate with material in other electronic databases, and 2) the need to plan for change and to actively incorporate new features in the journal as the electronic environment evolves.

2. The function of a scientific society

As a scientific society, we have a special set of responsibilities. The American Astronomical Society (AAS) was founded nearly a century ago to foster communication of research results to our fellow scientists and to other interested parties. This must continue to be our goal. But we have a responsibility to promote high standards of quality, to maintain the corpus of scientific knowledge and to encourage dissemination of that knowledge to a broad audience.

The AAS publishes three peer-reviewed scholarly journals which have a worldwide reputation for high quality and excellence. A substantial fraction of the cost of publishing the journals is borne by the “page charges” levied upon the author. Since the AAS does not use journal revenue for supporting other programs of the society, the AAS journal subscription costs to libraries are among the lowest of any journal in the physical sciences [Barschall and Arrington, 1988]. This is fitting with the Society’s mandate “...to further the advancement of astronomy, astrophysics, and related branches of physics” [Constitution..., 1910] adopted in 1899 and only slightly expanded since then. The scientific society must be responsive to the needs of the members, their responsibility to the field of science and, finally, to the institutions where the practitioners of the science work.

3. Functions of a scholarly journal

In the present environment the scholarly journal has several important functions [Taylor, 1994]. They are:

- Status – Keep community abreast of where expertise resides, institutional activity, etc.
- News – Disseminate latest results
- Information – Provide repository for body of knowledge about particular field.
- Author evaluation – Provide means for judging competence and effectiveness of authors.
- Historical – Maintain record of progress of science through the years.

4. Components of scholarly publishing

Five components of publishing have evolved through the years to ensure effective and accurate communication on paper. The need for these components does not disappear in the electronic era. On the contrary, the need for valid content, clarity of expression and effectiveness of presentation increases as more of the journal is read on the screen. In addition, the new electronic era requires a sixth step, preparation of the electronic manuscript database which composes the central core of
an electronic journal. The components of the publishing process are:

- Author preparation – first step in publishing process
- Peer review – ensure scientific quality.
- Copy editing and typography – for clarity and effectiveness of presentation.
- Database preparation – core of electronic system – to ensure access and interoperability.
- Production and distribution – to make literature available for use.
- Archiving – ensure continuing availability and authenticity; and maintain the historical record.

These functions are part of any publishing process. They may be given more or less prominence in a given circumstance, and, in the extreme case of self-publishing, the author assumes all the functions.

5. The AAS philosophy

As the AAS began to plan in 1992 what to do about moving into electronic publishing [URL: http://www.aas.org/Epubs/webinfo/Plan/epplan92.html], we opted to maintain the quality of our publications. It was our intention to fulfill, during this age of change, the responsibility of continuing to provide all journal functions listed above which we believe to be important to the health of the field. Nevertheless, we recognized early in the process that the new technology would bring great changes in the way information was delivered.

As we began the development it was not clear how rapidly the networking infrastructure would change and what the scholarly journal would look like in five years. Therefore, the AAS plan emphasized experimentation, flexibility and incorporation of feedback from users [Boyce and Dalterio, 1996]. Only by trying various approaches did we feel comfortable that we could develop electronic journals which would be most effective for the community. Because we could not find a commercial company who had the capability and the interest in trying innovative methods, we opted to develop our electronic journal in-house. Doing so allowed us to retain the degree of flexibility and control which has proven necessary for the development of an effective electronic journal.

The AAS also chose to move in an evolutionary fashion, building upon our well known paper journals rather than starting an entirely new electronic publication. In so doing, we have somewhat limited the approaches we could take, but we have retained the reputation and acceptance which our journals enjoy in the astronomical community. For a paper journal, the Astrophysical Journal has been one of the more adventurous journals, incorporating videotapes as early as 1992, and being one of the contributors of publishing data tables in machine readable form on a CD-ROM. Adding an electronic edition seemed a natural extension of what the readers had come to expect.

Another aspect of the AAS’ evolutionary approach was the successful experiment in 1992 of accepting abstracts of meeting talks in electronic form and making them available over the Internet. We now average 1,000 electronic meeting abstract submissions and 2 paper submissions for our meetings. Not only has this given us experience with handling electronic materials, but it has helped to educate the community about the advantages of electronic submission and dissemination of scientific results.

One lesson we learned early on is the necessity for considering the entire process from start to finish. As the electronic journal article makes its way from author to editor to copy editor to typesetter (using the traditional names) to electronic distributor to user, we found that every step depends critically upon every other step. Only by understanding the interdependence of the various processes along the way could we develop a smooth and efficient production process for an electronic journal.

To develop a prototype electronic journal, the AAS built cooperative development teams which included scientists (authors and readers), the publisher (the University of Chicago Press), computer and networking experts and users (the library community). We have proven that you do not have to be a large organization to be an effective electronic publisher. The core of the AAS development has been accomplished by a team of six people.” With the help of a grant from the National Science Foundation, the AAS developed an electronic version of the Letters section of the Astrophysical Journal (EApJL).


The EApJL was publicly launched in September, 1995, and includes the issues since 1 July, 1995. The journal incorporates a number of features which were first introduced for this journal, a number of which are still unique. All the features were tested by users, and several were developed in response to requests made by early users of sample issues.

The EApJL uses graphical images to represent the complex mathematics needed in science. The prime ob-
jective was to create a journal which did not require the reader to use software specific to our journal or to the publisher. To this end, we have adopted open standards for the storage and presentation functions of our journal. By adopting recognized international standards we have also assured ourselves of the ability to migrate to new standards as the field of electronic dissemination matures.

The core of the journal is the archival database of electronic manuscripts, stored in the Standard Generalized Markup Language (SGML). The manuscripts contain logical tags which identify every section, special character, mathematical symbol, hypertext link, etc. The database contains all the information needed to produce an exact copy of the paper in whatever form is required. Moreover, the tags conform to a recognized open standard (ISO 12083) which has been adopted by the publishing community. From this database we derive two versions of the electronic article; one in the HyperText Markup Language (HTML) for presentation on the screen and the second in PDF format from which the freely available Acrobat reader from Adobe can print a version which exactly reproduces the typeset paper journal. These are the products which the user sees. As described later, these are also the products which will have to be rederived periodically from the archival SGML database as new tools and functions are incorporated into the journal.

The most important features of the EApJL are:

- Contains every part of every article.
- Renders articles on screen using HTML; formatted for easy browsing.
- Includes novel and effective navigation tools, e.g. jump from figure into relevant text.
- Provides local printout of individual articles using Adobe Acrobat.
- Includes links to abstracts of most referenced papers through the Astrophysics Data System.
- Provides links to bitmaps of selected referenced articles through the ADS.
- Incorporates “forward referencing,” i.e. links to subsequent articles which refer back.
- Includes advanced search engine with Z39.50 gateway for outside queries.
- Built-in name resolver provides reference by name, not file location.
- Streamlined production schedule – appears one month before paper version.

The EApJL has been very popular. Since the electronic journal was announced we have served an average of about 40,000 files per week – excluding the images of the math and special characters. User comments emphasize the importance of including the links to the referenced literature.

7. AAS plans

The AAS plans to have the full Astrophysical Journal (25,000 pages per year) on line for public access by October, 1996, and restricted to subscribers starting in January, 1997. Our third journal, The Astronomical Journal, is scheduled for on-line availability one year later. In the meantime, we will continue to update and improve and add additional capabilities to our electronic journals.

8. Lessons learned

The most important result of the first six months of use is the realization that the links to the on-line database of abstracts and bitmaps comprise a critical segment of our electronic journal. In the electronic era, a journal can not stand by itself. Although our journal is only linked to one outside database at this time (Figure 1), it is clear that, as more resources become available on the Internet, the EApJL will have to link to them as well (Figure 2). Each journal will have to be able to link to other journals, sources of primary data, tabular material, catalogs of observations, stores of images and other reference material. Incorporating references to such outside material implies being able to
automatically query the material and calculate the correct addresses for references and links for inclusion in the articles. All this has to be done without expensive human intervention during the editing process. Consequently, it is imperative that standards for referring to material by name and not by location be established immediately. Likewise, standard query interfaces, such as the Z39.50 standard, must be built into every collection of scientifically interesting material being made available over the World Wide Web.

Gone are the days when every journal is an independent entity. Gone are the days of specialized formats and proprietary software. The ability to function with other databases is already an important characteristic, and will become even more so. Publishers whose products are not incorporated into the fabric of the Web will find themselves losing ground rapidly. The challenge is to establish the standards, the protocols and the access methods which will facilitate the necessary interoperability.

In addition to the growing need for interoperability we have shown that a successful journal has to provide what the users need and also must be easy to use. By now it should be clear to everyone that the environment for supporting electronic publishing is changing at breakneck speed and that we are into a period of very rapid evolution. During the next few years publishers will have to continually change and update their electronic offerings, incorporating features which readers will come to expect. Publishers must face the need to periodically reconstitute their electronic offerings to reflect the new tools and capabilities which will emerge. This will be difficult to accomplish unless publishers plan carefully, use open standards such as SGML, for the storage of data and plan for future, expanded use of their databases by archiving all the needed logical markup at the beginning. On the other hand, without sufficient planning and the inclusion of adequate logical markup, an electronic literature database is certain to become useless over time.

It is a difficult job to continue to innovate and evolve while still maintaining the daily production routine needed to produce the hundreds of pages each day which make up a major scientific journal. Nevertheless, with sufficient care to details and adequate planning, there is no reason that a well designed literature database will go out of date. Already in the first six months we have reconstituted the entire Astrophysical Journal HTML and PDF versions twice to incorporate new features, and we expect to continue doing this periodically.

As to costs, the six months of operation has convinced us that, at least during the transition to electronic delivery, a high quality electronic scientific journal is no cheaper to produce than the corresponding paper journal. First, any human intervention in an electronic manuscript is enormously costly. Adding and checking links is an additional cost which, so far, has exceeded the savings in typsetting and printing. As we evolve toward journals which appear only in electronic form, we may be able to streamline the production process even farther, with concomitant cost savings.

We also have the option of reducing the high standards of copy editing and typography which contribute to the clarity of the material in the AAS journals. This should also save some money. In theory, the closer we approach a “self-publishing” mechanism, the cheaper the production of the journal can be. In practice, it may not be possible to make significant savings without jumping to leaving all the publishing tasks outlined above in the hands of the author. At that point, we are left with nothing more than a high class equivalent of a Usenet Newsgroup, such as sci.astro, in which the there is very little “signal” and a lot of extraneous “noise.” The AAS has opted not to forsake our traditional quality controls yet.

All these issues are critical ones. The scientific scholarly literature is central to the continuing advancement of our disciplines. We, at the AAS, do not feel comfortable abandoning the system of scholarly literature which has grown up over a century. It has worked well
as the scientific community has grown from a few scientists who knew and communicated with each other to a broadly distributed cadre of scientists working at many institutions of varying sizes and reputations. The growth of the scientific literature has done much to support this proliferation of science, bringing the nearly up-to-date results to a broad and diverse audience. Now the ubiquitous WWW will make it possible for geographically remote scientists to be full players with access to most of the resources which formerly were only found in large, prestigious institutions. We are facing a world of opportunity such as we have never before seen. It is our opinion that the role of the well edited, peer reviewed and reasonably priced journal is now more important than ever. But, as the expanded capabilities for communication are adopted by the scientific community, we must face the future with an open mind and a broad point of view and support those options which will best serve all of science.

We believe that scientific societies have a special responsibility for the health of the scientific literature during this period of change. We have shown that it is possible for even a small society to carry some of the load. We encourage other societies and responsible publishers to participate in this exciting and changing electronic era, and to do so from the perspective of the broad health of science, not from the standpoint of an individual publication or an individual institution, or even an individual scientific discipline.

References


