

## ***New Wine in Old Bottles: The experience of free on-line publishing of the Surface Science Forum and of the Surface Web.***

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**Abstract:** The present paper describes the experience of the author with two on-line sites dedicated to the diffusion of scientific knowledge: The Surface Science Forum and the Surface Web. The Surface Science Forum was created by the author himself and is on line since late 1996, the Surface Web was created in 1998 and is the result of a cooperative effort of several university and small medium enterprise and has been sponsored by the European Commission under the program ESPRIT. Neither of these projects has succeeded so far in attracting a large number of scientific publications. "Putting new wine in old bottles", that is transforming the traditional scientific publication process into a new approach that takes into account the characteristics of the internet, remains to date an unfulfilled promise. On the contrary, there is some evidence that the internet is causing an actual decrease in the availability of scientific data for researchers (a "digital boomerang"). However the situation appears to be rapidly evolving with the perspective of basic changes in the way scientific knowledge is diffused.

### 1. Introduction

The internet has been hailed several times as carrying the potential of revolutionizing the way scientific and technical information is diffused<sup>1</sup>. In several ways this prediction is already realized: for instance, patent information covering all fields worldwide is available on the internet for free or at negligible costs and in forms that are easily and efficiently searchable<sup>2</sup>. However, with exceptions<sup>3</sup> in some fields of physics and mathematics, the situation is remarkably different in the case of academic scientific research, i.e. basic research or applied research not directly aimed to industrial production or commercialization. Although recently most of the traditional scholarly scientific journals have been made available on-line, in practice the access is restricted by the high subscription costs. The cost of subscribing to a full range of journals in a specific field is affordable only by large research institutions located in rich countries, and even in that cases many libraries are forced to cut on the number of subscriptions. This situation is may be leading to a true "digital boomerang"<sup>4</sup> where the new methods of on-line archiviatiion lead to lower accessibility of scientific data. This situation may be especially damaging for interdisciplinary research which, as well known, is based on the easy exchange of data and ideas among different disciplines.

There have been several attempts to shortcut the gridlock on the availability of scientific data and to bypass the high costs imposed by publishers, for instance with the authors self-publishing their results on their own web sites, or organizing free on-line journals, concepts which may be defined with the general term "self archiving"<sup>5</sup>, intended as publishing by scientists, for scientists, at minimal or no cost. In most

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<sup>1</sup> <http://www.arl.org/scomm/subversive/sub01.html>  
<http://xxx.lanl.gov/blurp/pg96unesco.html>,  
<http://www.amsci.org/amsci/articles/98articles/Walker.html>  
<http://www.princeton.edu/~harnad/nature.html>

<sup>2</sup> <http://www.european-patent-office.org/espacenet/info/index.htm>  
<http://www.uspto.gov/patft/index.html>  
<http://patent.womplex.ibm.com/>

<sup>3</sup> <http://xxx.lanl.gov>

<sup>4</sup> P. Davis, paper presented at the IIASA Workshop on "Building the Virtual House of Salomon": Digital Collaboration Technologies, the Organisation of Scientific Work and Economics of Knowledge Access. Dec 2-5 1999.

<sup>5</sup> <http://www.arl.org/scomm/subversive/sub01.html>

cases, these attempts have not been successful. Putting "new wine in old bottles" (or perhaps "old wine in new bottles"), that is transferring the slow and expensive process of scholarly paper publishing to the much more dynamic and cheaper internet environment is clearly a difficult task. There is evidence, however, that the situation is on the verge of an evolutive change which may lead to profound changes in the way information is shared in academia and also in many senses also in affecting the way scientific research is performed and approached. The turning point seems to have been the "Varmus proposal"<sup>6</sup> in May 1999 which aims at the creation of a free archive of all publications dealing with life sciences sponsored by the National Institute of Health (NIH) in the US. The proposal has sparked a lively debate, including some sharp criticism from publishers of traditional journals (e.g. ref. <sup>7</sup>). There is no doubt, however, that after Varmus the status of "free on-line journals" or "self archiving" has been raised to something to be taken seriously, rather than an affair of nuts and crackpots as they were held before.

The present paper is based on the experience of the author with two sites dedicated to the diffusion of scientific information. Although limited to a specialized research field, that of Surface Science, the author believes that many problems encountered are general of the diffusion of scientific information in most fields of science, and therefore the experience with these sites can provide a view on possible future trends.

## 2. Scientific publishing

The procedures of article publishing in scholarly journals are well known among scientists, however it may be worth to briefly sketch here the main features of the process. In most cases authors submit by their own initiative their articles to the scientific journal of their choice ("contributed" papers). More rarely, the journal editorial board may commission a paper to an author ("invited" paper). Invited papers may be paid a "honorarium", a symbolic sum, but for contributed papers authors are not paid, on the contrary some journals assess a "page charge". It may be surprising for the layman to discover that scientists give away for free their work to commercial publishers, who then use it to make a profit, but the situation of scholarly publishing is radically different from that of mainstream or "trade" publishing. Scientists publish papers not to make money but to advance in their career. The prestige of a scientist is directly related to the number of papers that he or she has published, corrected for such factors as the number of citations received, prestige of the journals in which the papers appeared, and others. For this reason, authors normally try to publish their work in the journals of highest prestige (often measured by the average number of citations that papers published in that journal receive) but also less highly rated journals receive submissions because of the limited space and the more severe selection in the best journals. For all journals, the review of the submissions is performed by one or more independent referees who are themselves active researchers in the field ("peer review") and whose identity is normally kept secret. The authors are allowed to answer to the referee(s)'s criticism, and the results of the debate may be the publication of a modified version of the originally submitted draft.

These elements of the process of diffusion of scientific results may appear to be universally accepted, but they are actually undergoing what appears to be a critical revision carried out in some segments of the scientific community. Two elements appear to be especially criticized:

- 1) The "peer review" process of quality assessment, perceived as too slow, biased, and averse to innovation
- 2) The cost of the journals, perceived a heavy burden to the research activity and involving unfair profits for the commercial publishers.

It would be out of place here to go into details about the debate that is taking place on these two points. Just as some quick notes, for the first point it is well known how major innovations in science were initially refused publication: At least eight articles that would eventually earn the Nobel Prize for their authors were initially rejected outright by reviewers<sup>8</sup>. Regarding the second point, the profit made by the commercial publishers of scholarly scientific journals was seen until recently by scientists as a fair return for the costs involved with specialized activities (typesetting, editing, printing, etc.) which could not be

<sup>6</sup> <http://www.nih.gov/welcome/director/pubmedcentral/ebiomedarch.htm>

<sup>7</sup> Kinne, Marine Ecology Progress Series, August 4, 1999, Editorial. Available on the internet at <http://www.nih.gov/welcome/director/ebiomed/com0808.htm#kinne270>

<sup>8</sup> J.M. Campanario, Science Communication, 16:304-25, 1995

performed efficiently in an academic institution. However, in the last few years the rising costs of these journals has put under serious strain the budget of academic libraries and started to cause a reaction of distress, or even of resentment among scientists. The situation has been examined, among others, by M. Case<sup>9</sup> and by P. Gisparg<sup>10</sup>. According to these and to other authors the high costs of scholarly journals are hard to justify for several reasons. First of all, the material to be published is not a cost since the authors work for free, the referees work for free and so do, normally, the members of the scientific editorial boards. Furthermore, publishing costs have been enormously reduced first by the use of computer processing for editing, typesetting etc., and - recently - by on-line distribution which has eliminated the costs of printing and diffusion. As a further factor affecting costs, journals tend to coexist rather than compete. In many fields there exist several journals covering the same scientific field and the institutions purchasing them have little or no bargaining power over the publishers: it is not possible to choose a journal in place of another one in the same way one would choose a brand of soap.

As discussed earlier on, "self archiving" on the internet has the potential to solve both the problems described here, that of innovation-averse refereeing and that of excessive costs. However, the practical problems to implement this idea are not easy to solve, as it will be discussed in the next section.

### 3. Two examples of on-line free scientific journals

The author will now report about his own experience with on-line self-archiving. This experience is most likely similar to the experience of many other free on-line journals which have sprung up over the past few years, and which have often disappeared very rapidly.

#### 3.1 The "Surface Science Forum"<sup>11</sup>

The Surface Science Forum (SSF) was set up on line in late 1996 by the author. To the author's knowledge this was the first attempt of this kind on the area of Surface Science, a subfield of physics and chemistry which deals mainly with the properties of solid surfaces. The aim was to set up a site dedicated to the free exchange of information in all forms in the community of surface scientists. The reasoning behind this concept was that the work of scientists is paid by institutions and research grants and that this payment already implicitly includes the time spent in making results available to the public and to fellow scientists. It was therefore possible to use this time to set up a truly "zero cost" service, maintained by the author and by graduate students in their spare time.

The work started in early 1996 with the only guide of the beginner's enthusiasm. The Department of Chemistry of the University of Firenze made available space on a server for free and all the pages of the site were written using a simple text editor. The site was more or less ready and complete by early 1997, including a mailing list, conference announcements, jobs posting, address lists, links to companies and universities and other services. The main point of the SSF site was thought to be, however, what was termed the "virtual poster session". It was envisioned as a "self archiving" system very similar to that proposed also by Harnad<sup>12</sup> and to the concept of the Los Alamos Archives. Publication and access was free. Initially, no peer review system was set up, but if the virtual poster session were to be a success it would have been possible to transfer "on-line" the normal editorial journal system, with an editorial board, referees, etc.

In practice, the SSF site had a moderate success as message board and as a "link gateway". It had also a good share of troubles due to failures of the servers and on the variable availability of the author and of his students to work on it, however it was never abandoned. The mailing list had a number of members oscillating in the several hundreds range (many from less developed countries) with an average of a few messages per week received and sent. At present (December 1999) the site has become somewhat obsolete and it would need a complete revision and upgrade. However, it maintains a certain vitality with a few "hits" per day. The link to the "scientific humor"<sup>13</sup> section by the author seems to be one of its most popular features. However, the "virtual poster session" never really lifted off. Most of the articles posted are from

<sup>9</sup> <http://ar1.cni.org/newsltr/196/sparc.html>

<sup>10</sup> <http://xxx.lanl.gov/blurb/pg14Oct94.html>

<sup>11</sup> <http://www.unifi.it/unifi/surfchem/ssf>

<sup>12</sup> <http://www.nih.gov/welcome/director/ebiomed/com0815.htm#harn269>

<sup>13</sup> <http://www.unifi.it/unifi/surfchem/solid/bardi/jokes.html>

the author or from members of his group and only a small number are submissions from authors of different groups.

### 3.2 The Surface Web<sup>14</sup>

The Surface Web was placed on line in 1998 as a cooperative effort of several European small and medium enterprises (SMEs). The author of the present paper was involved in this work as part of his collaboration with the R&D department of one of these enterprises. The Surface Web was dedicated to surface engineering, a scientific area closely related to Surface Science although more applied and directed mainly to industrial and commercial applications. Unlike the Surface Science Forum, the Surface Web was thought from the beginning as a commercial, profit oriented, venture and was financed by the European Commission under the ESPRIT program. As it can be understood, the site could use up-to-date facilities and the work of expert programmers. For instance, it could afford the time-consuming activity of setting up extensive databases of products and technologies.

Although commercial in its main features, the site approach from the viewpoint of the exchange of scientific information was the same as that of the Surface Science Forum. That is, the access to the data was supposed to be free for users. The idea was that when someone had some problem related to surface engineering he/she would peruse the publications stored in the site to try to find a possible solution. Then the user would use the site services to contact the companies or research institutions that could deliver that solution or propose another one.

Despite the availability of financing and the commitment and expertise of the founders, the Surface Web did not succeed in achieving its stated goals. The idea was that after one or two years of operation the site should have reached a critical size capable of attracting more commercial companies to join the initial group of founders. These companies should have provided a substantial profit in the operation of the site. In practice, this industrial commitment never materialized and as soon as the ESPRIT support ended it appeared clear that the site could not be financially profitable. The Surface Web ceased to exist as an alive site in March 1999 and has been intermittently on and off line since then. It may perhaps be reborn to a new life one day or another but at the time of this writing it is just another of the many "zombie sites" of the internet.

In terms of diffusion of scientific information, the approach of the Surface Web was very similar to that of the Surface Science Forum, with a section dedicated to contributed and invited papers freely available to users. Also in the case of the Surface Web, this section never hosted a large number of papers, and all those which have appeared on-line seem to be the work of members of the founding organizations.

## 4. Assessment

The basic wisdom that can be extracted from the experience of the Surface Science Forum is that zero-cost or nearly zero cost internet diffusion of scientific information is possible, at least in principle, i.e. that the "self archiving" concept is a concrete possibility. Perhaps "zero-cost" is an over-optimistic view, and the experience of the "Surface Web" shows that some financing may be necessary. However the resources necessary to run a scientific archive turn out to be truly minimal in comparison to the overblown costs of commercial scientific journals. So, the free on-line journals internet *could* - in principle - replace traditional journals at a much lower cost. However, the failure of the SSF site as well as of the Surface Web and of most of the sites which offer free hosting to scientific publications and free viewing to users indicates that there are other factors besides cost that must be taken into account.

The author here does not pretend to have performed a statistically significant study on these factors but can report a summary of the results of the debate about on-line publishing that took place in relation to the SSF site both via e-mail and orally at scientific conferences. The opinions expressed in this debate can be classed into two major ones: the first is that the whole idea of self archiving is crap, that the old ways have always worked, and so what is the need to change? The second is that, yes, self archiving is a great idea, but it takes so much time, and with so many things to do right now..... well, maybe one of these days. Noting that the first opinion has been maintained mainly by a minority of older scientists, basically then it seems that most scientists are not opposed in principle to the idea of publishing in free on-line archives.

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<sup>14</sup> <http://www.surfaceweb.com>

However, their interest in doing so is not sufficiently high to overcome the small barrier of cost and effort needed for on-line self-publishing or of preparing and submitting an original version of their papers to a free on-line archive.

The lesson is then clear: the fact that a free on-line archive has a larger visibility and can be accessed by a much larger audience than a commercial journal does not appear to affect the scientists' attitude, which seems to be dominated by the desire of gaining prestige within their own specialized community. So, as long as a journal or archive cannot guarantee the required *official validation* of a paper provided by the peer review process, and hence the associated prestige, scientists, and especially young scientists facing an uncertain career, will show little or no interest in publishing in that journal or archive. This factor explains the failure of the two journals considered here, as well as of most on-line journals which have started as efforts of enthusiastic, but perhaps not sufficiently prestige-holding, scientists or groups of scientists.

There remains to explain the exception of the Los Alamos Archives<sup>15</sup>. Why did these free, non-peer reviewed archives succeed where most other similar attempts have failed? Here, we may probably find an answer in some specific factors relative to the initial field covered by the archives, that of high-energy physics. This is a field where research is extremely expensive; as a consequence researchers tend to produce a limited number of papers and the number of authors per paper is of the order of a few hundreds, much larger than in most scientific fields. In this specific scientific subculture individual authors may not associate the same degree of prestige to papers as authors in other fields do. Furthermore, a paper which is signed by several hundred names must necessarily be validated by some kind of internal review before it is submitted to an external editor. It is highly unlikely that such a large collective effort could be the result of the whim of an individual crackpot or of a few of them. Hence, it was easier in the high energy community to accept that the main vehicle of diffusion of results was a non-peer reviewed process. Indeed, even before the on-line archives the main exchange of data in the field was obtained by preprint exchange. With time, the large number of papers published in the archives in high energy physics has led to a bootstrapping effect where the high degree of visibility of the site stimulated submissions from other fields of sciences. It may be worth noting that these fields are mainly areas of physics and mathematics where the degree of "computer literacy" of the authors may be higher than in other areas of science such - say - chemistry and biology, which are conspicuously missing from the Los Alamos archives. Although these considerations may not be considered as definitive, it appears that the success of the Los Alamos Archives will be difficult to replicate in different fields of science, at least for the time being.

## 5. Conclusion and Perspectives

A hot debate is presently ongoing on the future of self archiving and of free on-line publishing<sup>16</sup>. It seems clear that the positions of commercial publishers and of supporters of free information sharing are incompatible. As usual, in these spirited debates positions tend to be radicalized and the debate may degenerate to slogans or even to insults. A strong current of opinion seems to have formed among scientists which sees publishers as sharks intent at siphoning unreasonable profits out of the overheads of scientific institutions. The publishers, on their part, seem to see themselves as the defenders of true science against the blows of a band of fanatical self-styled freedom fighters. So, is one of the two parties going to "win"? As it often happens, while the contestants are deadlocked in the struggle the world goes onwards and in the background of it all there is a much larger paradigm shift: the general approach to what we call "scientific research". Is basic research still performing a valuable role in our society? The present emphasis of funding agencies on market-oriented research is rapidly creating a new generation of scientists who look more like entrepreneurs than knowledge searchers, and whose worth is measured in terms of the amount of money they manage in their research grants. In this approach the traditional attitude of scientists of freely diffusing their results may become obsolete (as perhaps it is already) and give way to a new paradigm in which scientific knowledge is something not to be shared but sold.

On the other hand, the emphasis of the publishers on protecting data may also rapidly become obsolete in a world in which the internet has caused the cost of publishing to plunge to nearly zero. Nobody can (nor should) prevent anyone from publishing their data/results/opinions on the internet, but this has led to the previously unthinkable situation that the visibility of scientific data has shifted in a way strongly

<sup>15</sup> <http://xxx.lanl.gov>

<sup>16</sup> <http://www.nih.gov/welcome/director/pubmedcentral/ebiomedarch.htm>

unfavorable to "official" science. For instance, using a search engine to look for "evolution" or "Darwin" in the Internet mostly leads to sites dedicated to Creationism and Darwin-bashing, whereas the results of evolutionary biology research are locked in expensive journals and therefore invisible to the public. Creationists have not been shy to give out their information for free on the internet. Although many of their sites are clearly low-quality ones, some are impressively well made and the wide availability of anti-evolution information may (and probably does) give quite a wrong impression to the public about the generally accepted facts in science. At the present, evidently, we are facing an extremely dynamic and evolving situation. The only thing that may (and should) remain a fixed is that whatever policy of data exchange is implemented it should be aimed at fueling and supporting scientific progress, and this in turn can only be obtained by supporting interdisciplinary research. For this, we need rapid and *free* exchange of data and information, we should take great care in avoiding that legislation aimed at "protecting" publishers and authors should stifle this progress.

On the basis of these considerations the opinion of the author of these notes is that free on-line archives can succeed and perform a useful role in science, but only if they will appear gradually in an "evolutionary" (rather than "revolutionary") approach. Initially, these archives should adhere at least in part to the rules established for traditional journals, in particular to those relative to peer review. Some form "double track" status should be set up for papers: one for refereed papers and the other for preprints, with the status of each clearly marked. It is also likely, still in the opinion of the author, that attempts to do everything at once, that is establishing very large archives, may risk excessive clamor and criticism and face the possibility of failure, as it may be happening for the Varmus proposal<sup>17</sup>. It may be more practical to start with specialized archives in the form of "free, on-line journals" in various subfields of science. Once such journals are well established, it will be possible to link them together to form one or more large archives of basic scientific research, easily and freely accessible and a worldwide source of innovation.

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<sup>17</sup> <http://www.nih.gov/welcome/director/pubmedcentral/ebiomedarch.htm>