Science online?
A contextual analysis of the debate on electronic journals in science communication.

by

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DEDICATION

This thesis is dedicated to my grandmother, Ellen Errey, whose last words to me were:

It doesn't matter what other people want for you, or what other people want you to do, you go on and do what <u>you</u> want in life.

So I have Ellen, and this is for you.

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LIST OF TABLES AND GRAPHS

INTRODUCTION

For the past few years the debate about a move from printed journals to electronic journals has been gathering momentum. As more and more literature is written on the subject, the complexity of the situation becomes apparent. In a comprehensive discussion of this kind, it is necessary to 'start at the beginning' and open with the history of journals.

What exactly is a journal? Although the modern scientific journal has a fairly rigid format, publishing procedure, and purpose, these have not always been significant features. The scientific journal began over 300 years ago, as a formalisation of an extensive letter writing network across Europe. The events surrounding this period of time: the break of science from theological control; the opening of the postal service; improvements in printing facilities; and the professionalisation of science, all contributed to create an environment that was conducive to the development of the journal. Science has changed enormously since then, and so has the scientific journal. The significance of this is that the modern scientific journal is not, when placed in historical context, a rigid object, but an evolving one. As was the case 300 years ago, significant changes in science and technology today are causing calls for a new system of communication of science. Some people hail the electronic journal as the answer.

While the electronic journal is an innovation, using technology that is only about 20 years old, the concept of a replacement or supplement to the printed journal system is nearly as old as journals themselves. Almost from the beginning, inadequacies in the system were noticed and remedies have been attempted since. The main problem is the sheer volume of academic literature. The second chapter explores the two main ways of dealing with this problem. The first is creation of bibliographic methods for controlling, ordering and searching for the information.

The second are replacements for the printed journal as the central unit in the system of science. By placing the electronic journal amongst this historical backdrop, it becomes possible to assess it in the light of other attempts to solve the problems. Is the electronic journal really something revolutionary, or is it simply another in the series of unsuccessful attempts to resolve the problem?

What is it about electronic journals that many people do not consider them to be 'real' journals? This is an extremely complicated question, opening up subsiduary questions such as: What is the function of the scientific journal?; Where does the scientific journal fit into the system of science?; What is it about scientific journals that gives them the prestige they hold? Chapter 3, is an attempt to answer these questions. It delves into the journals' involvement in the quality control system of science. This opens up discussion of the reward system of science (in which scientific journals play a starring role). To try to analyse the debate surrounding the introduction of electronic journals, it is necessary to place the arguments being used within a theoretical framework, and it is at this point that the normative and interpretative descriptions of the workings of science are introduced.

As with any fundamental alteration to an established system, there are many factors and instututions that will be affected. The fourth chapter is a discussion of the main professions affected by such a change. The question of who benefits from a change to electronic journals is fundamental to the eventual outcome. The forces, both institutional and personal, and their influence on what is happening are analysed and evaluated.

The final chapter presents the results of an empirical study conducted on scientists at the University of New South Wales. As scientists, their attitudes are an interesting insight into the system of science as it actually stands. Some surprising results eventuated from the study, and these are analysed in relation to several of the theoretical frameworks used in the main body of the thesis. This is a thesis that begins and ends with a question. It is not possible to accurately predict whether electronic journals will be introduced as a major factor in science, but I hope that this work adds positively to the lively and contemporary debate.

CHAPTER 1

AN HISTORICAL LOOK AT JOURNALS

When looking at a topic as current as electronic journals it is often possible to be swept into the excitement of the technology and the push 'ever forward'. However, in discussing the potentialities of the electronic journal, it is valuable to consider current events and debates in their historical context. This chapter explores the origins of the scientific journal, from inception in the 1660's. What we consider to be a scientific journal today is the result of an evolution of journals that has occurred over the last 300 years in response to changing social and historical events. It is necessary to define the essential properties of journals, both to identify journals through their changing forms, and to distinguish them from supplements, books and other periodicals. A discussion of this kind would not be complete without historical exploration into attempts to organise the information provided by the journals, so an introduction to abstract journals will also form part of this chapter. The development of the refereeing system, an integral part of scientific journals now, is also explored. Changing social and political situations affect the role journals play in the system of science, subsequently the problems the journal was originally created to overcome have changed. In the wake of the latest technology, the type of problems faced in the past are interesting to explore, as there are many parallels with the changes moving upon us today.

The essential elements of a scientific journal.

A scientific journal in 1995 can be defined as a periodical appearing regularly at indicated intervals containing refereed original articles written by different authors that follow a particular field. Each journal has an editor(s) who gathers in articles and coordinates the refereeing of them. The periodicy of publishing can vary, but there must be an intention for continuation. Journals have not always been so clearly defined.

Because journals have taken many forms over the past 300 years, the best place to start this discussion is with a description of the essential features of a journal. Journals have many characteristics, but the one chosen for this thesis is that used by David A. Kronick, who has written extensively on the origins of the journal. He describes the inherent quality that defines a scientific journal as format. (He also points out that this is merely one of the potential classifications that could have been used.[1]) The main qualities of format are; periodical publication, duration, collectivity, availability, and continuity. These qualities do not define the journal apart from the newspaper, but the final qualities of timeliness (not concerned with the events of the day) and universality are specific to the journal.[2]

There is no clear point at which journals began, and there exists some dispute as to the original journal. Kronick maintains that the claim to the earliest journal was made by Constantin Wolf on behalf of Photius, a Greek patriarch who wrote to his student Frere Taraise. His writings, which contained critical comments and extracts from his readings of the classics, were as this view, the original journal. However, if the definition of a journal is accepted (as it is here) as the Kronick version, it does not hold as a claim to be the original modern journal. Another claim to the origins of the scientific journal is the Journal des scavans, first published in France on 5th January 1665[3]. In addition to discussing experiments in chemistry, physics and anatomy, and inventions or machines, this journal included 'principal decisions of civil and religious courts'.[4] Because of the

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1 D. A. Kronick, A History of Scientific and Technical Periodicals, Scarecrow Press, New Jersey, 1976, p. 29. The alternatives offered were: Subject, Motivation, Content Access and Geographic.

2 Ibid., pp. 16-17.

3 B. Houghton, Scientific Periodicals, Clive Bingley, London, 1975, p. 13.

4 Ibid., p. 14.

inclusion of theological and legal matters, the Journal des scavans does not stand as the first journal devoted purely to scientific matters.

The role of the Royal Society in the beginnings of the scientific journal.

It is generally accepted that the Royal Society (founded in London in 1660) is responsible for the beginnings of the modern scientific journal. 1660 was the year of Charles II's Restoration. During the Interregnum (the period between reigns), the court had taken refuge at Oxford, and scientific meetings had also been occurring there. With the Restoration, the Society's foundation in London (chartered by Charles II in 1662 and re-chartered in 1663[5]), was 'an attempt by university men to continue a research atmosphere in a metropolitan environment'.[6] There were, however, many members who did not live in London, and thus their involvement was restricted to correspondence.

The Society also represented a shift away from patron-sponsored science, and a 'radical departure from the university system whose main function in the seventeenth century and up through the late nineteenth century remained the preservation rather than the expansion of culture.'[7] The broad aim of the Society was 'a widespread enthusiasm for institutionalisation as a more productive way of pursuing scientific enterprise'.[8] This institutionalism manifested itself in many ways, but the most important from an historical look at journals perspective was the constitutional requirement that 'encouraged the careful preservation of

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5 G. K. Roberts, 'Scientific Academies across Europe', in Colin Russel and David Goodman (ed.s), The Rise of Scientific Europe, 1500-1800, Houghton & Stoddard, Scotland, 1991, pp. 227-250, at p. 231.

6 M. Hunter, Science and Society in Restoration England, Cambridge University Press, Cambridge, 1981, p. 34.

7 D. Kaufer and K. Carley, Communication at a Distance, Lawrence Erlbaum, New Jersey, 1993, p. 351.

8 Hunter, op. cit. (note 6), p. 35.

minutes and papers read at meetings'.[9] While one of the original aims of the Society was to conduct corporate experiments, 'proceedings were increasingly taken up with reports on work done elsewhere [and] discussions of this and its significance'.[10] At this point, the form that later scientific journals would take began to emerge. This was partly (or mainly, depending on who you read) due to the work of Henry Oldenburg,[11] who held the Secretaryship of the Society from 1662 until 1677.[12] Oldenburg made an effort 'to stimulate scientists to work on specific problems by reporting the progress of others'.[13]

In the position of Secretary, Oldenburg was responsible for recording the proceedings of meetings, and sending these and entries sent to the Society, to those members who were unable to attend meetings, or lived out of London. He was in 'correspondence with at least fifty persons',[14] and it seems that this required a large amount of his time, as he questioned 'whether such a person ought to be left unassisted'.[15] As 'one of the important prerequisites for the existence of any medium of communication is an audience',[16] the social and historical events occurring at the time that allowed a wider form of communication must be taken into consideration. For example, the improvements in the printing press, which allowed up to 1500 copies of the same work to be printed at one time, meant letters were able to be duplicated without rewriting.

The other major social change was the creation of a regular postal service. 1516 is cited as the origin of the postal service in Europe[17] and this allowed an

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9 Ibid., p. 36.
10 Ibid., p. 42.
11 It should be noted that David Kronick spells his name Oldenbourg.
12 Hunter, op. cit. (note 6), p. 49.
13 Ibid., p. 50.
14 Oldenburg quoted in Kronick op. cit. (note 1), p. 60.
15 Ibid., p. 36.
16 Kronick, op. cit. (note 1), p. 34.
17 Ibid., p. 54.

increase in scholarly communication. Before the appearance of the periodical, the 'primary medium available to scholars for the communication of ideas was personal correspondence.'[18] Private letters were sent between scientists in England and the continent, and London and the provinces.[19] In the provinces, Robert Plot was active in sending out circulars and questionnaires, and 'entering into correspondence with local naturalists'.[20] Kronick notes that as important changes in technology (for example the improvement of mining) could take place and be transmitted to other parts of the world without being committed to print there is evidence of a large part of the process of communication in science that was taking place along informal channels.[21] Until the nineteenth century, the journal article 'often retained the informal characteristics of letters of correspondence.'[22]

Science itself was changing focus, 'one of the most significant changes was a result of the successful efforts to establish philosophy as a discipline separate from theology'.[23] Under the 1662 Licensing Act, the Society's officers were given permission to licence books. This broke from the previous practice of bishops approving books on science and philosophy.[24] It also was an official recognition of the perceived position of the Society in the "scientific community".[25] One method of enhancing science's social respectability was 'recruiting eminent public figures to its ranks'.[26] Oldenburg, in his position of 'intelligencer'[27] of the Philosophical Transactions, was able to define scientific

18 Ibid., p. 56.

19 Hunter, op. cit. (note 6), p. 54.

20 Ibid., pp. 54-55.

21 Kronick, op. cit. (note 1), p. 35.

22 Kaufer, op. cit. (note 7), p. 355.

23 Kronick, op. cit. (note 1), p. 33.

24 Hunter, op. cit. (note 6), p. 36.

25 Note that the expression 'scientific community' has not always held the meaning that it does today.

26 Hunter, op. cit. (note 6), p. 48.

27 J. R. Ravetz, Scientific Knowledge and its Social Problems, Penguin Books, Middlesex, 1973, p. 249. Ravetz uses this term relating to the individuals who undertook the 'task of establishing genuine communication in 'philosophy'.

aims and methods. He 'espoused a mature, Baconian concept of the proper role of science'.[28]

In 1665, Oldenburg founded Philosophical Transactions which became a public symbol of the work of the Society. It was 'his own enterprise, not to be officially taken over by the Society for a hundred years, but it had the Society's approval and reported its activities.'[29] The intended audience was wider than simply the members of the Society, and the language used for the journal was English rather than Latin. Philosophical Transactions represented the beginnings of a new formal method of communication in science. Before the emergence of journals the formal method of communication was the scientific book. This was usually the work of one person, and represented their life's work. This system however did not allow a timely release of discoveries, nor did it allow those who had done some work, but not enough to produce a book, to publish. The journal was recognised at the time as an appropriate place to record experiments that would not have been enough to fill a book, and 'would else be lost'.[30] With this system, the formal channels of scientific communication were closed from the informal, and often collaborative, channels of scientific activity.[31] The journals were an attempt to make a formal line of communication more responsive to the activities of science.[32]

The changing role of the journal in science

In the 1680's, Philosophical Societies were founded in Oxford, Dublin, and Boston. They were based on the model of the Royal Society, and they too produced journals. There began tension between the societies as 'information was

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28 Hunter, op. cit. (note 6), p. 54.

29 G. K. Roberts, op. cit., (note X), p. 235.

30 The quaint words of John Wallis quoted in Hunter, op. cit. (note 6), p. 52.

31 Kaufer, op. cit. (note 7), p. 352.

32 And isn't this exactly what we should be doing now? It is a great opportunity to look at the activities of science and the difficulties with having too much information.

often only reported to the Royal Society after first going to Oxford'.[33] This introduces the issue of claims of priority, a major function of modern journals. The journal held the prestige and quality assurance associated with scientific books, but had the advantages of the newspaper in that it was more timely, cheaper and held a wider audience.[34] The transition to specialised journals as the dominant form of publication came in the half century coinciding with the industrialisation of Europe and the changing social charter of science.[35]

The major growth of scientific periodicals occurred during the last half of the eighteenth century. According to Kronick, 52 journals originated during 1740-1749, and 416 journals originated during 1780-1790.[36] It should be noted that these numbers are totals of all the major formats of periodicals listed above. (See Table 1 below.)

Table 1
Types of scientific periodicals 1665-1790.

Titles Issued Classified by Decade
In Which They Had Their Origin

	1665-1699	1700-1709	1710-1719	1720-1729	1730-1739	1740-1749	1750-1759	1760-1769	1770-1779	1780-1790	Totals	Per cent
Substantive	20	7	9	11	16	16	40	65	92	225	501	48
Proceedings	8	2	2	9	10	24	38	38	56	77	264	25
Collections	-	-	1	-	3	3	11	9	15	39	81	8
Dissertation	-	-	1	-	3	4	6	4	11	10	40	4
Abstract	-	1	2	-	1	2	10	6	4	16	42	4
Review	2	1	-	-	1	-	5	2	9	20	40	4
Almanac	2	-	-	-	1	-	3	3	17	21	47	4
All Others[a]	3	1	3	3	-	3	6	2	8	8	37	4
Totals	35	12	18	23	36	52	119	129	212	416	1052	

[a]Includes: Collections of prize essays, satires, monographic series, question journals, and unclassified titles.

Source: David Kronick, History of Scientific and Technical Periodicals, Scarecrow Press, Metuchen, N. J., 1976, p. 78.

33 Hunter, op. cit. (note 6), p. 56.

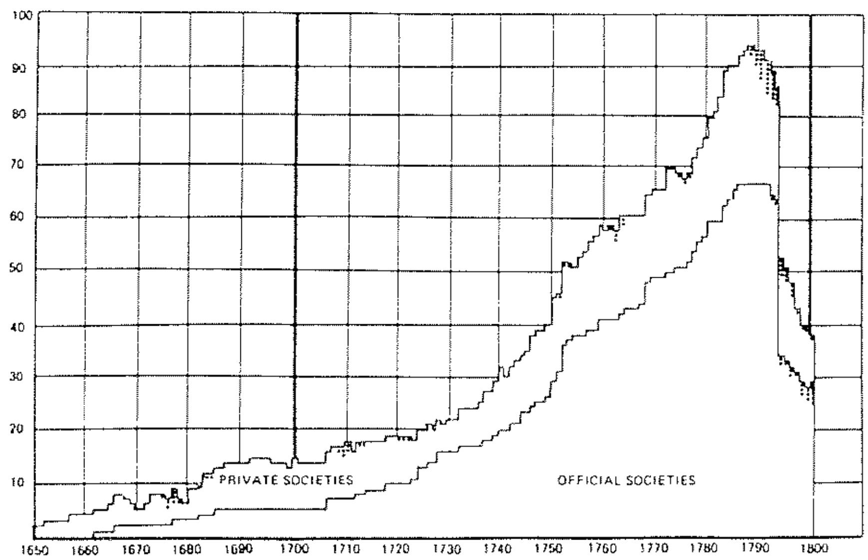
34 Kaufer, op cit. (note 7), p. 354.

35 Ravetz, op. cit. (note 27), p. 251.

36 Kronick, op. cit. (note 1), p. 78.

This represents an 800% increase over 50 years. The compartmentalisation of science and the increase in journals was mirrored by a large increase in scientific academies, 'from the mid seventeenth century to roughly 1800, some seventy official scientific academies were formed in Europe and America'[37] See Graph 1 below for the growth of academies and societies of science between 1650-1800. By the middle of the nineteenth century over one thousand scientific and technical journals were being published throughout the world.[38] The fragmentation of science and the rigid compartmentalisation of scientists into particular disciplines did not occur until well into the eighteenth century.[39] This was reflected in the changing professional status of science in the second half of the eighteenth century and first half of the nineteenth century, as a move towards laboratory based science created the necessity for 'specific equipment, expertise, a coherent theory of science and a research plan'.[40] For the sciences that had this requirement, such as physics, chemistry and physiology, there was a definite movement away from the amateur towards the professional scientist.

Graph 1
Growth of academics and societies of science, 1650-1800.



Source: David Goodman and Colin A. Russell (ed.s), The Rise of Scientific Europe 1500-1800, Hodder & Stoughton, UK, 1991, p. 244.

37 Roberts, op. cit. (note 5), p. 227.
38 Houghton, op. cit. (note 3), p. 24.
39 Ibid., p. 16.
40 A. A. Manten, 'Development of European Scientific Journal Publishing before 1850', in A. J. Meadows (ed), Development of Scientific Publishing in Europe, Elselvier, Amsterdam, 1980, pp. 1-22, at p. 13.

A major change occurred on 4th November 1869, when the first issue of Nature appeared. This was a weekly journal, that had been suggested by Norman Lockyer (a young scientist and Fellow of the Royal Society) to Macmillans. It was a general scientific journal, and the stated objects were to present to the general public the results of scientific work and discovery and 'to urge the claims of science to a more general recognition in education and daily life'.[41] The reason this was a major change was because Nature was a commercial journal, not associated with a learned society. The aims of the journal have changed slightly over the past century, 'after the second world war Nature's speed of publication became one of its distinguishing features and the quality which gave scientists the opportunity to be seen to be first in their fields to a world-wide audience',[42] and Nature now holds the position of one of the world's most prestigious scientific journals.

The concept of intellectual property has only developed in the last 300 years, and 'the conception of a single demonstrated result embodying new knowledge, and belonging as property to its author, came first in mathematics.'[43] As this concept developed, mechanisms for protection of intellectual property were required. The first devices were crude. Mathematics used a system where the mathematician issued a statement of a mathematical problem (that he[44] had solved). Later, a complicated system of anagrams was used. It operated with scientists encrypting 'the statement of an intended discovery into an anagram to disguise the original meaning'.[45] This was then sent to a trustee allowing the scientist to spend time establishing certainty. There were difficulties with this system as the anagrams were often vague, and the system supported a one-on-one

41 Houghton, op. cit. (note 3), p. 26.

42 Ibid., p. 27.

43 Ravetz, op. cit. (note 27), pp. 247-248.

44 Mathematicians were all 'he' then.

45 Kaufer et al., op. cit. (note 7), p. 353.

mode of interaction. It was also merely a system of claiming the property, not necessarily offering a guarantee to the authenticity of the result.[46] At the end of the seventeenth century 'the learned journal was still far from being the accepted means for the announcing of discoveries.'[47] It was not until the middle of the eighteenth century that certain journals came to rival the prestige of the book market, 'allowing an author to establish virtual universal priority through journal publication.'[48]

The organisation of science consists of an exchange of social recognition for information. This is described as 'gift-giving' by Warren O. Hagstrom.[49] The process is such that the desire to obtain recognition induces scientists to publish their results, as 'the acceptance by scientific journals of contributed manuscripts establishes the donor's status as a scientist.'[50] The gift is the manuscript for publication, and Ravetz refers to this as a piece of property. It has unusual qualities in that the 'property comes into existence only by being made available for use by others'.[51] The reward referred to here (the return gift) is not financial gain, but social status amongst peers.[52] One of the internal systems of acknowledgment in science is the practice of citations. The citation plays a vital role in the property issue as 'the citation thus represents a payment for use of the material; the author of the original paper derives continuing credit from this evidence of the quality of his work'.[53] Journals, therefore have come to represent a world wide community, where status and recognition can come from unknown

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46 Ravetz, op. cit. (note 27), p. 249.

47 A. R. Hall, The Scientific Revolution 1500-1800, Longmans, Great Britain, 1962, p. 203.

48 Kaufer, op cit. (note 7), p. 355.

49 W. O. Hagstrom, The Scientific Community, Basic Books, New York, 1965.

50 Ibid., p. 13.

51 Ravetz, op. cit. (note 27), p. 245.

52 As will be discussed in Chapter 3, the publications of a scientist also have a direct affect on the allocation of grants and tenure, so the reward for publication is in fact financial to a certain extent, however the point being made here is how the journal is critical to the workings of the scientific community.

53 Ravetz, op. cit. (note 27), p. 247.

scientists in another country, in the form of a citation. They have become integral to the reward structure of science.

One type of 'journal' that was in use in the seventeenth and eighteenth centuries was the prize essays, which are interesting as they are a form of publication for which it is difficult to find counterparts today. During the eighteenth century societies would pose questions requesting essays to be submitted. Some of these were in competition and awards were offered by the societies. This introduces the concept of financial reward for written work. As these essays were printed and there was the association of the granting of money, it could be claimed that the complicated reward system involving grants and tenure currently in place in modern science had its origins here.

In this period, the current requirement for originality and primary publication was far less rigid. In fact, 'editors and publishers were exceedingly casual about copying and reprinting articles from other periodicals, frequently without indicating any source or indeed that they were not being printed for the first time'.[54] While de Solla Price claims that 'scientific communication by way of the published paper is and always has been a means of settling priority conflicts by claimstaking',[55] this was neither the main original intention nor use of journals.[56] It was not until the nineteenth and more particularly the twentieth century, that 'scientists [began] to frown upon the printing in multiple places of substantially the same information.[57] In addition, 'multiple authorship, which is considered an indispensable characteristic of the modern periodical, is by no

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54 Kronick, op. cit. (note 1), p. 26.

55 D. de Solla Price, Little Science, Big Science, Columbia University Press, USA, 1965, p. 69.

56 Price implies that the journal arose as a solution to the problem: 'the scientific paper . . . arise[s] out of the claim staking brought on by so much overlapping endeavour.'

57 Manten, op. cit. (note 40), p. 9.

means a constant among what can be regarded as genuine seventeenth and eighteenth century periodicals'.[58]

The system developed in Germany, of a university based science, with journals serving specialised fields was 'dominant in the later nineteenth century all over the world of active research in science.'[59] This is an example of a large change in the system of science and the same issues, of intellectual property and guarantee of recognition, are being explored currently in relation to publishing on the Internet. This is connected to the issue of quality control, which will be discussed in depth in Chapter 3.

The development of quality control in journals.

Quality control, the process of refereeing and verifying work that is submitted to a journal, is central to the debate surrounding the introduction of electronic journals. While firmly entrenched in the scientific journals of today, it has not always been of major importance. Early papers that appeared in Philosophical Transactions did not undergo a formal refereeing process. However since the published papers had been subject to critical scrutiny during presentation at meetings, their subsequent publication gave them authority.[60]

The Royal Society was aware that 'to retain the confidence of scientists they . . . [needed to] arrange for the critical sifting of materials which in effect [carried] the imprimatur of the Society'.[61] This reflected the growing need for scientists to have their work recognised through publication in forms valued by other members of the emerging scientific society. The process 'provided an

58 Kronick, op. cit. (note 1), p. 21.

59 Ravetz, op. cit. (note 27), p. 251.

60 D. Lindsey, The Scientific Publication System in Social Science, Jossey-Bass, San Francisco, 1978, p. 9.

61 R. K. Merton, The Sociology of Science, theoretical and empirical investigation, University of Chicago Press, Chicago, 1973, p. 468.

arrangement through which members of the scientific community could affect editorial practices. . . [and the journal] gave a more institutional form for the application of standards of scientific work.'[62]

The rise of the scientific journal affected the character of scientific correspondence, which became primarily a medium of informal communication, 'it continued to be used frequently. . . to invite other research workers to repeat a given experiment and to report back their results.'[63] This acted as a form of quality control, but not an institutional one.

The journal had become the accepted means of communication by the middle of the eighteenth century. One of the roles the journal had by this stage was to act as 'a forum for the continuous critical examination of scientific hypotheses and theories'.[64] This critical examination, however was not conducted within a rigid well defined system. In 1832 Justus Liebig commenced an organic chemistry publication, <u>Annalen der chemie</u>. As editor, Liebig was 'a rigid authoritarian who felt it his duty to criticise the papers he published in his journal and he insisted that all ideas must be supported by empirical data and experimental detail'.[65] This is the sort of practice we expect as a matter of course today, but the necessity for insistence on this point in 1832, means that it was not standard practice then.

The origin of the abstract journal

The abstract journal was developed in response to an inability to keep up with the increasing literature. The body of journal publication was growing rapidly, and there 'accordingly developed a need for a more methodical and

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62 Ibid., p. 469.
63 Manten, op. cit. (note 40), p. 8.
64 Houghton, op. cit. (note 3), p. 19.
65 Ibid., p. 21.

systematic apparatus to provide bibliographic control of the journal literature'.[66] Derek de Solla Price maintains that it was about 1830 that the situation had become untenable, when about three hundred journals were in existence.[67] The abstract journal was founded to deal with the crisis. While the original meaning of the word was slightly different, an abstract was defined in 1949 by the International Conference on Science Abstracting as 'a summary of a publication or article accompanied by an adequate bibliographical description to enable the publication or article to be traced.'[68]

Most early abstract journals did not exist for very long, with more than half of them not lasting for longer than a year.[69] The first recognised abstract journal was the Aufrichtige[70], published in Germany in 1714. This was published over three years with a total of two volumes of twelve issues each.[71] In comparison to the advent of journals, abstract journals were much slower. Table 2 below shows the abstract journals issued between 1665 and 1790.

Table 2
Abstract journals issued 1665-1790 by subject and decade of origin.

	1660-69	1670-79	1680-89	1690-99	1700-09	1710-19	1720-29	1730-39	1740-49	1750-59	1760-69	1770-79	1780-90	Total
General	--	-	-	1	2	-	1	1	9	1	3	4	2	24
Medical	--	-	-	-	-	-	-	1	-	4	1	7	-	13
Other	--	-	-	-	-	-	-	-	1	1	-	1	2	5
Total	--	-	-	1	2	-	1	2	10	6	4	12	4	42

Source: Bruce M. Manzer, The Abstract Journal, 1790-1920, The Scarecrow Press, Metuchen, N. J., 1977, p. 62.

66 B. M. Manzer, The Abstract Journal, 1790-1920: origin, development and diffusion, Scarecrow Press, Metuchen, N. J., 1977, p. 7.

67 Price claims that this is the critical magnitude of journals, so the point at which the critical magnitude (300) of abstract journals was reached abstracts of abstracts became necessary. This is discussed fully in the next chapter. Price's discussion implies that abstract journals began in 1830. This differs from Manzer's version of the history of abstract journals which puts the date of the first abstract journal at 1714. The reason for this discrepancy could be a definition difference, however there is no dispute that the numbers of abstract journals increased significantly after 1830.

68 Manzer, op. cit. (note 66), p. 2.

69 Manten, op. cit. (note 40), p. 16.

70 The complete title has 32 words in it, so forgive me for using the shortened version.

71 Manzer, op. cit. (note 66), p. 58.

While it is important to mention abstracts in a discussion of the history of journals, they will be discussed fully in the next chapter that looks at alternatives to the printed journal.

The development of electronic journals

When discussing electronic journals, it is necessary to again define the terminology. This thesis is concerned with electronic journals that appear on the Internet. However, when looking at the history of electronic journals, it is important to explore the electronic precursors to what we refer to today as electronic journals. In 1966 Simon Pasternack, in response to the burgeoning growth of journals, wrote of a method of control that 'offers some hope of making information storage and retrieval controllable, [it] is the tremendous growth of computer technology.'[72] He pre-empted the current situation by stating that 'it seems to be feasible in the not too distant future to put whole articles into computers to be printed out on demand'.[73]

Early discussion of the electronic journal was a response to the 'serials crisis', and this will be discussed fully later in the text. One of the first attempts at what we now consider to be an electronic journal was the Electronic Information Exchange System at New Jersey Institute of Technology, where there was available an electronic version of paper journals, an informal newsletter, an unrefereed paper fair and an inquiry-response feature.[74] At that time (1983), the options available were; on-line versions of printed journals, on-line access to raw research data and abstracts, encyclopaedias, and a journal database. The

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72 S. Pasternack, 'Is Journal Publication Obsolescent?', Physics Today, May 1966, 19, pp. 38-43, at p. 38.

73 Ibid., p. 39.

74 S. W. Terrant, 'Publishing Scientific information, today. . . and tomorrow', Chemical and Engineering News, April 1983, 61, pp. 51-58.

advantages of the on-line facilities were stated as 'currency. . . immediate access to the full article. . . and the ability to search the full text rather than only title words and index terms'.[75] These cover advantages to the reader, but advantages to the publisher would be the ability to 'determine which articles people are reading. . . and which items are being accessed most frequently'.[76]

Ann Okerson, who has written extensively of the impending inevitability of electronic journals, states that there are two potential versions of the electronic journal. The first type is a conservative version, one that is merely an electronic version of current paper journals, the main difference being that 'it may be article rather than issue based'.[77] The second, more radical, version has many different suggested formats. Okerson states that 'the idea is sprouted precisely when it is ready, critiqued via the 'Net' and put out immediately for wide examination or "open peer commentary"'.[78] This is only one of the possibilities.

The electronic journal opens up possibilities that are so innovative it is sometimes difficult to assimilate them with our current concept of an academic journal. To begin with, the requirement for page integrity, which allows identification of articles within a journal, and quotes within an article will, it can be argued, become redundant. Henry Rzepa argues that

> the "page" does not necessarily always serve the very best interests of science. . .and does nothing to extend the concept of a journal into something more akin to a piece of experimental apparatus, to be used alongside other laboratory equipment[79]

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75 Ibid., p. 54.

76 Ibid., p. 55.

77 A. Okerson, 'The electronic journal, What, Whence and When', The Public-Access Computer Systems Review 2, 1991, 1, pp. 5-24. This effectively forms a separates service.

78 Ibid., p. 9.

79 H. Rzepa, 'The Future of Electronic Journals in Chemistry', available electronically by hypertext from The Chemistry Internet Guide at http://lib4.fisher.su.oz.au/Branches/Chemistry/CIGhtml (no page numbers)

As well as discussing the page issue, this is an example of an innovative attitude towards the potential place of journals in academic pursuits. If journals are electronic, any citation to another journal will be electronic, and that citation will be able to be accessed at the click of the mouse button, thus eliminating the need for page numbers as identification 'bookmarks'. However, during the transition period, as an author who is using both electronic and printed references for a thesis that is produced in paper form, I can safely say that having to count line numbers in an electronic journal that has no 'pages' is time consuming and frustrating. This is another example of the difficulties that will be encountered in the move to electronic journals.

Many of the issues that surrounded (and to a certain extent formed) the printed journals, are having to be readdressed in relation to electronic journals. As discussed earlier in the chapter, the niche the early journal occupied incorporated the benefit of the speed of newspapers and the intellectual standing of books. It is interesting, then, to note that one of the motivations given by Edward Jennings in his article 'EJournal: An Account of the First Two Years' for creating his electronic journal was a desire for 'something less stodgy than the familiar pseudo-permanence of paper journals, but less quick-triggered than the bright snippets on MegaByte University [80](MBU) and less scattered than the stream of observations on HUMANIST'.[81]

One of the proposed procedures of Jennings' electronic journal EJournal, An Electronic Journal for Humanists[82] related to ownership and stated: 'we will do nothing about copyright, permissions, first-refusals, or other paraphernalia of intellectual possessiveness. We're operating in the domain of search, not re-

80 This was started by Frank Kemp on BITNET in 1989.

81 E. M. Jennings, 'EJournal An Account of the First Two Years', The Public Access Computer Systems Review, 1991, 2 (1), pp. 91-110, at p. 92.

82 Ibid., p. 98. It should be noted that the reason for the subtitle was due to a hurried decision, and in retrospect the name would have been different.

search'.[83] This relates to their position of editors of a journal, not as contributors to it. While this is in keeping with the philosophy of the Internet, it unfortunately clashes with ideas within the sociology of science.[84] Chapter 3 will discuss this issue. However, this policy does not mean that EJournal does not have a refereeing process, it uses a senior editor who 'decides what to send out for review, sifts the panel's responses, and communicates consensus to the authors'.[85]

Conclusion

By studying the history of journals it is possible to place the developments of the electronic journal into a constantly changing and evolving domain. When the postal service opened up channels of communication, the journal was able to develop. The equivalent is occurring now, as the Internet opens up 'postal' services globally. Science now, as was then, is changing. Derek Price wrote in his book Little Science, Big Science of the change to 'big science', which mainly occurred in the first half of this century. In the latter half of the 20th century, 'collaboratories'[86] are possible with experiments being worked on jointly by people who have never met.

In the 1660's the journal filled a niche between books and newspapers, keeping the benefits of the speed of newspapers and the authority of books. Those who hail the electronic journal as a necessary development often use the slow turnover time of having an article printed as an argument for the electronic journal. Looking at examples such as quality control, it becomes clear that many of the features of modern printed journals have taken some time to develop. The printed journal has evolved to reach its current form and with the impending threat of electronic journals altering the status quo, there is an opportunity now to assess the qualities of printed journals. The evolution can be regarded as hard-won

83 Ibid., p. 96.

84 It is also interesting to note that Jenning's article was copyrighted.

85 Jennings, op. cit. (note 81), p. 100.

86 Collaboratories is a new catch phrase to describe collaborations of laboratories.

wisdom, or as irrelevant cultural baggage. It is likely to be a mixture of both. While the electronic journal will be able to speed turnover and address other current problems, whether the criterion of quality control is able to be (or needs to be) met is one of the main issues addressed by this thesis.

CHAPTER 2

WHAT'S SO SPECIAL ABOUT ELECTRONIC JOURNALS? PREVIOUS ATTEMPTS TO SOLVE PROBLEMS WITH THE BURGEONING SUPPLY OF JOURNALS.

When journals were first produced in the seventeenth century, they served the purpose of allowing a larger number of scientists than simply those attending meetings of scientific societies to gain access to the information being presented there. Over the next fifty years, journals became more prolific as more scientific societies were founded, and science became a profession rather than a pastime. In 1714, the first abstract journal appeared, a journal that contained only condensed versions of the findings of the scientists. This was the first bibliographic attempt to present scientific information in a form other than the scientific paper. By 1830, the number of journals in existence made it difficult to 'keep up' with the literature. The abstract journal from this point began to grow along the same exponential path that journals had been following. In 1869, Nature, the first commercial scientific journal began, and this and others that followed, added further to the supply of scientific information. One of the major problems facing scientists, publishers and librarians today is both the increasing number and increasing cost of scientific periodicals.[1] The electronic journal is being hailed by those who support its implementation as a solution to these problems. However, this is not the first attempt in history to find a solution, and this chapter will look both at the problems involved with the system, and the previous attempts to control the information that have been made. Many of the proposed solutions to the problems, while seeming rational and realistic, have not survived over the long term. Often the reason for this is institutionalised practice. Where

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1 The use of the expressions 'scientific periodicals' and 'scientific journals' will be used interchangeably throughout this work.

does the electronic journal fit into this picture? And is it a real solution, or simply one in a long line of attempts to solve a possibly unsolvable problem?

Recognising problems with printed journals

The scientific periodical performs several functions. Ostensibly it exists as a means of communicating scientific ideas to a wider scientific community than the one a scientist is in direct contact with. In addition to this it serves as a vehicle for the formal recognition of work, and is thus implicated in the process of assessing a scientist for promotion or grant allocation. There are now and have been for some time, recognised deficiencies in the scientific periodical as a means of communicating scientific information. Sir William Bragg, in his presidential address to the Royal Society in 1938, outlined the problems as he saw them then. In 1957 it was suggested to Unesco[2] that a 'long term study of the whole problem . . . be commissioned.'[3] In 1960 a preliminary report was published detailing the findings of this study. The problems of 1938 and 1960 still exist, and it is worth noting them, to place the current situation in context.

The main argument being used for the introduction of electronic journals is the need to speed up publication time and to lower costs of journals. An equally important argument is the necessity of stemming the increasing tide of journal issues filling libraries. These are not new problems. Bragg stated back in 1938 that 'the very great increase in the output of the results of research . . . [means there is] correspondingly more to be

2 While U.N.E.S.C.O. is an acronym, the publication in which the paper appears (see below) and subsequent references to it use Unesco as a word in its own right, which I will do here.

3 R. H. Phelps and J. P. Herlin, 'Alternatives to the Scientific Periodical', Unesco Bulletin for Libraries, March/April 1960, XIV (2), pp. 61-75, at p. 61.

published, and, at the same time, publication costs have increased'.[4] These sentiments were restated in 1960, where the point was made that the increasing number of papers had resulted in a scattering of papers making it difficult for scientists to keep informed of new developments, and for libraries to cover a field completely. The high cost of journals has made it difficult for libraries and abstracting services to maintain a complete coverage of any field.

The time it currently takes between a paper's submission to a journal and its subsequent publication is unsatisfactory from the point of prompt dissemination of information. It takes about twelve to eighteen months to have a paper published, while 'under half a year is "fast track".'[5] This however, is not a new problem. Bragg mentions it, and one of the reasons the Unesco paper was commissioned was 'a committee for the American Association for the Advancement of Science. . .[had] reported delays of one year from the time of acceptance of a paper to its appearance in print.'[6] It is evident that any attempts in the past to resolve the situation have not met with success.

Because of the increasing number of journals, for some time there have been restrictions on the length of articles. This has posed another problem because 'necessary data, illustrations, and background information must be omitted.'[7] Odlyzko notes that a defect in the scientific paper is 'the emphasis on brevity that was encouraged by an expensive system of

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4 Sir W. Bragg, 'Address of the President of the Royal Society', Science, 23 December 1938, 88, pp. 579-583, at p. 580.

5 A. Okerson, 'The Electronic Journal: What, Whence and When?', The Public Access Computer Systems Review, 1991, 2 (1), pp. 5-24, at p. 7.

6 Phelps, op. cit. (note 3), p 61.

7 Ibid., p 62.

limited capacity'.[8] This, he argues has resulted in 'exposition that is often hard to follow, especially by non-experts'.[9] Bragg spoke of this in his 1938 address, stating that 'such writings make dull and difficult reading for the great majority of those who are interested in scientific discovery.'[10] Varying proposals have been put forward to resolve this situation, but again, the problem remains, and to date no satisfactory solution has been found.

From a user's perspective, the continually increasing number of articles published in a continually increasing number of journals makes finding a particular article difficult and expensive. Libraries are taking the responsibility of ordering the information into a useable form, but libraries are working within restricted budgets, and no one library has either the resources or the shelf space to have a complete collection of scientific periodicals.

The current system has problems that are not new. The reason for an increasing awareness of the situation is that the situation is compounding at a rapid rate. There are calls that something must be done now, before the system collapses under the weight of so many journals. This, however, is not the first time the situation has been considered close to crisis point. So what has been suggested in the past, and why hasn't it worked?

There are two types of solution to the problems outlined here. Each proposal is either a supplement to the current printed journal system or a substitute for it. The supplemental approach simply makes the information easier to retrieve and has greatest impact upon the role of libraries in the

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8 A. M. Odlyzko, 'Tragic loss or good riddance? The impending demise of traditional scholarly journals, available on amo@research.att.com, 30 December 1993, pp.1-29, at p. 18.

9 Ibid., p. 18.

10 Bragg, op. cit. (note 4), p. 581.

scientific system. The methods that lean towards substitution are more complex in their implementation. The current system of science relies on the printed journal, and any major change to the printed journal would have implications far beyond the dissemination of information. This aspect of the problem is examined in Chapter 3.

The proposals for journal improvement or substitution fall broadly into three main categories: methods of managing the information; reducing the number of journals in existence; and publication utilising new types of media.

Managing the information explosion (a) Separates

Over the last 300 years the scientific literature has been increasing in volume at an exponential rate.[11] This has put pressure on libraries to create systems allowing easier search and retrieval. Today, a large percentage of interlibrary loans consist of copies of single papers. To give an idea of the magnitude of this situation, Ann Okerson stated that in 1991, 'of the 1.5 million items supplied to each other [by her member-libraries] . . . an estimated two-thirds consisted of single copies of articles'.[12] This movement towards issuing articles separately instead of bound in a journal had its origins nearly seventy years ago.

The idea of elimination of the periodical began in 1926 with a suggestion by J. F. Pownall that 'journals should be published as collections of separates, easily divisible by libraries for groupings by subject.'[13] In

11 D. de Solla Price, Science since Babylon, Yale University Press, New Haven, 1975, p. 165.

12 This was quoted at a conference on scholarly communication held at University of Chicago in 1992, and subsequently written up by: John Maddox, 'Electronic journals have a future', Nature, 16 April 1992, 356, p. 559.

13 Phelps, op. cit. (note 3), p. 62.

general, proposals for some form of separates service have required the establishment of a centralised publishing service. One of the earliest such plans was proposed in 1939[14] by Watson Davis. He suggested the establishment of a Scientific Information Institute which would take over all the existing media of publication. Papers would be submitted to the centre and after refereeing would be prepared in a format allowing duplication. Summaries would be published in weekly or monthly journals in discrete fields. Scientists could then order papers they wished to see in full from the centre.[15]

This plan has been used as the basis for other suggested changes to the system. In 1966 an article in Physics Today described a project taken on by the Committee on Scientific and Technical Information (COSATI) in the White House Office of Science and Technology which would embrace all government agencies dealing with scientific and technical information and the scientific societies and their journals.[16] The goal was to promote greater efficiency, but the article describes the situation as an unintended takeover, and that it could result in 'the most valuable features of the existing systems [being] destroyed.'[17] This is the real ideological difficulty with having a centralised system. Under such a system all control over what is and is not considered to be of scientific value would be in the hands of one organisation. Those making the decisions would not necessarily be scientists (there would need to be an enormous bureaucracy), and there would be no organisation to turn to if disagreement was felt about a decision.

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14 Ibid., p. 64. This proposal was first put forward as a mimeographed circular in 1933, and formally published in 1939.

15 Ibid., p. 64.

16 S. Pasternack, 'Is Journal Publication Obsolescent?', Physics Today, May 1966, 19, pp. 38-43, at p. 39.

17 Ibid., p. 39.

A slightly different proposal in 1945 was to reform scientific publications by federating societies, standardising journal sizes, distribution of preprints to all members of federated societies and clear demarcation of each field of science.[18] There are several other proposals outlined in the Unesco paper which cover the remainder of the 1940's and all the 1950's, but as they are in the same vein, it is not necessary to examine them in detail. Looking at these proposals, it becomes clear that there has been widespread and longstanding support for the movement of journal publication to a central body or bodies. Support for the centralised system was received from the USSR (not surprisingly) and Great Britain.[19]

There are several ways of approaching the question of why the centralised system was never implemented. First it is necessary to take into consideration the structures in place that would be affected by such a huge upheaval. There are many people and companies who currently rely on the scientific publication system for their livelihood. Their resistance to change is discussed in the 'Forces at Play' chapter below. Another major reason is the logistics of implementation. As the Unesco report stated, the co-operation required to put the proposal into effect would be impossible in one country, much less internationally. There would still remain large difficulties with classification within libraries to ensure that scientists were exposed to all available literature within their field. How much the ideological objections have been taken into consideration, and how much the Cold War attitudes towards the USSR were a factor can only be speculated upon.

Another approach to the question is to look at the impact on the user. These impacts tend to be ergonomic in relation to the use of scientific

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18 Proposal by N W Pirie, outlined in Phelps, op. cit., (note 3), p. 65.

19 Phelps, op. cit. (note 3), pp. 64-65.

papers by scientists. There are two different uses of scientific papers by scientists, 'practicing [scientists] would welcome synopses as quick and convenient methods of access to information, while researchers . . . [need] access to the complete texts'.[20] The researchers 'like to be able to see actual issues, or at least to scan the print-form contents, of a selection of journals.'[21] One of the problems with the centralised system is that it would not allow the 'casual reading or browsing [that] is important to scientists'.[22] Given this consideration and the others outlined above, the publication of separates has not been a viable solution to the problem.

Managing the information explosion (b) Bibliographic control

While the use of separates was untenable as a solution in 1960, the problem remained and still exists. By 1980, established methods were in use for control of the information explosion. These methods were (and still are) secondary publications that do not threaten, but supplement the printed journal system, and allow for easier perusal of the literature. They fall into four main categories: publications listing the titles of papers; abstracting; separate synopses; and review series. Of the four, abstracting is the longest standing, and will be dealt with in the most detail.

There are many publications available that list the titles of papers, and have author and subject indices.[23] One of the most prominent of these is Current Contents. This is a service that is produced weekly, in the form

20 A. B. Piternick, 'Attempts to Find Alternatives to the Scientific Journal: A Brief Review', The Journal of Academic Librarianship, 1989, 15 (5), pp.260-266, at p. 262.

21 Ibid., p. 264.

22 Phelps, op. cit., (note 3), p. 68.

23 B. H. Waksman, 'Information Overload in Immunology: Possible Solutions to the Problem of Excessive Publication', The Journal of Immunology, March 1980, 124, pp.1009-1015, at p. 1012.

of a small book. (It is also available electronically.) Current Contents is broadly broken up into categories, such as: Social and Behavioural Sciences; Life Sciences; Physical, Chemical and Earth Sciences; Agriculture, Biology and Environmental Sciences; Clinical Medicine; Engineering, Computing and Technology; and Arts and Humanities. The booklets are further subdivided into disciplines, and each of the journals that were published in the preceding week in that discipline are listed[24], with the titles of the articles in the journal. It is a method to keep on top of the huge number of journal and book articles published each year.

In 1961, the Chemical Abstracts Service (CAS) 'produced its first computer-processed publication, Chemical Titles, a table-of-contents service that featured a keyword-in-context index.'[25] This has expanded now into a massive indexing system, with the most recent Volume (the twelfth collective index), for 1987-1991 containing 115 parts.[26]

Synopses (in different forms) have been in existence for many years. In a synopsis system full length papers are summarised in one or two pages. They are 'intended to be concise and informative descriptions of the work'[27], and are refereed. Bragg spoke of fellows welcoming the 'recent plan of publishing summaries of papers as an appendix to the Proceedings as soon as the papers [were] received, publication of the papers themselves being deferred until approval [had] been given in the usual way.'[28] This was suggested both to reduce the time it takes to publish a discovery, and as a

24 Current Contents processes all journal issues within two weeks of their publication.

25 S. W. Terrant, 'Publishing scientific information today...and tomorrow', Chemical Engineering News, 25 April 1983, 61, pp. 51-58, at p. 57.

26 These parts are broken into; Authors (17), Formulas (19), Chemical Substances (51), General Subjects (23), Patents (3), and Index Guide (2). The volumes are so prolific in number that they do not fit into the numbered shelving, and occupy independent shelving in the UNSW library.

27 A. Singleton, 'Publishing at the Crossroads?', Physics Bulletin, 1976, 27, pp. 399-403, at p. 403.

28 Bragg, op. cit. (note 4), p. 582.

solution to the problem of papers being unintelligible to the majority of the scientific audience due to increased specialisation. In relation to this last point, the summary 'becomes literature, though the paper itself may be no more than a record.'[29] Some societies only publish synopses, an example being the Journal of Chemical Research, with the full articles available on request in microfiche form.[30] This has the advantage of lowering costs.

Review series are 'what people mainly read, as distinguished from the scanning of abstracts.'[31] There are three categories of review series, personal reviews (of one scientist and his or her collaborators), broad and detailed scholarly reviews and brief analytical reviews (which take the form of editorials or commentaries in journals).

As stated in the last chapter, an abstract is a summary of an article which has sufficient bibliographic reference to enable the article to be located. An abstract journal is

> a form of serial bibliography in which . . . periodical articles published elsewhere are summarised and accompanied by adequate bibliographic description to enable the original publication to be traced.[32]

The first abstract journal appeared in 1714, but it was early in the nineteenth century that 'burgeoning scholarship. . .resulted in a shift of emphasis . . .[to journal] publication as scholars sought both to establish priority and keep abreast of their fields.'[33] The volume of journal publication began to increase at a greatly accelerated rate, and there developed a need 'for a more methodical and systematic apparatus to provide

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29 Ibid., p. 582.

30 Waksman, op. cit., (note 23), p. 1012.

31 Ibid., p. 1013, original emphasis.

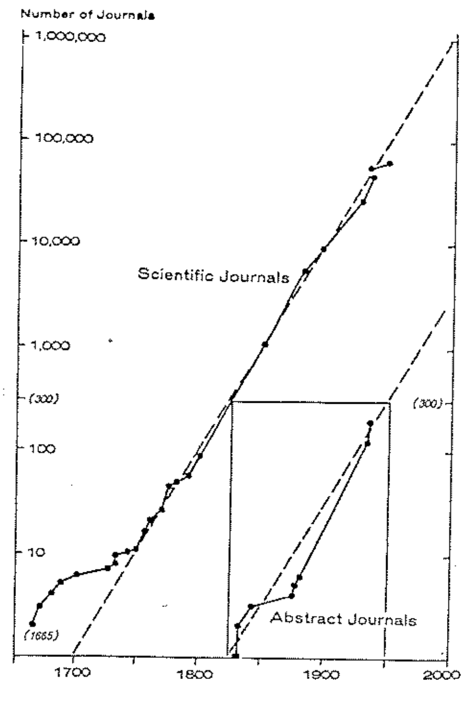
32 B. M. Manzer, The Abstract Journal, 1790-1920: Origin, Development and Diffusion, Scarecrow Press, Metuchen, N.J., 1977, p. 3.

33 Ibid., p. 6.

bibliographic control of the journal literature'.[34] Abstract journals began to increase in number.

The abstract journal was an attempt to meet both the problem of current awareness and of retrospective coverage.[35] The ability of the abstract to fulfil both of these functions has lessened during the last 250 years. Price observes that from 1830, the numbers of abstract journals began to increase at the same exponential rate that scientific journals were enjoying. (See Graph 2.)

Graph 2
Number of journals founded (not surviving) as a function of date. (The two uppermost points are taken from a slightly differently based list.)



Source: Derek de Solla Price, <u>Science Since Babylon</u>, Yale University Press, New Haven, 1975, p. 166.

Price maintains that by '1950 we reached a point at which the size of the population of abstract journals had attained the critical magnitude of about

34 <u>Ibid.</u>, p. 7.
35 <u>Ibid.</u>, p. 7.

three hundred'[36], and thus a new form of bibliographic control was required for the abstract journals. Manzer notes that in the period covered by his study (1790-1920) as the primary, and subsequently the abstract literature increased, 'further layers of bibliographic control were required'.[37] While abstract journals were able to provide temporary relief from the waves of literature, they eventually became part of the flood.

An abstract is approximately 200 words long, and summarises the main arguments of the article and the conclusions. The task of the abstractor is to 'convey what the author himself has done, why he has done it, and by what steps he has reached his conclusions, together with these conclusions'.[38] It takes longer to read abstracts than scan titles, but increasingly they are being used as the primary source of information, as 'it eliminates the need to keep the reference and find the original article'.[39]

One innovation that has remained addresses the problem of speed of publication, where timely announcement of results is necessary. This is the establishment of 'letters journals' in the 1950's and 1960's which permit 'rapid preliminary reporting of findings which would later be described at length through formal publication in traditional journals'.[40] It appears that these journals have become an alternative outlet for publication, but remain in publication.[41] The February 1972 editorial in Physical Review Letters (the first of this kind of journal) pointed out that despite the fact that 'the Letter format was never meant to be considered a complete scientific

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36 Price, op. cit. (note 11), p. 167.

37 Manzer, op. cit. (note 32), p. 7.

38 B. Houghton, Scientific Periodicals; their historical development, characteristics and control, Clive Bingley, London, 1975, p. 68.

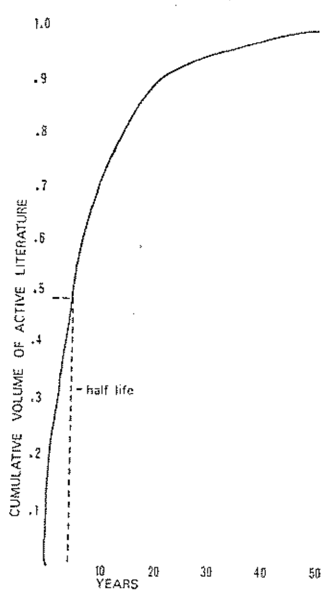
39 Waksman, op. cit., (note 23), p. 1012.

40 Piternick, op. cit., (note 20), p. 265.

41 At least until 1989, when Piternick's article was written.

communication . . . . far too few letters are followed by detailed Articles.'[42] This could be due to the fast turnover of information within Physics. The half-life[43] of physics articles is 4.6 years[44] (see Graph 3 below). The formal communication system, as discussed earlier, could take up to a year and a half to have an article printed, which is one third of the half life of the information. It is not surprising that physicists have taken to publication in faster, more informal formats such as letters journals and electronic prepublication (which is discussed later in this work).

Graph 3
Obsolescence graph for the journal literature of physics.



Source: B. Houghton, Scientific periodicals; their historical development, characteristics and control, Clive Bingley, London, 1975, p. 108.

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42 S. A. Goudsmit, editorial, Physical Review Letters, 7 February 1972, 28 (6), p. 331.

43 An article will only be read a certain number of times before the information becomes obsolete. This covers a certain period of time depending on the discipline. The half life is the time taken for half of the total number of times the article will be read, to be read. 'Hard' sciences such as Physics have much shorter half lives than 'softer' sciences such as sociology.

44 D. W. King, D. D. McDonald and N. K. Roderer, Scientific Journals in the United States, Hutchinson Ross, Stroudsburg, Pennsylvania, 1981, p. 172.

Restricting the numbers of journals

A different approach to alleviating the serials crisis[45] is to restrict the number of journals that exist. The suggestions outlined in the Unesco report were for scientific societies to make an active effort towards this end, private organisations discontinuing their journals to allow scientists to 'publish in recognised journals likely to be abstracted',[46] and scientists agreeing to publish only in recognised journals. In an article written in 1989, Anne Piternick quotes the National Enquiry (USA) into scholarly communication, as stating 'further net growth in the number of scholarly journals [should] be discouraged. . . by a continuing scrutiny of the usefulness and quality of existing journals as well as those that are proposed'.[47] This approach obviously has not worked, however, as there are today more journals than ever.

The reasons for scientists not restricting their choice of publication submissions is the 'publish or perish' reality of the scientific world. Journals serve two main functions for scientists, to disseminate information,[48] and to provide a formal record of their work which allows assessment of their work for promotion, grant allocation, and other reward processes. In theory it would be ideal that all scientists could publish in highly respected journals, but there are more scientists than there is available article space each year, so scientists turn to less presigious journals simply in order to be published. This means the proposal to eliminate these journals will not be fulfilled, purely as a result of numbers.

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45 'Serials crisis' is a term used to describe the information explosion. It is explained in detail in Chapter 4.

46 Phelps, op. cit., (note 3) p. 63.

47 Scholarly Communication: The Report of the National Enquiry, Johns Hopkins University Press, Baltimore, MD, 1979, p. 22, quoted in Piternick, op. cit., (note 20), p. 265.

48 Although this is less important now with the increased use of informal methods of communication such as preprints and electronic mail.

Publication utilising alternative media

Suggestions that use alternative media have included proposals for special radio or television stations for broadcasting science reports, distribution of reports on tape recordings and publication on microcards and microfilm. These methods are interesting because they reflect a continuing eagerness to incorporate the latest media technology into the scientific system. The use of the Internet as a means of disseminating scientific information can be seen as another episode in this history. Therefore it is worth exploring the success or failure of these methods in order to anticipate difficulties which the introduction of electronic journals may face.

Piternick has explored several alternatives to the print journal and discusses why they have not been successful. Often the reason has simply been ergonomic. There appears to be a reluctance to move to a completely new system because 'most people [place] a greater value on retaining their ability to select for themselves what they should read than on reducing the volume of material they [are] forced to read'.[49] The reaction to publishing articles in microcard format (where the print is very small and the user is provided with a special 'reader') was 'not popular, [and] members "expressed a preference for hard copy".'[50] Microfiches had similar problems: 'most authors didn't want to write for microfiche, and most readers didn't want to read articles in that format'.[51] Miniprint was an attempt to control the size of scientific journals, by reducing the point size of the type, and again this was abandoned on the basis that not enough authors considered miniprints

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49 Piternick, op. cit., (note 20), p. 262.

50 Ibid., p. 262.

51 H. R. Gould, 'GSA-A Legacy and a New Era', Geological Society of America Bulletin, January 1982, 93, p. 2, quoted in Piternick, op. cit., (note 20), p. 262.

'to be an acceptable solution for countering rising publication costs'.[52] Looking at these few examples it becomes clear that any alteration to the publication system of science must take into consideration the ergonomic use of the proposed form by scientists. The situation surrounding the introduction of electronic journals is summed up by Martyn Ray, 'people will only use electronic communication if it is quick, easy, and can replace tedious manual labour, otherwise paper (and pen) is the medium of choice.'[53] This must be considered in relation to electronic journals, and the ergonomic issue will be discussed as part of Chapter 4 and is looked at in the results of the empirical study in Chapter 5.

One of the difficulties of incorporating new media technologies into the journal publication system is the speed with which technology progresses. What may seem groundbreaking at the time is often obsolete within ten years. Houghton in his 1975 book discusses the introduction of journals published in microfiche, and explains the problems of antipathy of the user in relation to the technical shortcomings of the 35mm reader. However, he states,

> [since] the advent of cassette-loaded 16mm film with motorised reader printers in which it is no longer necessary to thread the film through the machine [!], there has been a more ready acceptance of microfilm as a medium of journal access.[54]

Apart from the fact it underlines the ergonomic issue, that passage also demonstrates technology obsolescence (the move from 35mm to 16mm microfiche). What is the point of embarking on a subscription to a journal in a new technological form if the means by which it is able to be accessed will no longer be available in a few years? This is an area that is relevant to

52 Piternick, op. cit., (note 20), p. 263.

53 M. Ray, 'Electronic Communications and the Internet', Chemical Engineering in Australia, June 1995, 20, pp. 7-12, at p. 9.

54 Houghton, op. cit. (note 38), pp. 44-45.

the introduction of electronic journals. While computers are more than likely a permanent addition to our lives, the Internet is not necessarily so, and nor are the protocols[55] that are currently being used on it.

One technology that has profoundly affected the way academics use journals is the introduction of the photocopier. This is a very clear example of Langdon Winner's statement that 'technologies are not merely aids to human activity, but also powerful forces acting to reshape that activity and its meaning.'[56] A study was done in 1977 looking at scientific journals in the United States. Surveying the 'form' of the articles read by scientists, it was found that 83% were the actual issue and 11% were photocopies (the remainder consisting of reprints, preprints and microfiche).[57] This shows a high dependence on photocopying as a means of obtaining articles. The results split into field of science are below in Table 3.

Table 3
Forms of articles read, by field of science, 1977 (in percent)

Field of Science	Actual Issue	Reprint	Preprint	Photocopy	Other
Physical Sciences	96	1	a	3	a
Mathematics	61	1	7	31	a
Computer Sciences	67	a	32	a	a
Environmental Sciences	79	19	a	1	a
Engineering	83	a	a	17	
Life Sciences	82	8	a	10	
Psychology	90	a		10	
Social Sciences	81	6	a	10	3
Other Sciences	95	3		2	
All Fields	83	2	3	12	a

aLess than 0.005.

Source: D. W. King, D. D. McDonald and N. K. Roderer, Scientific Journals in the United States, Hutchinson Ross, Stroudsburg, Pennsylvania, 1981, p. 167.

There is a strong usage of photocopies by Mathematicians. King, et al. do not speculate as to the reason for this.

55 The computer languages written that allow, for example, transferring files on the Internet, or accessing information through hypertext.

56 L. Winner, 'Technologies as forms of life', in, L. Winner (ed.), The Whale and the Reactor, University of Chicago Press, Chicago, 1986, pp. 3-19, at p. 6.

57 King, op. cit. (note 42), p. 173.

Photocopiers are a double-edged sword to publishers. While they pose a very real threat to enforceable copyright, 'it is a well known fact that in the 1980's publishers were severely damaged by photocopying,'[58] it is possible to argue that the continued dependence of academics on printed journals is due to their availability to photocopies. The phenomenal growth of photocopying that took place under the label of interlibrary lending, was a worldwide phenomenon.[59] This has allowed academics and students to use articles from journals without having to pay ever increasing subscriptions (partly due to photocopying). Whether the continued dependence on printed journals would have occurred without photocopying is impossible to establish, but the impact of photocopying cannot be understated.

Is the electronic journal going to be any more successful?

The electronic journal has the advantage over other attempts to deal with the serials crisis in that it addresses almost all of the problems outlined earlier in this chapter. Increased speed of publication, lowered cost of publication, efficient storage and retrieval, and a reduction in the amount of paper being consumed are all achievable through electronic publication. In addition, it allows complete publication of results without restrictions on length of articles, a feature that has not been realised with abstracting, microforms and the like. The problems with electronic journals as an alternative to printed journals tend to fall into two categories. First there is concern that quality control will be lowered with the change. This concern is discussed in the next chapter. Secondly the issue of ergonomics must be

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58 J. L. von Hagen, 'The Electronic Journal: Is the Future with Us?', Australian & New Zealand Journal of Serials Librarianship, 1992, 3 (2), pp. 3-30, at p. 6.

59 D. Schauder, 'Electronic Publishing of Professional Articles: Attitudes of Academics and Implications for the Scholarly Communication Industry', Journal for the American Society for Information Science, 1994, 45(2), pp. 73-100, at p. 81.

addressed, as this has been a major problem with many of the other technologically-current attempted alternatives in the past.

Piternick describes many of the past attempts to reduce the costs of producing journals, and concludes that none of the attempts have 'had a major impact on the scientific journal system as a whole.'[60] In her discussion of electronic journals, which were in their infancy at the time of the article, she describes issues such as computer illiteracy, lack of user friendly software, lack of equipment, lack of computer funding and problems with standardisation. Many of these problems have since been addressed, with computer illiteracy being the most relevant problem today. In the Electronic Information Exchange System (EIS) project in the USA and the Birmingham and Loughborough Electronic Network Development (BLEND) project in the UK, 'informal exchanges between participants were the most successful parts of the projects.'[61]

A switch to electronic journals would require a fundamental change in the way scientists browse, search for and use published information. Electronic publishing allows for much more than an alternative to printed publication. It can be instantaneous and interactive in a way that printed publication will never be. However, these changes must be made with two major design problems solved, 'the first is to allow human, not computer recognition to make the optimal 'connections' with the literature and the second is to support the scholars' reading styles and visual comfort'.[62] If this is not done, users will 'refuse to accept the system, and their behaviours [will] range from sabotage of the system to simply not using it.'[63]

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60 Piternick, op. cit. (note 20), p. 260.

61 Ibid., p. 264.

62 J. Olsen, Electronic Journal Literature, Implications For Scholars, Mecklermedia, Westport CT, 1994, p. 4.

63 Ibid., p. 29.

The computer system will have to accommodate the ways in which users interact with the literature, which tends to be idiosyncratic. Browsing is not premeditated, nor does it follow a rational pattern. The problem with reading styles and visual comfort is the concern about eyestrain and headaches resulting from sitting in front of a computer screen for hours. This was noted by a chemist in the empirical study, 'Time is needed to study and digest apart from the threat of eye strain and the long term effects of continual use of computers on health' (see 'Ergonomic concerns' in Table 15 in Appendix 2). Another feature of the printed form that is difficult to reproduce is the practice of flipping pages and scanning, which requires an ability to see the whole page. Scrolling through text on a screen does not have the same effect,[64] and this was commented on by a (different) chemist in the empirical study, ' I have a great dislike of not being able to scan paper copy of journals. The ability to browse the complete text and graphics, not just abstracts is very important' (see 'Ergonomic concerns', in Table 15 in Appendix 2). Computer 'pages' do not allow for annotation and underlining of text in the same way that a printed page does. These ergonomic issues are explored in more detail in the discussion of the empirical study detailed in Chapter 5. While printing out an article allows these practices to occur, one of the advantages of electronic journals is the ability to print only the required articles. This advantage will be lost if a browser needs to print out an article in order to be able to make the decision to keep it.

There is no doubt that electronic communication has assisted the informal lines of communication in science. The issue at stake here is whether electronic journals will be able to supersede printed journals as the primary formal method of communication.

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64 Ibid., p. 36.

Conclusion

The use of print journals is deeply embedded in the culture of scientific work. Any attempt at substitution of print journals must incorporate the complexities of the system of science. Those who support the introduction of electronic journals are not those who control the implementation. As can be seen from this chapter, what can seem to be a rational and realistic alternative to print journals (such as the introduction of some form of separates service) has been frustrated by the details of institutional practice, for example, politics, financial considerations and ergonomics.

There have been two types of alternative to the print journal discussed in this chapter. One is substitutional, such as a separates service, microfiche, microcard. None of these have been successfully implemented. The other is supplemental, such as bibliographic services (abstracts, review series and the like), and technology such as photocopiers. These supplemental systems have all served to make the print journal stronger in its position in the system of science. Electronic journals are a substitutional system. As a result their implementation involves taking into consideration all of the difficulties that previous substitutional attempts have faced.

It is very difficult to predict accurately what will happen. But given that the switch to computerised work practices has had a social impact on a scale similar to the invention of the printing press, it is fair to assume the technology is reasonably permanent. Electronic journals address most of the problems currently facing the print journal system, and therefore they have a fighting chance. It must not be forgotten, however, that while they are capable of improving many of the current difficulties, it is likely that they will create unique problems of their own. It would be good practice for those attempting to implement electronic journals to anticipate these difficulties. The determining factors over the introduction of electronic journals will be the way in which scientists and others with interests in the business of science communication respond to the evolving technological possibilities.

CHAPTER 3

SHOULD WE OR SHOULDN'T WE? THE DEBATE ABOUT ELECTRONIC JOURNALS.

In the debate about electronic journals, there are arguments that support the innovation, and those that disagree with it. Those arguments for electronic journals tend to concentrate on the positive aspects of the changes that the electronic journal will bring. The arguments against are intricately linked with the perceived disruption to the 'workings' of science. The current paper publishing system relies on refereeing and verification by peers in a given field. This verification then allows published papers to be an indicator within the scientific community of the value of a particular scientist's work. The reward system in science relies on this verification process. Merton proposed a theory as to the workings of the scientific community, a system of norms that all scientists adhere to. Those who argue against electronic journals[1] do so on the grounds that the current quality control mechanisms in place in science will cease to exist. This is a possibility, and an important aspect of the debate that will be looked into here. However, it is also an example of the use of the normative argument to support a resistance to change. The interpretive argument maintains that the norms do not embody, nor are they driven by, the scientific community, but are in fact a flexible ideology used to try to legitimate particular practices in science. This chapter is an attempt to analyse the various arguments surrounding the introduction of electronic journals, and to look at those arguments from their normative or interpretative standpoints. In order to understand the full implications of both arguments, it is necessary to begin with a description of how science operates, and how printed journals currently fit into the system.

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1 There are not a large number who do. There are two possible reasons for this. One is a feeling of 'ignore it and it will go away', and the other is a contemptuous approach that the discussion is too futile even to participate in it.

The journal's involvement in the quality control system of science

There is an established procedure scientists must follow in order to have a paper published. Once the paper is completed, it will usually be given to a colleague to read and proof, so that '[f]or most investigators the formal submission of a manuscript for peer review is not the first time it has been subjected to peer scrutiny'.[2] Increasingly the Internet is being used as an electronic method of releasing pre-prints. Which journal a scientist submits his or her paper to must then be considered. As it is only permissible according to scholarly etiquette to send a paper to one publication at a time, the author must make a decision about which journal is most likely to print the work. 'As articles queue for peer review, editing, and publication in the journal "package", distribution delays of months are the norm. One to two year delays are not unusual',[3] so a miscalculation at this point could mean a dangerous delay in the publication, especially if an issue of priority is at stake.

The 'standard' of science is maintained by a system of accreditation, '[a]ccredited knowledge is grounded in collegial recognition of the individual and his/her work. . .[and] journals are the prime medium for accrediting knowledge'[4]. The refereeing system is the main method of accreditation, and is controlled by the editor of the journal to which the article is sent. Upon receiving a paper, the editor of the journal assesses whether it is appropriate. To indicate the level of 'culling' that occurs at this level it is worth looking at a case study. In 1965 The Physical Review received about 2600 papers for publication. Of these, 500 were

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2 Steven Harnad, 'Scholarly skywriting and the prepublication continuum of scientific inquiry', Psychological Science, 1990, 1, pp. 342-343 (reprinted in Current Contents, 11 November 1991, 45, pp. 9-13.

3 Ann Okerson, 'The Electronic Journal: What, Whence and When?, The Public -Access Computer Systems Review 2, 1991,1, pp. 5-24, at p. 7.

4 James Christenson & Lee Sigelman, 'Accrediting knowledge: journal stature and citation impact in social science', Social Science Quarterly, 1985, 66, pp. 964-974, at p. 965.

not accepted. In this case the culling that was done by the editor was 150 papers, 100 were returned as being more suitable for other journals and 'about 50 were crackpot papers'.[5] If the paper submitted is appropriate, the editor writes to (or e-mails) one or two reviewers. The subsequent culling after refereeing in The Physical Review case was about 200 that were deemed incorrect or below standard and 150 that were withdrawn by the authors.

Reviewers (or referees), are scientists who work in the same field as that covered by the paper. Referees serve multiple functions and

> often . . . suggest basic revisions for improving papers. They sometimes link up the paper with other work which the author happened not to know; they protect the author from unwittingly publishing duplications of earlier work; and, of course, as presumable experts in the subject, they in effect certify the paper as a contribution by recommending its publication'[6]

While Merton considered these judgements to be based on impersonal pre-established criteria, others, such as Ravetz, consider assessments of quality to involve making 'a number of subtle, indeed tacit judgements, which depend on an intimate craft knowledge of the work under review'.[7] The referees return the paper to the editor, who returns it to the author. If advised to proceed, the author makes the appropriate amendments to it and returns it once more to the editor. It is then finally published.

The reward system of science

It is generally understood (at least within the discipline of Science and Technology Studies) that journal publication plays an integral part in the reward

5 Simon Pasternack, 'Is journal publication obsolescent?', Physics Today, May 1966, 19, pp. 38-43, at p. 40.

6 R. K. Merton, The Sociology of Science, University of Chicago Press, London, 1973, p. 492.

7 J Ravetz, Scientific Knowledge and its Social Problems, Oxford University Press, Oxford, 1971, p. 273.

system of science. Academic status is increased according to the number of publications and citations an academic has, and according to the prestige of the journals involved, 'one widely used indicator of the recognition awarded to a scientist or to a particular paper is the number of references in the research literature to his work in the paper'.[8] The act of referring to another published paper is citation. A citation must identify 'explicitly what sources of information are being used and how they are being used'.[9] It must also have enough information to allow a reader of the paper to locate the cited source with relative ease. Citation counts are used as indicators of the quality of work a scientist has done. Any assertion made in a scientific paper (or any academic paper for that matter), must be substantiated by reference either to experimental results that are original to the author, or to previously published work. (As all printed published work is refereed, it is assumed that it is accredited[10].)

In making decisions on research grants, 'science planners find journal ratings helpful in assessing the payoffs of various research programs and the productivity of various researchers and research teams'.[11] And 'citation counts have been used to evaluate [academic] departments [and facilities]',[12] and in making academic tenure decisions.[13]

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8 M. J. Mulkay, 'Sociology of the Scientific Research Community', in Science, Technology and Society, Ina Speigel-Rosing and Derek de Solla Price (eds), Sage Publications, London, 1977, pp. 93-148, at p. 101.

9 The School of Science and Technology Studies, Essay Booklet, Published by UNSW School of Science and Technology Studies (date unknown)

10 However, as noted by Odlyzko 'the reliability of the literature in any field depends primarily on the publishing norms in that field, and not on the medium' (p. 17.)

11 Christenson, op. cit., (note 4), p. 965.

12 Philip Howard Gray, 'Using Science Citation Analysis to Evaluate Administrative Accountability for Salary Variance', American Psychologist, January 1983, 38, pp. 116-117, at p. 116.

13 Lowell L. Hargens and Howard Schumann, 'Citation Counts and Social Comparisons: Scientists' Use and Evaluation of Citation Index Data', Social Science Research, 1990, 19, pp. 205-221.

The reward system in science is intricately tied up with scientists' print publications. The reward scientists receive for work is not (usually) personal financial gain. Tenure, allowing the freedom and security necessary to the pursuit of long term or unorthodox research, grants that ensure the continuation of a project, and peer recognition are the main 'units of currency' in the scientific reward system. This last point, 'for most scientists, recognition of the quality of their work by other competent researchers [is] an important incentive and valued reward'[14] introduces the concept of peer evaluation as reward. Scientists are specialists, and often the only people who are in a position to assess the quality of their work are other specialists in the same field.

This recognition is demonstrated in many ways, 'from the award of a multitude of graded prizes and medals, through honorific practices such as eponymy, to the routine procedure of citing work which has influenced . . .[the] research'.[15] Underlying all of these is the necessity of priority. It is likely that more than one scientist will be working on a given problem at a given time. However, the scientist who communicates a particular finding to the research community first is the one who gains recognition. This however, does not 'lessen the quality of work of those who independently, but subsequently, arrived at the same result'.[16] So when talking about quality in science we are not discussing the whole of the quality work that has been done, but only that work which has been through the system and been given the recognition of the scientific community.

There are arguments that the refereeing function is taking a lesser role in the system of science, 'although refereeing may indeed serve the function of technical quality control, it appears more and more ineffective in distinguishing

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14 Mulkay, op. cit. (note 8), p. 100.
15 Ibid, p. 100.
16 Ibid, p. 100.

innovative from pedestrian research.'[17] In addition to this 'one is forced to conclude that the refereeing system is not successful in holding back the tide of new literature',[18] and is one of the main factors in the time lapse between submission and publication of a paper. As stated by Sir William Bragg, 'the number of possible referees is limited, and is even becoming relatively smaller as specialisation increases'.[19] This situation has worsened since 1938, and as the number of referees becomes more limited, the higher the pressure on those available to perform their refereeing functions in addition to their normal work. Some writers, such as Waksman and Odlyzko suggest that these are reasons for eliminating the refereeing process altogether. I do not support this point of view. Refereeing, although not ideal, is still an important part of the system of science, and while it may need some alteration, should not be discarded if a change to electronic journals occurs.

One of the 'value-added' features of print journals is that journals are 'archived'. Once a paper is published in a journal, it becomes part of the permanent scientific record, bound in leather volumes, indexed and stored to allow them to be referred to and located. This was one of the incentives to publish in early journals, as reported by a patron of the Royal Society, Robert Boyle who saw contributing as 'a way for the scientist to have his work permanently secured in the archives of science'.[20] The act of archiving, however does not guarantee recognition of work. As is well known, for example, the geneticist Mendel's work 'lay in the archives for generations before its importance was recognised'.[21] But,

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17 B. H. Waksman, 'Information Overload in Immunology: Possible Solutions to the Problem of Excessive Publication', The Journal of Immunology, March 1980, 124, pp. 1009-1015, at, p. 1011.

18 Ibid., p. 1012.

19 Sir W. Bragg, 'Address of the President of the Royal Society', Science, December 23, 1938, 88, pp. 579-583, at p. 580.

20 Merton, op. cit., (note 6), p. 466.

21 D. Schauder, 'Electronic Publishing of Professional Articles: Attitudes of Academics and Implications for the Scholarly Communication Industry', Journal for the American Society for Information Science, March 1994, 45(2), pp. 73-100, at p. 82.

to allow work to be 'challenged, built upon or ignored both by contemporaries and by future generations',[22] it must first be entered into the general archive of science, and this is through publication.

The importance of archiving is integral to academic publishing, and this is one of the concerns in a move to electronic journals. Electronic technology is ever evolving, The Internet, by its nature, is not institutionally controlled like, for example, a library. The difficulty with archiving electronically is not whether the medium the information is saved on (such as a disk, or a hard drive) will survive , but whether it will be able to be retrieved. This is both a hardware problem 'as one storage system replaces another, spare parts, repair expertise, and even the original manufacturers [of equipment] are disappearing by the day',[23] and a software problem as the amount of data transmitted in graphics, text and potentially video will create 'untold quantities of data.'[24] The problem of archiving is rarely discussed in the literature, although one of the comments made by a mathematician in the empirical study was 'I am concerned about the long term archival availability [of electronic journals] - an important aspect of material published in paper journals' (see 'Comments about the current journal system', in Table 15 of Appendix 2). This problem is one that must be addressed if a switch to electronic journals is to happen.

One of the inherent problems in the current system is the need to "publish or perish", 'because publication is one of the main measures of an academic's productiveness.'[25] There is a recurring suspicion in the literature that the quest for an increase in publication has led to a decline in quality,

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22 Ibid., p. 82.

23 Author unknown, 'Store wars', The Economist, 18 September 1993, 328, p. 85.

24 Ibid., p. 85.

25 Schauder, op. cit. (note 21)., p. 82.

scholarship suffers, both because the authors have insufficient time for contemplative reading and as a consequence of the attempt to inflate the importance of the work being published relative to competing work in the field[26],

and this has resulted in various methods to bolster publications. One of these is the practice of splitting information, where material adequate for a single paper is sliced into smaller units and are sent to different journals[27]. (It is considered very bad form to submit a paper to more than one journal at a time and can lead to rejection if the practice is discovered by the editors involved.) In a footnote of Ravetz's paper, one example of this practice is demonstrated by 'an author who first published a paper in Science, . . . but who proceeded to use one-half of the data, and then one-quarter of the data, for two later publications in speciality journals, with no cross referencing between articles.'[28] Apart from automatically increasing their publication count, this can result in the same author being cited twice or three times instead of once, which would also boost their citation count. In addition, it is not unknown to have informal citation agreements, '[a]uthors will choose their citations so as to make the citation indexes serve their purposes'.[29] Self-citation or reciprocal citation is another well known method. The necessity to bolster publication counts is a concern with the proposed move to electronic journals. A comment made by an applied geologist in the empirical study was

> I am concerned that the quantity of material published will increase, making it yet more difficult to find the original work amongst the mass of publications designed prinicipally to inflate the author's C.V. (see 'Comments about the current journal system', in Table 15 of Appendix 2)

With the "publication push" being a contributing factor to the serials crisis, it can be argued that it is the system itself that is one the causes.

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26 Waksman, op. cit., (note 17), p. 1009.

27 Schauder, op. cit. (note 18), p. 82.

28 Ravetz, op. cit., (note 7), p. 287.

29 Kenneth O. May, in letter to Science, 1967, 156, p 890.

Mulkay has two conclusions in his discussion of the reward system of science:

> The first is that rewards are distributed by a social process of exchange, whereby valued information is made available to the research community in return for professional recognition. The second is that this exchange process generates a self reinforcing elite structure[30]

Looking at the first point, as the system stands, not all information published electronically (even if published in electronic journals) is 'valued', as not all of it is peer reviewed. Therefore the 'social process of exchange' will not occur. While scientists may consider their contribution to be valuable and relevant, if it is not recognised by the scientific community as being so, then the exchange for professional recognition will not occur (unless the criteria on which professional recognition is accorded to people are changed).

Another difficulty with the first point is the 'egalitarianism and "anything goes" sensibility of the Internet [which] could work against attempts to raise the status of E-journals'.[31] Until now (at least), publication on the Internet has specifically not been for personal gain or reward, if a 'surfer' finds something interesting, they post it onto the Internet for the general information of anyone who is interested. There is no expectation of recognition or reward. So there is a conflict of philosophy. What scientists will need the Internet to provide for them is some sort of exclusive protocol that allows evaluative work. The difficulty is that it is not scientists who are writing the protocols that allow easy use of the Internet and those who devote their time to providing facilities for the Internet may not find it necessary to create this facility.

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30 Merton, op. cit., (note 6), p. 103.

31 G. Stix, 'The Speed of Write', Scientific American, December 1994, 271, pp. 72-74, at p. 75.

Mulkay's second point is one that is used as an argument for electronic journals. It is related strongly to the Matthew effect (as coined by Merton). The name comes from the Gospel according to Saint Matthew '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'.[32] This idea is reflected strongly in observations of Zuckerman and Merton, that Nobel laureates 'repeatedly observe that eminent scientists get disproportionately great credit for their contributions to science while relatively unknown scientists tend to get disproportionately little credit for comparable contributions.'[33]

The result of the Matthew effect is that the type of science being done is, to a certain extent, being manipulated by referees, 'the peer review system is biased in favour of established scholars who work within a field's accepted paradigm, at the expense of less established scholars pursuing less conventional research agendas.'[34] This idea is also explored by Cole & Cole. They state that 'the significance of work done by a scientist is not always recognised immediately, for new ideas, especially those that lead to changes in basic scientific paradigms are sometimes resisted or ignored'.[35] Those arguing for electronic journals (Paul Ginsparg for example) maintain that the use of electronic journals will free up the constraints on people 'with an unorthodox approach'[36]. This, they argue will open up new areas of science.

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32 Quoted in R. K. Merton, The Sociology of Science, Chicago University Press, London, 1973, p. 445.

33 Merton, op. cit., (note 6), p. 443.

34 Ibid, p. 494.

35 Jonathan Cole & Stephen Cole, 'Measuring the quality of sociological research:, Problems in the use of the *Science Citation Index*, The American Sociologist, February 1971, 6, pp. 23-29, at p. 23.

36 Robert Matthews, 'Storming the barricades', New Scientist, 17 June 1995, 146, pp. 38-41, at p. 40.

The Normative vs. Interpretative argument

In 1942[37], Robert K. Merton first wrote of a set of institutional norms that attempted to 'identify the social norms which distinguish the scientific community, and in particular the pure research community, from other social groupings.'[38] A norm is a specific sort of rule. The norms of science are an agreement between a scientist and the scientific community, they constitute part of the ethos of science. This ethos is often internalised, and subsequently, individuals will not always be aware of it. While Merton's norms are merely one of several attempts to describe the activity of science in terms of norms, they have caused the most debate. That debate will be discussed later, after a description of Merton's theory.

Merton split the 'institutional imperatives' (Merton's words) into four; universalism, communism, disinterestedness and organised scepticism. Universalism enjoins that evaluation of any information presented to the scientific community be made, regardless of the source. This eliminates any rejection on the basis of 'race, nationality, religion, class and personal qualities'.[39] It is this norm which (so Merton argues) is 'rooted deep in the impersonal character of science.'[40] Communism[41] relates to common ownership of goods, and it is here that the reward system is acknowledged. 'The scientist's claim to 'his' intellectual 'property' is limited to that of recognition and esteem which. . .is roughly commensurate with the significance of the increments brought to the common fund of

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37 This first appeared in 'Science and Technology in a Democratic Order', Journal of Legal and Political Sociology, 1942, 1, 115-126, it later appeared in his book Social Theory and Social Structure, published in 1949. The references to Merton used here are from 'The Normative Structure of Science', chapter 13 of his 1973 book, The Sociology of Science.

38 Mulkay, op. cit, (note 8), p. 97.

39 Merton, op. cit., (note 6) p. 270.

40 Ibid, p. 270.

41 Often referred to nowadays as communalism so as not to offend tender political sensibilities.

knowledge'.[42] (This is reflected in Mulkay's 'social process of exchange'.) Disinterestedness is 'a distinctive pattern of institutional control of a wide range of motives which characterises the behaviour of scientists'.[43] Disinterestedness enjoins the pursuit of scientific truth above all else. This relates to the peer review process, where all material that is published has already been 'subject to rigorous policing'.[44] It is this norm, Merton claims, that has the major role in reducing the level of fraud. In addition, it stands as one of the most important, precisely because science is a profession where only those who are in a particular field are in a position to assess the work of the others in that field. The last norm, Organised Scepticism is a mixture of individual and institutional mandate. Results from another scientist should never be taken 'on trust'.[45]

As a result of these norms, Merton is able to create an image of scientists as impersonal, objective and moving towards the common goal of the furtherance of knowledge. However, he qualifies this by saying:

> Although it is customary to think of the scientist as a dispassionate, impersonal individual-and this is not inaccurate as far as his technical activity is concerned-it must be remembered that the scientist, in company with all other professional workers has a large emotional investment in his way of life, defined by the institutional norms which govern his activity.[46]

While this paper is not an in depth discussion of the validity of Merton's claims, it is important to have an understanding of them, as they are often referred to in arguments about the electronic journal issue.

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42 Merton, op. cit., (note 6), p. 273.

43 Ibid., p. 276.

44 Ibid. p. 276.

45 Mulkay, op. cit., (note 8), p. 98.

46 R. K. Merton, 'Science and the Social Order', Philosophy of Science, 1938, 5, pp. 321-337, at pp. 327-328.

Michael Mulkay has spent much energy discussing Merton's theory. The basis of his discussion is 'the relationship between norms or rules and social action.'[47] According to Mulkay, the erroneous assumption of normative sociology is that once the norms are identified, 'we can apply the rules to particular acts without any further interpretative work by the analyst.'[48] The difficulty with applying rules to any situation is that they are then open to interpretation from different angles allowing in extreme cases polar arguments that are both supported by the same set of rules. In the situation of Merton's description of the normative structure of science, the norms 'have been used in such a loose and all-inclusive way by us all that any conceivable professional act on the part of research scientists has been classifiable, with a little ingenuity, within their frame of reference'.[49]

As quality control is so closely linked with the reward system operating in science, it is worth noting the problems Mulkay has in finding connections between the 'distribution of professional rewards and the Mertonian norms'.[50] There are three main problems, first, 'there is no institutionalised link between conformity to these norms and the receiving of recognition, [second,] that although organised scepticism may operate as part of the rhetoric of science, it is not firmly institutionalised in such a way that general conformity is maintained [and third that the norms are] open to a great variety of specific interpretations'.[51]

Taking the argument of norms into the discussion of electronic journals, it is possible to discuss conflicting arguments in terms of the same norm. Looking at the argument about quality control, which is central to the debate, those arguing against electronic journals are doing so on the basis that if quality control in

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47 Michael Mulkay, 'Interpretation and the use of rules: the case of the norms of science', Transactions New York Academy of Sciences, New York, 1980, pp. 111-125, at p. 111.

48 Ibid., p.111.

49 Ibid., p. 113.

50 Mulkay, op. cit., (note 8), p. 105.

51 Ibid., p. 105.

science is reduced (because electronic journals are not necessarily subject to formal peer review), then the reward system will no longer be operative. This is supported by the norm of disinterestedness, which is related to the idea of 'the ultimate accountability of scientists to their compeers'.[52] Therefore, if peer review is reduced by a move to electronic journals, the norm of disinterestedness is violated.

However, it can be argued that the norm of disinterestedness will be upheld more strongly if there is a switch to electronic journals. This will occur in two ways. One of the arguments for electronic journals concerns itself with the standard methodology of presentation of work to journals. Issues such as the length of articles must be restricted. The necessity for brevity of articles has its origins in history, 'because printing, although much cheaper than hand copying, was still expensive, [and] mathematical journals were constrained into a format that emphasised brevity'.[53] If work was able to be published electronically, the length of the article would cease to be as important. This would allow all results to be included in the paper (see the previous chapter for a full discussion of this point). In addition, electronic journals can address the problem of inaccurate citation, and over citation, because with the use of hypertext, the citation reference is available at the click of a button (assuming the reference is also available electronically), instead of being a library search away. With both of these points it can be argued that this increases the level of quality control, as any reader of the paper (the compeer) will first have a more complete and understandable paper to read. Second they will, with almost no effort, be able to check the citations. So the norm of disinterestedness will be even more strongly upheld if a movement to electronic journals occurs.

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52 Merton, op. cit., (note 6), p. 276.

53 Andrew M. Odlyzko, 'Tragic loss or good riddance? The impending demise of traditional scholarly journals', available from amo@research.att.com, p. 16.

By looking at the paragraphs above it becomes clear that Merton's norms can be used to support very different sides of this debate. The norm of disinterestedness supports both sides of the argument. Mulkay's argument about the use of rules is relevant and topical. It is well to keep in mind the reasons an individual or group may have to present a point of view. The topic of 'who benefits' is the topic of the next chapter.

How does the electronic journal fit into this argument?

The literature is heavily weighted with arguments that support the introduction of electronic journals. Those who argue against it tend to do so in response to this literature rather than by instigating arguments. It is logical therefore to begin a discussion of the argument with the pro-electronic journal papers and discuss the detractors as they occur. The pro-electronic journal arguments seem to be taking two main forms. One is negative, where the difficulties that exist within the current system are highlighted. For example the serials crisis is often cited as an insurmountable problem, where the only solution will be a shift to electronic publishing. As discussed in Chapter 2, the serials crisis is not a new problem, and over the past seventy[54] years various attempts have been made to find a viable solution. It is possible to argue (as done here), that the push for electronic publishing is merely one in a series of attempts to find a solution. The other main argument is positive, where the advantages the electronic system has, and the potentialities it contains are highlighted.

This second form of argument puts forward benefits which are responses to current problems within the printed journal system. The most obvious difference between the two arguments is the type of language used. It is very noticeable that

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54 Sir William Bragg's address to the Royal Society in 1938 discussed the problem. See previous chapter.

those who take the detractive stance use deterministic language. A typical example is found in the words of Andrew Odlyzko, a proponent of electronic publishing: 'I do not think we have much choice, since drastic changes are inevitable no matter what our preferences are'.[55] Those who argue from the 'added benefit' point of view are less sanguine in their argument, as will be shown for example in the arguments of David Rodgers, outlined below.

The main arguments for electronic publication consist of an increased speed of publication, a lowering of paper and library costs, and more efficient storage and retrievability. These constitute the core arguments and are repeated in almost every major paper (in the author's reading at least) on the topic. There are of course, other arguments, and this section will attempt to give an analysis of the main papers in this area.

David L. Rodgers[56] in a paper presented to the International Conference on Refereed Scholarly Journals in 1993 discusses the concept of 'value-added' knowledge. He states that publishers have a role in adding 'value' to the quality of scholarly journals. Once a paper has been published in a journal, the publisher has added value to it by selecting the material, applying editorial expertise and peer review to it, distributing it to a primary audience and archiving it, thereby enabling others to use and access the information in the future.[57] This argument is echoed by John Franks[58], although he also refers to the costs of publishing. Franks points out that the 'next most important value added [after the paper itself] is the certification achieved by the editorial and peer review process'[59] and this cost is

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55 Odlyzko, op. cit., (note 53), p. 1.

56 David L. Rodgers, 'Maintaining Scholarly Quality in Electronic Journals', presented at the International Conference on Refereed Scholarly Journals, October 1-2, 1993, (no page numbers).

57 Ibid., (no page numbers).

58 John Franks, 'The Impact of Electronic Publication on Scholarly Journals', available under veronica search - 'electronic publishing/Scholarly electronic publishing communication and publishing', (no page numbers).

59 Ibid., (no page numbers)

not borne except in an organisational sense by the publisher. The issues of costs and benefits related to publishing will be discussed fully in the next chapter, although it is valuable to keep them in mind when looking at this area of the argument.

Rodgers describes a system that will allow electronic journals to continue the tradition of refereeing and verification, while incorporating the potentialities of the new medium. He lists the potential benefits that electronic journals will have. His argument is that there is a 'new added-value' with electronic journals. In addition to the arguments of an increased speed of publication, solutions to archiving problems and easier retrievability are the features currently unattainable in print journals. Cross disciplinary search and retrieval, annotation/commentary by a world wide community and live-link with multimedia applications are three of the more innovative ones. His vision then, for electronic journals appears to be one of a radical rather than conservative type. It should be noted here that Rodgers, in his suggestion of these radical features is not at any point trying to undermine the importance of refereeing, unlike other proponents of a 'radical' journal. His is a vision that seeks to incorporate the benefits of both systems.

By looking at increasing trends in use of electronic mail, and the fact that most academics now have access to a computer and do their own typing straight onto it, it is possible to argue that there is already a strong movement towards electronic communication. This argument is supported by the empirical study discussed in Chapter 5. A paper by Amiran et al., lists seven projects underway in 1991 in America, Britain and France that were specifically designed to 'archive and index texts in electronic form'[60] by major universities or associations. Preprints are available, being read and commented on electronically, 'it is much

60 Eyal Amiran, Elaine Orr and John Unsworth, 'Refereed Electronic Journals and the Future of Scholarly Publishing', Advances in Library Automation and Networking, 1991, 4, pp. 25-53.

easier to write a shell script or create an alias to send 50 copies electronically than it is to make 50 xerox copies, stick them in envelopes and address them'[61], and there is an increased move towards a standardised format for articles submitted for publication. This is particularly evident in Mathematics with the introduction of a program called TeX 'which means that little conversion is needed [by the publisher]'.[62]

While Franks' article is mainly concerned with cost of publication, he does look at the issue of composition and typesetting. He maintains that the cost of these is being moved by the publisher from them to the author or the author's institution, and this is moving to a point where if the article is not submitted in the standard format then the cost of transferring it is referred to the author on a 'per page' basis.[63] So we have a situation where academics are becoming more and more reliant on the computer for communication and publication. And it is not just in these areas that academics are reliant on computing. For example, 'medicine is gradually being permeated by electronics. . . .[r]esearchers use computers to store and retrieve data, perform statistical analysis and word processing, and search the literature.'[64] This infiltration of electronics is incorporated with technological momentum[65]. Publishing an article is one element in an interlocked system of communication, and many other elements of the system are undergoing technological change and becoming electronic.

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61 Odlyzko, op. cit., (note 53), p. 22.

62 Ibid, p. 9.

63 Franks, op. cit., (note 58), and, A. Singleton, 'Publishing at the crossroads? A look at trends in physics journal publishing', Physics Bulletin, September 1976, 27, pp. 399-403, at p. 401.

64 J. P. Kassirer, 'Journals in Bits and Bytes, Electronic Medical Journals', The New England Journal of Medicine, 16 January 1992, 326(3), pp. 195-197, at p. 195.

65 Not to be confused with technological determinism, which assumes technological change is a "cause", and everything that follows is an "effect." This discussion of technological momentum recognises 'that as technologies are being built and put to use, significant alterations in patterns of human activity and human institutions are taking place'. For a full discussion of this concept, see Langdon Winner, 'Technologies as Forms of Life', in L. Winner (ed.), The Whale and the Reactor, University of Chicago Press, 1986, pp. 3-19.

Informal lines of communication are becoming reliant on electronic mail, article submissions to publishers are increasingly required to be in an electronic format (on disk) and so forth. It is therefore, not a great step to move towards complete electronic publication.

Moving away from the positive argument into the negative, we look at some of the difficulties with the current system. Robert Matthews in an article about electronic publishing has discussed Paul Ginsparg's views. Ginsparg is the 'editor' of a pre-print service that is run entirely on the Internet. Whilst he too argues about time and cost, Ginsparg is also critical of the entire peer review process. His argument is that 'the way refereeing is handled is entirely inept. . . it only results in pointless delays benefiting no-one'.[66] The problem with the system (the argument goes) is that if an author is unconventional in approach it is possible to take years to publish despite writing 'brilliant but unorthodox papers'.[67] This sort of argument seems to be stemming from younger people in scientific fields, which could well be related to difficulties they have experienced in attempting to be published in conventional printed journals. It could also be related to being 'swept up with the technology'.

Odlyzko argues that the current system is unreliable despite the rigorous standards that are in place. 'Even conscientious referees often miss important points. Furthermore, many referees are not all that conscientious.'[68] While the discipline of mathematics, simply due to its nature, requires exact proof reading and thus mistakes in refereeing are more obvious, this difficulty with the quality of refereeing probably affects many disciplines.[69]

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66 Matthews, op. cit., (note 36), p. 38.

67 Ibid., p. 40.

68 Odlyzko, op. cit., (note 53), p. 18.

69 It may be due to the exact requirements of mathematics and physics that these two areas seem to have more support and more activity in the area of electronic publication.

Matthews' paper outlines a proposal by Odlyzko for a new form of journal where papers are posted and after verification by an editor and timestamping by the computer (to resolve priority disputes), they would be available for comment by everyone. The authors would be able to modify the paper in response to these comments. Rodgers also outlines this idea, although the difference is that Rodgers suggests that at some time the paper is 'frozen' and from then on only a read-only form is distributed.[70] The benefit of this is that 'the traditional added values of scholarly publishing are thus incorporated in a journal metaphor where the mechanisms by which they are expressed have been largely transformed.'[71]

It is interesting to note at this point that despite recognition that 'academics need to contribute quality research to respectable journals as often as possible to win funding',[72] the issue of how electronic journals are to acquire prestige is not actually addressed. The 'solution' being offered is to have a peer review process within electronic publishing. But will that change the opinions of those compiling formal or informal rankings of publications in the complex calculus applied in the reward system?

One electronic journal that is refereed is EJournal. (The origins of this journal are discussed in Chapter 1). An article by Doug Brent appearing in it in June this year discussed Stevan Harnad's 'subversive proposal'. Brent draws on the work of Odlyzko and Okerson (two other major proponents of electronic journals, who have written extensively on the topic). What is particularly radical (the subversive part) about the proposal is the 'recommendation of direct action on the part of the scholarly community, action that would end the hegemony of the publishing industry'.[73] This has been noted by others, K. R. McKinnon made the

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70 Rodgers, op. cit., (note 56), p. 3.

71 Ibid., p. 3.

72 Matthews, op. cit., (note 36), p. 40.

73 Doug Brent, 'Stevan Harnad's "Subversive Proposal", Kick Starting Electronic Scholarship, A summary and analysis', EJournal, June 1995, 5(1), line 232-235.

observation that the 'new technology offered an opportunity "for universities to assume greater control over the publishing process and to lessen the intervention of commercial publishers" '.[74] As things currently stand, the benefits that scholars gain from publishing are in the form of grants and tenure. This is one of the arguments for a movement to university controlled publication, because as things stand,

> publishers and an inner circle of referees decide who gets published and, therefore, who receives tenure and merit raises . . . [but if universities regained control over publishing they] could ensure the quality and fairness of the review of research in all fields.[75]

Publishers obviously derive benefit from scholarly publishing (which is mainly financial), and scholars are required under the current system to 'give' their work to publishers in order to gain academic benefit from publication. (This 'gift-giving' concept has been explored in the first chapter.) Harnad is proposing a system where the gain achieved by the scholar through publication could be obtained without the necessity to enter into a 'Faustian bargain' with the publishers. The impact such a proposal would be likely to have on publishers is discussed in the next chapter.

One of the major concerns about electronic publication is that there will be a drop in the standard of authorship. In meeting such concerns, an oft-used argument for the expected quality of electronic journals is the current quality of pre-prints that have appeared so far in electronic journals. An example of this is Paul Ginsparg's journal, which started in 1991 as 'merely an electronic clearing

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74 K. R. McKinnon, 'Challenges confronting university libraries and strategies for response', in W. B. Rayward (ed), Confronting the future: University libraries in the next decade: Proceedings of a conference at the University of New South Wales, Australian Academic and Research Libraries, Canberra, 1992, pp. 41-47, quoted in Schauder, op. cit., (note 18), p. 85.

75 S. J. Rogers and C. S. Hurt, 'How Scholarly Communication should work in the 21st Century', College and Research Libraries, January 1990, 51, pp. 5-8, at p. 8. It is interesting, although not surprising to note that the past two quotes have come from library oriented sources.

house for pre-prints in high energy physics'[76] and is now being funded by the National Science Foundation to the tune of US$1million.[77] However, Harnad argues that the reason for this high standard is due to the pre-prints' intended destination within traditional journals. 'In other words the preprints are generally of good quality because they are destined for a paper publication system which already has in place a mature and well organised peer review system'.[78] The question remains that if we do move to a completely electronic system, will this advantage disappear?

Brent discusses an idea of Harold Innis that refers to bias that is built into media. The argument is that paper journals have 'tangible, object-centred quality indicators'. These relate to the appearance of the journal, there being a distinct difference in the perceived quality of a journal when looking at the use of high quality paper, the choice of typeface to create a styled effect and so on. These quality control signals are simply not available to electronic publication. The bias runs further as there is already a perceived element of 'graffiti board' about discussion on the Internet. How does an editor 'display' the higher quality of their particular electronic journal?

One of Stevan Harnad's earlier papers on this issue was 'Scholarly Skywriting and the Prepublication Continuum', which discusses a few of the early concerns and arguments (the article was written in 1991). Harnad points out that while the act of writing is more disciplined and reflective than thought or conversation, thought occurs at a much faster speed. After the time that it takes for an article 'to be accepted, published, read by others and responded to',[79] the original thought is no longer active, thus arguments and discussions that could

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76 Matthews, op. cit., (note 36), p. 38.
77 Ibid., p. 38.
78 Brent, op. cit. (note 73), line 345-348.
79 Harnad, op. cit., (note 2), final page.

have occurred at the time the article was written are lost. This opens a new side to the problem of speed of publication, that the current extended periods between submitting and publishing an article are resulting in lost knowledge.

Preparation for publication, Harnad argues is the period during which most of the cognitive work is done. This is the informal side of communication, where scholars interact by telephone, mail e-mail and in discussion at conferences. It is the formal side of publication, (currently relatively unproductive) that is being threatened/replaced by electronic journals. Electronic journals have the potential to keep the informal lines of communication open after the paper has been submitted. The ability of electronic communication to provide almost instant publication of pre-prints to a wide audience allows a more extensive and timely debate of the topic to occur. So it is possible to argue that electronic publishing, instead of lowering the standard of academic discourse, will in fact increase it.

Harnad identifies a number of potential obstacles to the 'revolution' of scholarly use of the Internet. Of these obstacles, three are worth noting: that old ways of thinking about scientific communication and publication constrain our imaginations; that the current intellectual level on the Internet is low; and concerns about academic credit and advancement. In each case Harnad suggests that such obstacles will be overcome as follows: as more and more academics publish electronically, the standard will increase and subsequently the perceived quality will also increase. This type of argument is a 'demonstration and diffusion' argument, once a few people start to publish (demonstration), others will realise the benefits and follow (diffusion). This is plausible, but it may be necessary to 'start the ball rolling' a little, and a solution such as an established journal publishing electronically as well as in printed form may be the required factor. A full discussion of the forces behind electronic publishing and those resisting it follow in the next chapter.

Conclusion

In order to understand the complexities of introducing electronic journals, it has been necessary to establish how entrenched journal publication is in the system of science. The arguments that support electronic publication include: relieving the 'serials crisis' by lowering publication costs and reducing the space needed for storage; as well as increasing ease of access; increased speed of publication; allowing ideas and discussion to occur at the time of conception without a time lag; increased inclusion of those wishing to be published; and inclusion, too of people outside the speciality to the information. In addition to this, others have demonstrated that the system as it stands does not work. The arguments against electronic journals are concerned with the lack of quality control practices. Concerns over lack of refereed articles, low perceived status of electronic journals (and subsequent reluctance to publish in them), and therefore a breakdown in the reward system of science constitute the main arguments. It is possible that the radical proponents of electronic journals will try to set up a different standard of quality, and it is also possible for them to use the normative arguments to support their point of view. Rules (such as norms) do not have instructions as to how they are to be deployed, so it is necessary to keep in mind the argument as presented here when looking at the forces at play discussed in the next chapter.

Electronic journals offer many potential improvements to the current system of science. Increased multi-disciplinary searches are possible, and innovations such as hypertexting can allow immediate cross-referencing to citations. There is an opportunity unprecedented in science for the community to 'take stock' of the current system, decide which areas could be improved, implement those and discard those areas that are superfluous to modern needs. If this is not done, it is possible that electronic journals will become a reality in the next ten years, and instead of controlling their implementation, scientists will be forced to try to fit the current system into a technology that doesn't support it.

CHAPTER 4

THE FORCES AT PLAY. IN THE MOVE TO ELECTRONIC JOURNALS, WHO DECIDES WHAT, AND WHY?

The sheer volume of journals that is currently on library shelves, and the exponential growth of serial publication that is occurring, is driving the academic publishing world towards an information explosion. The situation is such that no one library, or one academic, can possibly keep up with the burgeoning literature. New methods for searching and archiving are desperately needed. The rising cost of publication is a major problem for libraries, academics and publishers alike, and the environmental impact of more and more trees being turned into unread paper articles, (not to mention the oil and human labour required to transport these publications around the world), is increasing. Not surprisingly, the electronic journal, being hailed by some as the answer to these problems, is the subject of much debate on behalf of all three of these groups.

Any innovation will have differing opinions of it, and subsequently be subject to two sides of an argument. One way of framing the argument surrounding the introduction of the electronic journal is the agency/structure theory. In its most general form, the 'agency' is the person or people who are involved in a situation; the 'structure' is the institutional or social structures surrounding it. The agents in this case are those who wish to see the introduction of electronic journals. Much discussion of electronic journals by those people is couched in voluntaristic terms, making the assumption that the electronic journal is an idea whose time has come. However, deeper issues are at stake. Existing economic, institutional structures and patterns of career and skill development provide a structural background, or set of constraints on 'free agency'. The discussion in terms of technological determinism is an example of this. Those who argue that the introduction of electronic journals is inevitable are assuming that the technological structures in place limit the freedom of those involved (academics, publishers and librarians) as agents. This chapter is looking at the three main professions affected by the potential change to electronic journals. As with any change, there will be positive and negative aspects for the players involved. What these are and how they affect the arguments being put forward is the topic of this chapter.

The serials crisis - who will drive the vehicles on the information superhighway?

The expression 'serials crisis' is used to describe several situations, 'what librarians refer to as the 'serials crisis' has been brought about by dramatic increases in the cost of scholarly journals (an average of 13.5% annually for more than a decade) combined with financial constraints facing most academic institutions today.'[1] So it could be argued that the increasing cost of subscription is due to the increased number of publications. Graph 4 below demonstrates that costs for journals more than doubled during the eight academic years covered by the graph, whereas the number of subscriptions actually dropped. As the market is further and further saturated with new journals, libraries are forced to choose between journals, subsequently the cost of individual journals rises to counter the falling subscription rates.

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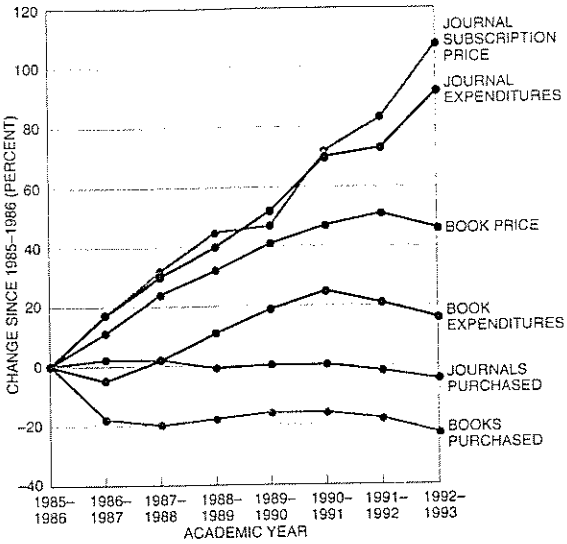
1 J. Franks, 'The Impact of Electronic Publication on Scholarly Journals', (from Veronica search: 'scholarly electronic communication and publishing'), p.1.

Graph 4
Changes in price, expenditure and purchases of books and journals from 1985 to 1993.



Source: Gary Stix, 'The Speed of Write', Scientific American, December 1994, pp. 72-77, at p. 74.

However the expression is defined, there is no doubt that an information explosion is occurring. A dramatic explanation of the situation is by Odlyzko,[2] who outlines in explicit detail the exponential growth of papers in mathematics. He claims (with reference to de Solla Price) that 'the number of scientific papers published annually has been doubling every 10-15 years for the last two centuries'.[3] The gravity of the situation becomes clear when we realise that 'almost half of [the mathematical papers ever published] have been published in the last 10 years'[4]

The growing amount of information available has led to an increase in the number of positions within the information industry. Academic publication is not

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2 It should be explained that Odlyzko is a mathematician, and is able to blind us with a convincing numerical argument.

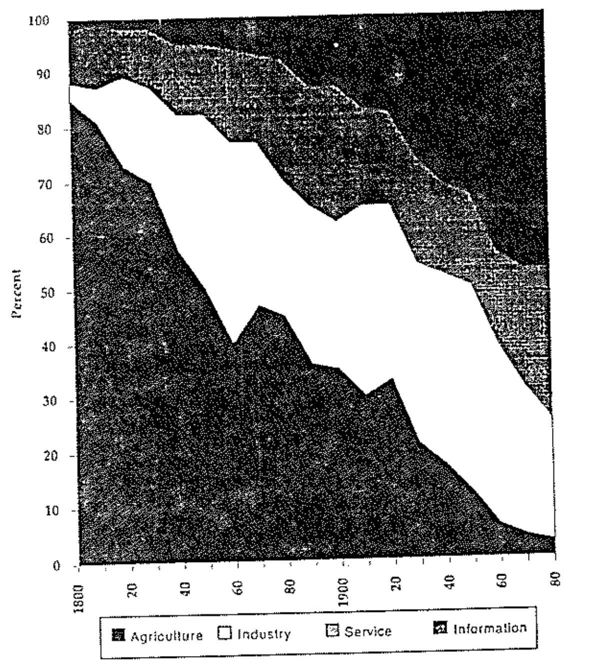
3 A. M. Odlyzko, 'Tragic loss or good riddance? The impending demise of traditional scholarly journals' (amo@ research.att.com.), Preliminary version, December 30, 1993, pp. 1-29, at p. 2.

4 Ibid., p. 2.

alone in having an information explosion. Graph 5 below demonstrates that the percentage of labour working in information has grown from approximately 2% in 1800 to over 40% in 1980. Librarians are the main information professionals in the academic information explosion.

Graph 5

U.S. Civilian labour force by sector: 1800 to 1980



SOURCE: Reprinted by permission of the publishers of *The Control Revolution: Technological and Economic Origins of the Information Society* by James Beniger. Cambridge, Mass.: Harvard University Press, Copyright © 1986 by the President and Fellows of Harvard College.

Source: Paul N. Edwards, 'From "Impact" to Social Process. Computers in Society and Culture', in: Sheila Jasanoff, Gerald E Markle, James C. Petersen and Trevor Pinch (ed.s), Handbook of Science and Technology Studies, Sage Publications, California, 1995, pp. 257-284, at p. 271

Some discussions on this topic lay the responsibility for the serials crisis in the hands of particular groups. As libraries and librarians work in an industry of information, they are often the subject of these discussions. Byron Waksman suggests, in his list of possible solutions to the serials crisis, that if libraries 'refused to subscribe to commercially motivated scientific journals, most would rather quickly disappear since they depend for their existence on libraries rather individual subscribers.'[5] This implies that libraries are to a certain extent responsible for the current situation. While not denying that by refusing to subscribe, the libraries can affect the existence of some serials, the situation is in fact more complicated than that.

The 'publication push', outlined in the previous chapter, has been described as a result of the way the reward system operates in science. However, the chain extends further than simply a response to the need to publish. The increased number of articles require space in ever more journals and 'the costs of producing the journals to hold all these papers are recovered from a tiny subscriber base that consists mostly of university libraries.'[6] Thus it could be argued that libraries are contributing to the current serials crisis. It could equally be argued that the reward system of science is responsible by forcing academics to 'publish or perish'. Odlyzko makes the point that 'with world population growing towards 10^{10}, in the next three or four decades, we might end up in the second half of the 21st century with 10 times as many researchers as we have today'[7] and so the situation is purely a result of numbers, not the result of direct action on behalf of any one group. This is an example of a structural constraint beyond the control of any individual agency.

The serials crisis is used by almost all proponents of electronic journals as a strong argument for change. Electronic journals have been heralded as a solution. Free electronic journals have the advantages of substantially lowering the cost of access to information, as well as almost eliminating the problem of storage space. One of the main factors in this solution is the 'reaction of librarians to these

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5 B. H. Waksman, 'Information overload in Immunology: possible solutions to the problem of excessive publication', The Journal of Immunology, March 1980, 124(3), pp. 1009-1015, at p. 1014.

6 G. Stix, 'The Speed of Write', Scientific American, December 1994, 271, pp. 72-77, p. 73.

7 Odlyzko, op. cit., (note 3), p 3.

innovative publications'.[8] The role of librarians will change substantially if electronic journals become the main medium of academic exchange. This has been the subject of debate, and several predictions have been made. Franks claims that librarians' current roles as archivers and cataloguers will remain unchanged, but the means by which they will fulfil the roles will alter dramatically. He concludes that one of the advantages for the librarian is that their job will become a glamorous high tech position.[9] Odlyzko, however predicts that many of the traditional roles of librarians will disappear, such as 'keep[ing] track of loaned material, since there is only one physical copy of each book or journal issue.'[10] Searches will be able to be done electronically (obviously), so 'it should be possible for a few institutions. . . to provide most of the services needed'.[11] Odlyzko concludes his argument with the statement that 'in the future both journal publishers and libraries will play a much diminished role in scholarly publications.'[12]

If this were the case (and there is at least some reason to believe it would be), then it would be beneficial to librarians to avoid the move to electronic journals. After all, a difficult job is better than no job at all. However, there has been some attempt to restrict the number of printed journals (in a move towards electronic journals). Franks in his paper suggests that librarians have 'begun to take action by campaigning to persuade faculty not to submit papers to the most expensive journals or to serve on their editorial boards'.[13]

Librarians take a slightly different view of the situation. Daniel E. Atkins (who began his career as an engineer and is now dean of the library school at

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8 Franks, op. cit., (note 1), p. 4.
9 Ibid., p. 5. An interesting observation, but will a librarian whose job is threatened feel better for it?
10 Odlyzko, op. cit., (note 3), p. 15.
11 Ibid., p. 16.
12 Ibid., p. 16.
13 Franks, op. cit., (note 1), p. 4.

University of Michigan), wishes to redefine the job of the librarian. The vision is 'an "information professional" who will combine the skills of the computer scientist, the business graduate and even a little of the old-school librarian'.[14] There is an increased need to look at alternatives to journal acquisition, 'there is a growing trend in having *access to materials* rather than *owning* those materials.'[15] James Powell, who is heavily involved in creating a hypertexted[16] library information system maintains that librarians are vital in instigating and managing the change, 'this web of information would benefit enormously from the organisational and information management skill librarians could bring it.'[17] He notes the difficulty people have with locating specific information on the Internet (a problem not unfamiliar to the author), and claims this is where the new role of the librarian will be; 'it is unlikely that any of these local collections of information will become reliable resources until librarians step in and sort out what resources are available where'.[18] Whether librarians will be the means by which the sorting will occur is something time will resolve. It could equally fall to publishers collaborating to produce journals in a uniform format, or computer experts creating ever more innovative search methods like the World Wide Web. However the point he is making is very important, and often overlooked in the discussion.

The Internet is a large and confusing resource. If there is to be a move to electronic journals, many subsidiary support mechanisms will have to be created. The most basic of these is provision of computers that have access to the Internet. Training on the Internet, both as a search facility and a publishing facility is a current and growing need.[19] The information will have to be sorted, and if the

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14 Stix, op. cit., (note 6), p. 76. (original emphasis)

15 A. Keyhani, 'The online journal of current clinical trials: an innovation in electronic journal publishing', Database, February 1993, 16 (1), pp. 14-23, at p. 15.

16 Hypertext is an electronic system of cross-referencing, free of the constraints of linearity that connects words, phrases, and concepts instantly at the click of a mouse button.

17 J. Powell, 'Adventures with the World Wide Web: Creating a hypertext library information system', Database, February 1994, 17(1), pp. 59-66, at p. 66.

18 Ibid., p. 66.

19 The initiatives the UNSW is making in this area will be discussed in the next chapter.

system is to be complete, eventually back issues of journals will need to be scanned or typed into the system. All of these support mechanisms require qualified people and, most importantly, financing. While in the long term a switch to electronic journals will free funds currently being used to subscribe to printed journals, there will be a period of conversion that will be costly. The initial outlay for this innovation will fall on the shoulders of institutions such as universities. Harnad and Odlyzko argue that much of this initial cost has already been spent as most academics in Australia, Britain and USA already have access to linked computers. Powell argues that the cost will be minimal because 'locally or nationally funded development groups provide these tools [new developments in computer science] and documentation free, and with virtually no licensing restrictions.'[20] However, the sorting and dissemination of the information is still necessary and will continue to be so. Therefore this will be a continuing cost.

Another argument the serials crisis creates for the move to electronic journals is the move to specialisation. It is simply not possible for an academic to keep up with the burgeoning amount of written work in their field. This results in a situation where 'as our numbers grow, we tend to work in narrower specialties, so that the audience for our results stays constant'.[21] However, this information is being dispersed (due to libraries cutting costs), and there remains a need for access to the whole body of literature. One solution (and some argue the only solution), is to move to a centralised archival system that allows easy access to all literature. Chapter 2 discussed the various centralised system proposals that have been made over the past few decades, and the reasons why they were not introduced. However, electronic journals published on the Internet do represent a system with the advantages of a central archive, without the political difficulties of having centralised control.

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20 Powell, op. cit., (note 17), p. 65.
21 Odlyzko, op. cit., (note 3), p. 4.

There is a trend towards this already. The Directory of Electronic Journals, Newsletters and Academic Discussion Lists showed for 1994 that there were '440 electronic journals and newsletters, up from 110 in 1991. . . During the past two years, the number of peer-reviewed titles has quadrupled to about 100.'[22] One of these electronic journals (and it should be noted that this thesis is only referring to electronic journals, not newsletters) is the Online Journal of Current Clinical Trials (OJCCT). According to the editor of Database, the OJCCT is 'the first electronic, full-text with graphics, peer-reviewed journal'.[23] The first issue was released online on July 1, 1992.

This particular journal is interesting for several reasons. The most obvious feature when looking at the literature on this topic, is the proportionally large amount of publicity the OJCCT has received. This is partly due to the high profile of the joint developers, the Online Computer Library Centre (OCLC), and the American Association for the Advancement of Science (which produces amongst many things the journal Science.) The second interesting point is that it has been a library initiative. The OCLC has been conducting research directly related to this journal since 1982, and the AAAS and OCLC agreed to co-operate on the project in 1989.[24] This implies that the OCLC recognised at least 13 years ago that there was a need for electronic communication of academic results. The AAAS developed the editorial content and focus, while the OCLC developed the interface and distributes the journal. The third interesting point is the choice of medicine as the end-user community. The OCLC looked first at the advantages of electronic publishing,

22 Stix, op. cit., (note 6), p. 74.

23 Keyhani, op. cit., (note 15), p. 14. Many electronic journals claim to be the first in some way, the distinctive feature of the OJCCT seems to be the inclusion of graphics.

24 Ibid., p. 14.

> 1) the speed of publication and dissemination, 2) no page quantity restraints, 3) the ability to link automatically to related documents, and 4) the ability to include experimental data,[25]

before deciding that medicine was the ideal community. Considering that there is a need for timely dissemination of the results of clinical trials, that results can be lengthy, that the graphics are primarily charts, tables and graphs, and that physicians already use computers, it is a sound decision. Why this is interesting however is, as mentioned in the last chapter, most of the people discussing the advantages of electronic journals and creating journals of their own are physicists and mathematicians. The OJCCT is an example of externally driven innovation rather than internal discipline response to a problem.

The serials crisis cannot be blamed on any one group or individual. It has come about as a result of many different forces. While some (non librarians) predict the demise of the role of the librarian, librarians have realised their vital role in the paving and signposting of the information superhighway. Information is their trade. It has been librarians such as Powell who have undertaken to create systems that incorporate and utilise the wonderful possibilities of the Internet.

Which sciences are using electronic journals, and why?

Chapter 3 discussed the various pros and cons of a move to electronic publishing. Most of the positive arguments related to an improved service for the academic in terms of speed and cost. These benefits are cross-disciplinary, and therefore apply to all academics. However, the interest in electronic publishing varies from discipline to discipline. While the majority of electronic journals are addressing themes in the humanities, some scientific disciplines are taking an interest. There appears to be a strong positive interest from the disciplines of physics and mathematics. This interest has been translated into innovations by

25 Ibid., p. 18.

physicists such as Paul Ginsparg's database. The World Wide Web which has provided the programming to allow the point and click interfaces such as Mosaic and Netscape,[26] was 'developed at CERN, the European Particle Physics Laboratory in Geneva, Switzerland, to link collections of documents on high energy physics located around the Internet into one huge resource.'[27] However, when making a decision about which scientific community would benefit most from an electronic journal, the OCLC chose the medical profession. This is interesting if only for the fact that the literature (at least in the author's experience) seems to contain only one article on the debate for or against electronic publishing written by a member of the medical profession.[28]

While not much study has been done to establish why there might be varying interest from different faculties, it is possible to put forward some conjectures. The first and most obvious question is, are there simply more physicists and mathematicians than members of any other discipline? Without even looking at real numbers this theory does not hold, as about half of the literature has been generated by physicists or mathematicians, and they certainly do not constitute fifty percent of the active scientific population.

The second hypothesis is that physics and mathematics are both symbols-based disciplines. They both require mathematical formulae (and therefore symbols) to communicate ideas. This theory does have some evidence to back it. The introduction of TeX as a near standard for mathematics supports it.[29] TeX was created to eliminate the necessity for re-entering information for publishing

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26 (Author unknown), 'A survey of the Internet', The Economist, July 1995, 336, pp. 1-20, at p. 14.

27 Powell, op. cit., (note 17), p. 60.

28 This is the article written by Dr. Byron Waksman (see note 5) that is used extensively throughout this thesis. Noted on the first page of the article was the fact that the article was solicited by the Editor of the Journal, as the subject was 'of pressing importance'. Responses were encouraged, which implies an active increase in interest in the subject.

29 TeX is a computer language specifically designed for mathematical formulae that requires very little conversion for publication.

(and therefore eliminating another potential source of error). By the same token, it could be argued that chemistry also communicates in symbols (ie: molecules[30]) and therefore, if this argument is to hold, the same innovations should be occurring there. Two years ago, a paper was published[31] (electronically) that outlined the introduction of MIME (Multipurpose Internet Mail Extensions). This is a set of applications that handle 'the details of retrieving, converting, and displaying a wide variety of message types in a manner transparent to the user'.[32] This will allow chemists and biologists to 'display, manipulate and even annotate a molecule'[33] over the Internet. MIME was developed by Henry Rzepa, a computational chemist, Benjamin J. Whitaker, and Peter Murray-Rust. It came as a result of 'the difficulty. . . in trying to act as a referee of scientific papers without being able to visualise the results of the work presented'.[34] These details are worth noting because the developers were not computer programmers, but researchers in response to a need. Both these innovations display a realisation within the scientific world (at least in some disciplines) that the Internet needs to have supplemental programs to allow it to be useful to the scientific community, and given such programs, it will have distinct advantages.

Symbols-based communication is directly related to the concept of codification, 'the consolidation of empirical knowledge into succinct and interdependent theoretical formulations'.[35] Mathematics is highly codified, as the only form of communication are formulations. Physics, biophysics and chemistry are fields 'we intuitively identify as more highly codified [than the rest of the

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30 Obviously molecules are not symbols, but as they are not text, they require some form of computer program that allows entry of their description.

31 S. Weibel, 'Mime and the Future of Internet Journals', Electronic Journal of Virtual Culture, August 1993, 1(5), (no page numbers)

32 Ibid., (no page numbers)

33 Stix, op. cit., (note 6), p. 74.

34 Ibid., p. 74.

35 R. K. Merton, The Sociology of Science, Chicago University Press, Chicago, 1973 p. 507.

sciences]'.[36] How this information ties in with the question over the involvement of mathematics and physics is the relationship between highly codified disciplines and the immediacy factor of the papers in those disciplines, 'the more highly codified the field, the higher the rate of "obsolescence" of publications in it.'[37] Cole and Cole[38] point out that (in 1971 at least) 'papers in physics now have a half-life of no more than five years.'[39] Therefore mathematics and physics as highly codified fields, have, in addition to symbols-based communication, papers that become redundant (in an innovative sense) within a short period of time. The combination of these makes them ideal disciplines for electronic journals. Other scientific disciplines (with lower codification) have 'classic' literature[40] with longer half-lives[41], which means that any transfer to electronic publishing will still need to incorporate archived printed papers. With physics in particular, the entire body of currently used papers could be on the Internet and available electronically within a couple of years, as the half-life of the first electronically published papers that appeared is reached. Paul Ginsparg's database is already four years old, so well on the way to being in this situation.

If electronic journals are introduced, the 'job description' of a scientist will change. Obviously the methods of sending information and submitting papers will switch to electronic form, but the changes would go deeper than that. Scientists have four main roles: research, teaching, administration and gatekeeping.[42] All of these will be affected somewhat, in that the mechanism by which the roles are

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36 Ibid., p. 508.

37 Ibid., p. 508.

38 J. Cole and S. Cole, 'Measuring the quality of sociological research: Problems in the use of the Science Citation Index', The American Sociologist, February 1971, 6, pp. 23-29, at p. 26.

39 Ibid., p. 26.

40 D. de Solla Price, 'Networks of Scientific Papers', Science, 1965, 149, pp. 510-515, at p. 514.

41 See Chapter 2, note 43 for an explanation of the term 'half-life'.

42 Merton, op. cit. (note 35), p. 520. Gatekeeping is a term used to describe the quality control system in science.

fulfilled will change. The gatekeeping role could change considerably, as the 'selection of referees [will be limited] to those who have access to facsimile reproduction or computer networks'.[43] That observation was made in 1985, and it is fair to say that most academics do now have access to this equipment, but not all are familiar with it, and not all are prepared to use it. (This claim is substantiated in the results of the empirical study, appearing in the next chapter). Therefore the conclusion that 'a drop in quality [will occur] since the best reviewers for a particular paper [may not be able to do it]'[44] still has validity.

There is a certain amount of resistance by the academic community to the introduction of electronic journals. This is often expressed in terms of the normative structure of science (and the use of that argument is discussed in the previous chapter). The underlying reason may well be simply fear of the technology, but because this is not seen as a legitimate argument, the negative reaction is expressed in other terms. Pacey discusses this phenomena (in relation to VDUs in computer installations), where 'a negative reaction to the new equipment may be expressed in terms [other than the real fear] because in our society [those reasons are] regarded as a legitimate reason for rejecting it'.[45] When considering that there is a considerable personal investment in being a scientist-it takes 'an average period of eleven years after entry into college to obtain the doctorate in science'[46]-the reluctance some scientists have to change is understandable. The position a scientist holds is due to operating within the current system, so any change to that system, which may invalidate some of the previous work is threatening. In addition, those eleven years have been spent being indoctrinated not only into the paradigms of the discipline, but also into the paradigm of the

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43 C. Bishop, 'Electronic publishing: To be or not to be', The Quarterly Review of Biology, March 1985, 60, pp. 43-52, at p. 46.

44 Ibid., p. 46.

45 A. Pacey, The Culture of Technology, Basil Blackwell, Cambridge Mass., 1983, p. 11.

46 Merton, op. cit., (note 35), p. 500, This figure comes from a study done in the U.S.A., in 1971.

system of science. A threat to this is able to cause (with apologies to Kuhn) a revolution. It is interesting to note that the word revolution is often used in discussion of this topic.

By looking at idiosyncrasies of different disciplines it becomes apparent that the introduction of electronic journals to scientific publication is more complicated than an umbrella solution. Different disciplines have different requirements, and the academics in each discipline have differing familiarity with and willingness to operate with computer technology. It is likely that mathematics and physics will pave the way for other, less inclined, disciplines to follow.

Are the publishers friend or foe?

As with almost any situation, when trying to peel back the layers of incentive behind decisions, one invariably ends with the problem of who pays the bill. The situation with electronic journals is no different. While most of the arguments (which are discussed in the previous chapter) do not use costs as a central issue, they are in fact fundamental to the decisions that will end up being made. It is important to take a step back and decide who benefits and who does not if electronic journals come to pass, because these factors determine an individual's or group's stance on the subject and may subsequently influence their argument. Publishers have a vested interest in whether scientists turn to electronic journal publication or not. Depending on what form electronic journals take, they can pose a threat to publishers' livelihoods.

As discussed in the last chapter, publishers place 'added value' onto an article they publish by: editorial selection; organising referees; dissemination to an audience; and archiving the information. The added value is mainly in the form of certification of a paper in the eyes of the scientific community. A paper written that sits on the author's desk has no value. The value of the paper starts accruing once other academics can read it, and its perceived 'value' increases the further into the editorial system it has progressed. However, the role publishers play in this process is mainly administrative. Those parts of the value adding process that are highest in value (the verification of the paper) are performed by other academics, for no charge. The remainder of the added value, dissemination and archiving, is about a third of the cost, 'printing and distribution accounts for about 30% of the cost of a traditional research journal'.[47] There are two conclusions from this figure. First, the whole publication system will cost less if it becomes electronic because there is no need to pay for printing and distribution. Second, more than two thirds of the cost of publication is spent in areas that do not benefit academics directly. It can of course be argued that some of that cost is in typesetting and layout, but as academics are increasingly presenting work in a printable form (especially since the introduction of programs such as TeX, and MIME), this cost to the publisher is decreasing, with no comparable lowering of subscription cost.

The issue of cost can be approached from many angles. Odlyzko (as can be expected from a mathematician) has actually costed the production of a paper and of publishing a paper. While these numbers are estimates, his argument is convincing, and it is fair to take the estimates as reasonably accurate. In calculating the cost of producing a mathematical paper (and these numbers can be easily extended to other disciplines), Odlyzko considers the average publication production of a given academic, and the cost of employing that academic. He calculates that on an average, a researcher produces two or three papers a year, and it costs taxpayers, students and donors to universities about $150,000 per year to employ the academic. This includes salary, grants, capital works and equipment. If one third of this cost is assigned to research activities, 'each paper costs at least

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47 Franks, op. cit., (note 1), p. 5.

$20K'.[48] His method for calculating the cost of publishing a paper is more complicated, based on a survey of American research journals. He concludes that the estimated cost of publishing a paper is $4000.[49] There is a large difference between the two figures, and Odlyzko concludes that in monetary terms, 'the value added by the publishers is dwarfed by that of scholars'.[50] This becomes even more evident when considering that much of the added value in publishing is from academics' unpaid involvement in peer review.

These figures move the argument towards having less involvement by publishers in the publication process, which appears a contradiction in terms. Certainly there is strength in the argument that publication costs should be lowered. Various people have suggested what the costs of publishing would be if a move to electronic publishing were to occur. Publishers maintain that the immediate lowering of cost (due to the elimination of printing and mailing) would be about 30% of the current cost of publishing printed journals.[51] Others argue that in the switch to electronic journals, the costs of journal publication will in fact be considerably lower than that. This is based on the fact that many of the 'set-up' costs of electronic publications have already been spent. Stevan Harnad argues that 'scholarly writing on the net is cheap enough that it does not need a trade model for support',[52] and the cost of production will be 25% that of paper journals. Odlyzko is even more enthusiastic in his estimation, and argues that 'the financial costs of electronic journals should be so low that they will be absorbed into general overhead expenses'.[53] Storage costs automatically plummet, as 'it is already possible to store all the current mathematical publications at an annual cost much

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48 Odlyzko, op. cit., (note 3), p. 11.

49 This figure is so low partly because of the unpaid work of referees and editors, but the argument is based in real monetary terms, so it is not possible to include this work.

50 Odlyzko, op. cit., (note 3), p. 11.

51 Ibid., p.12. and D. Brent, 'Stevan Harnad's 'Subversive Proposal': Kick Starting Electronic Scholarship', EJournal, June 1995, 5 (1), l. 258.

52 Ibid., (Brent), l. 256.

53 Odlyzko, op. cit., (note 3), p. 12.

less than that of the subscription to a single journal.'[54] Odlyzko's final figure for the publication of electronic journals is 10% of the estimate of current costs for printed journals.

This prediction is very bleak for publishers, who are being written out of the futuristic equation. Harnad, in his 'subversive proposal' (which is discussed in the previous chapter), is arguing that this should occur. He maintains that academics should take a pro-active (author's expression) stance on the issue of electronic publishing, since it is not in the publishers' best interest to instigate the transition. This should take the form of an electronic archive of preprints, which are replaced with the published versions once verified. It is only once publication is fully electronic that the break from publishers can occur: 'only all-electronic journals have the potential to free themselves from the Faustian bargain with publishers.'[55] Odlyzko takes an almost flippant approach to the demise of publishers,

> The transition to a paperless system is likely to be painful though. It will be painful for the employees of the publishers. After all, what I am predicting is that most of their professional skills, acquired at great effort, and formerly highly valued by the scholarly community, will become obsolete.[56]

So what are publishers doing about this situation? 'Publishers are still trying to figure out how they can recover their costs'.[57] Some have realised the increased interest in electronic publication, and are now actively doing something about it. Paul Ginsparg's online electronic preprint service for high energy physics has prompted Elsevier Science to create an electronic journal which is an 'on-line compilation of already reviewed papers that are being readied for print in Nuclear

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54 Ibid., p.5. Odlyzko does not appear to have included the printing costs to the users in his estimations, and these should be taken into consideration.

55 Brent, op. cit., (note 51), l. 300.

56 Odlyzko, op. cit., (note 3), p. 14.

57 Stix, op. cit., (note 6), p. 76.

Physics'.[58] It was the market response to Ginsparg's database, 'clearly the market was ready; Ginsparg more than proved that',[59] that swung the research into electronic journals into reality (the database reputedly receives 45,000 instances of access per day[60]). This example shows the reluctance of publishers to be innovative in the field of electronic publishing, at least until there is a proven market (and subsequent return on the investment). It can be argued that an individual, Ginsparg, has altered the status quo in relation to an institution, Elsevier. If so, this is a rare case of an agent changing a situation against the odds of a structure.

In the first section of this chapter, Keyani's statement relating to access versus ownership was discussed. The idea of uncoupling ownership from access has also been adopted by publishers. However, the fundamental philosophy behind it is very different. The commercial publisher's concept is one where 'a one year subscription entitles the subscriber to one year of access. . . . the subscriber always owns the medium and never owns the message'.[61] This, in effect, means that the ownership is always in the hands of the publisher, and the (limited) access is paid for by the subscriber. Obviously 'such an arrangement is very advantageous to the publisher.'[62] These sorts of ideas give strength to Harnad's subversive proposal. Unless a break is made from publishers now, when there is an opportunity, the publishers will take over the electronic medium as well, thus undermining any possibility for breaking the 'Faustian bargain'. It is, of course, possible that publishers may take over electronic publishing anyway, but this opens an interesting question, can scientists and other academics exercise agency given these structural features?

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58 Ibid., p. 76.

59 Stix, op. cit., (note 8), p. 76.

60 Brent, op. cit., (note 51), l. 209.

61 Franks, op. cit., (note 1), p. 3.

62 Ibid., p. 3.

Howard Rheingold is an author and 'net activist'. An article featuring an interview with him states;

> What really worries Rheingold is the issue of monopoly control. So far the Internet has been an ad hoc, self regulating media frontier. . . . What happens if one of the major corporate players gains a great deal of control over Net traffic? What kind of power would they have over content?[63]

As Winner points out, 'technologies are not merely aids to human activity, but also powerful forces acting to reshape that activity and its meaning'.[64] Therefore, when decisions need to be made about the technology, the 'ways. . . in which everyday life is transformed by the mediating role of technical devices'[65] need to be taken into consideration. Unfortunately, if a large corporation (and many publishers are large corporations) is making these decisions, the judgements are made on narrow grounds, especially whether the new technology makes a profit.[66]

Harnad's proposal touches on the issue of copyright. This has been a much debated topic in the literature. This thesis, through space restriction, will not look into the issue in detail. However, a brief overview is appropriate. Copyright in the case of academic publishing is held by the publishers, not the authors of the work, and so it is an issue that will affect publishers most. The main difficulty with copyright and the Internet is the problem of policing. The reason the Internet has been created in the form it has been- i.e., one with no central controlling force - is specifically to allow it to withstand such disasters as a nuclear attack. In this

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63 J. Casimir, 'Keeping the Net Free', <u>Sydney Morning Herald</u>, June 13, 1995.

64 L. Winner, <u>The Whale and the Reactor</u>, University of Chicago Press, Chicago, 1986, p. 6.

65 <u>Ibid.</u>, p. 9.

66 At the risk of painting Bill Gates as the devil, the introduction of Windows '95 this year is a very good example of this. The Australian Navy held off the upgrade while it asked questions of Microsoft about security. The almost complete absence of any reporting of this incident is starkly opposed to the fanfare the launching received by the press.

manner, the Internet has been, from the start, given an identity of its own. No-one owns the Internet, and no-one controls it (yet). Controlling the Internet would be extremely difficult to do, by its very nature, and it is due to this feature that there is currently so much debate about copyright (and legal issues such as pornography and the like). How does one state (or country) pass laws for something that is not directly responsible to a person or organisation? The Internet's highly distributed nature makes restrictions and regulations fundamentally difficult to enforce.[67]

There have been attempts to create systems that will enforce copyright on the Internet, and 'so far most of the work . . . in the U.S. has been done by the publishers.'[68] There are several different methods for controlling copyright, and most of these are related to access to the material in the first place. The European Commission is funding a project called Copyright in Transmitted Electronic Documents (CITED), and so far the systems being developed assign specific viewing rights to different users. This is monitored with either a password, or a 'swipe card', and all accesses to the system are monitored.[69] A different approach is similar to that used for photocopies today, which relies on the honesty and goodwill of the readers. It is manifested in the form of copyright notices that appear on the opening screen when a new document is called up, similar to the ones posted on photocopiers in university libraries and schools. Other systems include 'a copyright statement on every printout or downloaded file.'[70] Irrespective of the form, the systems are not yet sophisticated enough to control electronic use of information, and given that control of photocopying has yet to be achieved, it is likely that a truly successful system of copyright will not be able to be implemented.

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67 Author unknown, op. cit., (note 26), p. 18.

68 C. Long and C. Neesham, 'Whose copyright is it anyway?', New Scientist, 24 July 1993, 139, pp. 21-22, at p. 22.

69 Ibid., p. 22.

70 M. K. Duggan, 'Copyright of electronic information: Issues and questions', Online, May 1991, 15, pp. 20-26, at p. 23.

Harnad's proposal suggests that there is no need for copyright, as 'it only became an issue in scholarly publishing because publishers-not scholars-had to protect their financial investment in the paper infrastructure'.[71] This is supported by the statement[72] that

> 'many potential electronic information publishers are reluctant to disseminate digital-based content until some kind of technical and legal standards can ensure that their sizeable investments in intellectual property won't be illegally copied, sold or altered.'[73]

The issue of copyright, as with that of pornography, could well be the 'big lie technique to manipulate public opinion on the eve of far-reaching and intrusive legislation'.[74] Rheingold outlines a specific case relating to a claim of pornography that is occurring on the Internet that was based on false information and was blown out of proportion. The point he is making is that 'basing sweeping legislation on bad science demeans scholarship, journalism, and democracy.'[75] By the same token, publishers waiting for copyright laws to change before introducing electronic publishing are using the issue of copyright to attempt to gain some form of control over electronic publishing (if we accept Harnad's suggestion that scholarly copyright does not need to exist.)

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71 Brent, op. cit., (note 51), l. 291.

72 The article the quote appeared in was written from the publishers' perspective.

73 K. Martin, 'Understanding the forces for and against electronic information publishing', CD_ROM, July/August 1994, 7, pp. 129-134, at p. 131.

74 Rheingold's paper, 'Would-be Censors Base Arguments on Bogus Research'. (available electronically through his home page)

75 Ibid., (no page numbers)

Conclusion

There are many factors and many people involved in the move to electronic publishing. Inevitably, such a move will cause changes to the way librarians, academics and publishers operate. Publishers have the most to lose financially, and not surprisingly are attempting to instigate patterns that protect their current hold on the academic publishing system. Librarians, while potentially in a livelihood threatening situation, seem to be taking an adaptive stance to the change, incorporating their skills with the technology in order to continue their services in the new environment. This is a clear example of agents working within prevailing structures. Academics (or at least some) have begun their move towards what will ultimately be a more beneficial system for them. In considering these motives, it becomes clear that the fundamental necessity to assess the impact these changes will have on the transformation of everyday life of scholarly communication will be overlooked in the race to 'get in first'.

CHAPTER 5
RESULTS OF AN EMPIRICAL STUDY

The Nature of the Study

The decision to conduct a survey as part of this thesis was partially inspired by a study conducted in America in 1989 on the introduction of The National Research and Education Network (NREN). That study looked at the impact of high speed networks on scientific communication and research. While electronic journals only comprised part of the elements of discussion, the results were quite clear. The attitude of scientists towards them was negative: 'there was general contempt for the "Fleischmann and Pons Syndrome", ie., using networks to circumvent the traditional peer review and publication process'.[1] All participant groups generally asserted that sending research results out on the network 'cheapens' the status of the researcher.[2] There was an implication that the network was far more relevant in relation to submitting papers electronically, than supporting electronic journals. Given that the Internet's public profile had risen dramatically in the last 18 months, and computer use and availability in the academic environment has become the norm, I felt a similar study conducted in 1995 could show a different outcome.

The first step was to establish if any study of this kind had been conducted by the University of N.S.W. in the last couple of years. This was for two reasons: first, there was no need to go to the trouble of conducting a survey if one had already been done; and second to gain an insight into the subject matter. The Computer Services Department (CSD), which is responsible for the Campus Wide Network, and allocates e-mail addresses, was approached to establish if any statistics existed about which academics at the university were connected to the network. The CSD referred me to the Division of Information Services in the library. Marion Bate, Principal

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1 C. R. McClure, et al., The National Research and Education Network (NREN): Research and Policy Perspectives, Ablex Publishing Corporation, New Jersey, 1991, p. 103.

2 Ibid., p. 149.

Librarian (of the Division) said that no study of this kind had been done, and expressed interest in the results. She also referred me to the Educational Testing Centre to have my survey checked for obvious errors. Robert Dias at the Educational Testing Centre kindly did this and stated that with a few minor modifications, it was a good survey. No pilot study was conducted, however, and the returned questionnaires showed some problems with the survey design. These problems are discussed in full in Appendix 3. A study on attitudes to Computer Mediated Communication had been recently done by an honours student in Social Science and Policy, and we met to discuss our work. I also went into the Physical Sciences Library and spoke with the co-ordinator of the Internet training courses that are being run.

The subjects

The population used in the study are scientists at the University of New South Wales. The Faculties of Science, Engineering, Applied Science and Biological and Behavioural Sciences were targeted. In total 473 surveys were sent out, and 116 were returned. This represents a 24.5% overall return rate which was fairly consistent throughout the Faculties. On a School by School breakdown, between 10% and 60% of the surveys were returned, with most Schools returning between 23% and 33%. (See Table 4 for a full breakdown of the Schools). Therefore it is fair to say that this survey shows an across the board representation of academics in all schools in the Faculties surveyed.

All academic ranks were targeted, from postgraduate students to Professors. The breakdown of respondents is given in detail in Table 5. This shows a reasonable representation of the numbers of each professional rank within the university, although it does show a proportionally higher than expected number of returns from Associate Professors.

Of the 116 surveys returned, only 14 were completed by women. Women are very under represented in the science faculties at UNSW, given that in all other respects the returned surveys show a realistic representation of the sample population. I was not aware that the situation was so acute and this is a shame from the survey perspective, as I had intended to try to ascertain whether the sex of the user affected the general attitude towards electronic journals. Because of the very small representation of women, I was unable to separate most issues on the basis of gender.

The Survey

The survey questionnare was printed on a double sided sheet of yellow paper. A covering letter signed by Professor Randall Albury, the Head of the School of Science and Technology Studies endorsed the survey, and was sent with the questionnaires. (See Appendix 1 for a copy of the survey and the covering letter). The survey was conducted through the internal mail with provision for return by the same route. The questions were a mixture of multiple choice and free answer.

The overall question being asked is: do academics at UNSW in 1995 consider electronic journals to be viable as a mode of publication? My hypothesis is that scientists' attitudes towards electronic journals in 1995 are more positive than were shown in the 1989 study, and that there is an acceptance of the inevitability of a switch to an electronic medium.

The experimental variables are demographics: department ('hard' or 'soft' sciences), professional rank, sex, and age. (Although as discussed above, the variable of sex of the respondent will only be used when the percentages represent a viable sample space). There are four main dependent variables which were chosen as a result of the work done on the main issues surrounding the introduction of electronic journals that are explored in the main body of this thesis: internet use; quality control; comparitive attitudes towards electronic and printed journals; and ergonomics.

First, questions were asked about the extent of respondents' use of the Internet. It is possible that a negative attitude towards the introduction of electronic journals could be a result of ignorance or fear about the Internet itself. Questions 12, 13, 14, 18 and 19 looked at this, both in relation to searching for academic information and the use of e-mail. The questions on e-mail use are specifically attempting to ascertain how dependent a given respondent is on electronic communication.

Consistently throughout the literature, the debate over quality control appears. Questions about quality control were 14, 16, 17and 20 and they began with an open ended question to try to establish the respondents' understanding of the issue in general, and then in relation to the Internet. The question asking which 5 journals they use most often was an attempt to find out whether respondents were aware if their journals were refereed or not.

The questions that explored the comparative attitude towards electronic journals and printed journals were 13, 16, 22 and 23. Unfortunately, many respondents who had not experienced electronic journals did not include answers for electronic journals, so while this category can show some good insight into attitudes towards printed journals, the comparative attitudes towards electronic journals need to be surmised.

In Chapter 2 above, previous attempts to find supplements or alternatives to the printed journal are discussed. One of the recurring problems that these attempts encountered were ergonomic issues relating to the way academics use journals. Questions 19 and 23 look at which forms of communication the respondents use most, and how they use journals. This will allow some conclusions to be made about the sorts of adaptations electronic journals may need to make to be successfully integrated into the current habits of academic life.

A section on computer use was included to ascertain the percentage of respondents who had access to computers and which of those were connected to the Campus Wide Network (which has Internet access). 113 of the 116 respondents had access to a computer on their desk, and only 9 people did not have a connection to the Campus Wide Network. These people come from different departments, so it is likely to be individual problems with their computers rather than no connection (or possibly a lack of awareness of their connection). Therefore all respondents at least have access to the Internet (and thus electronic journals), so no distinction needs to be made on the basis of access.

Discussion:

Internet Use

The respondents' use of the Internet is being ascertained in several ways. Firstly, they are asked if they have searched for academic information on the Internet, and if not, why not. This will establish the percentages of respondents who actually use the Internet as an academic resource. Secondly, they are asked about training, it is possible that the problems people have with the Internet could be resolved through training. Thirdly, the respondents are asked about their usage of e-mail as a form of communication.

Table 8(a) summarises the results to the question, 'Have you ever searched for academic information on the Internet?' In the three categories of: females 36-50, males 26-35 and males 36-50, almost exactly 75% had tried to find academic information on the Internet and 25% had not. However, in males 50+ , 56% had tried to search and 44% had not (females for this age group is too small a sample space). It is possible to argue on these grounds that age is a factor in the willingness of an academic to search for information, as the percentage who had tried decreases significantly once the respondent's age is over 50.

This question then had a section asking for reasons why the respondent had not searched for academic information on the Internet. The responses are summarised in Table 8(b). Their main thrust is best expressed by a comment from a respondent from Optometry, 'No training, no time, no perceived need'. The lack of perceived need to use the Internet is a common theme in these responses, and partly this is due to the availability of information elsewhere, such as through the library. Another repeated theme is the perceived amount of time that is required to search for information. This is partly due to lack of training, and a few people specifically mentioned this as a reason for not searching for information. So what sort of training have the respondents had?

The results of the question about training are summarised in Table 7(a). Originally this was to be analysed on the basis of Department. However, upon looking at the respondents who had replied that they had had formal training, it was apparent that the 17 replies came from a wide range of departments. There appeared to be no discernible pattern (see Table 7(b)). The only interesting result according to department was in relation to those who were self taught. Of the 48 who answered they were self taught, 21 came from Computer Science, Mathematics or Physics. They comprised 66%, 53% and 66% respectively of the respondents from those departments. As Mathematics and Physics are in the forefront of the electronic journal debate, and Computer Scientists are highly skilled in computer use, it is these three departments that would be expected to be the most involved in work on the Internet and more likely to be using it. This result tends to support that.

Overwhelmingly (41%), 'self taught' was the most frequent single response. This is underlined by the fact that many of the respondents who answered 'colleagues' and 'documentation' also ticked 'self', so the total is actually higher. The next most popular forms of training were Colleague (23%), Formal Training (16%), No

Training (12%) and the least popular was Documentation (8%). Formal Training and Documentation are the only forms of training that could be considered 'structured'. Therefore, less than a quarter of the respondents had been trained in any sort of structured manner. It is not surprising then, that many people are attempting to use the Internet and then giving up, dismissing the Internet as 'unstructured', 'disorganised' and having 'too high a noise to information ratio', which is what many of the respondents have done.

Training on Internet use is offered at UNSW by the special libraries. The Physical Sciences Library offers courses free of charge to academic and general staff, and postgraduate students of the Faculties of Applied Science, Built Environment, Engineering and Science. The courses are ongoing, and the two hour course that is an introduction to browsing the Internet using Netscape runs approximately once a week. The faculties attending Netscape Classes in May 1995[3] were Engineering 34%, Applied Science 12% and Science 8% (with the total made up by Library 8% and Built Environment 38%). This information is important because it highlights the fact that training is readily available to all of the respondents. It must be considered that they could be unaware of the service. The importance of training on the Internet in the implementation of electronic journals is discussed in the previous chapter. While it is a positive step on behalf of the UNSW to offer the courses that they do, an increased awareness of the courses amongst the academic staff (and therefore an increase in the number who complete the course) could show a substantial increase in the awareness and use of the Internet as an academic resource at UNSW.

The questions about e-mail use were included because use of e-mail is use of the Internet although many people do not perceive it as such. It is an attempt to establish how dependent on e-mail academics are. The results to the question appear in Table 11, and are ranked according to frequency of use, age and professional rank.

3 Thanks to Jane Russell (Physical Sciences Library AARNet/Internet Training Co-ordinator) for providing these statistics.

Overwhelmingly, e-mail is used, with 110 respondents answering 'yes' to the question. This question had surprising results because of the ten people who said that they did not contact other members of their research area by e-mail, four had said that they use e-mail, so this use of e-mail must be for other purposes. Therefore e-mail use is more widespread than this survey indicates.

In response to the question asking how often the respondent would contact other members of their research area, 49% responded daily, with 24% weekly and 18% monthly. There is, therefore, a heavy dependence on the use of e-mail within the Faculties of Science as a form of communication. This result supports the theory that academics are increasingly using electronic mediums for communication and other aspects of their academic life. The concept of technological momentum, that it is not a much bigger step to move from use of electronic communication to a fully electronic journal system, is explored in the last section of Chapter 3.

The following question asked what the most common forms of communication were for the respondent (see Table 12(a)). A choice of seven forms was given, and the object of the question was to find where e-mail ranked amongst other forms of communication. 82% of respondents ranked e-mail in the top three forms of communication, with 42% having it as their first choice. The age group that use e-mail as a primary form of communication most is the 36-50 group (47%). This is contrary to expectations, but one reason why the younger age group (26-35) does not have a higher percentage could be because they are still establishing a circle of colleagues.

Internet use (in the form of e-mail) is widespread, many academics rely on it as a form of communication. However, the perceived usefulness of the Internet as a source of academic information is low due to concerns about quality, and lack of knowledge of how to use it. It is possibly necessary for the Physical Sciences Library to make their courses more widely known to academics so that they can take advantage of the service.

Quality Control

In general, the answers to question 15 ('What is your understanding of quality control') were comprehensive. This question was simply to establish if the respondents had a grasp of the issues the survey was trying to investigate. Almost without exception, the replies were 'peer review' or 'refereeing'. Three respondents answered in a way that implied it was up to the writer to control the standard: 'Should indicate integrity of part of researcher'; 'To obtain correct and comprehensive data'; and 'Use of accurate data presented truthfully'. Otherwise a good understanding of the quality control system of science was demonstrated.

Question 20, asking for the respondent's top five journals was a question to establish if they were aware whether these journals were refereed or not. One Optometry Associate Lecturer was unsure about three of hers, but apart from a couple of general interest magazines (mainly in Computer Science), all the journals used by the respondents are refereed.

The question regarding concerns about the quality of information gained from the Internet elicited varying responses (see Table 6 for a summary). The lack (or perceived lack) of quality control is a recurring theme. Two interesting responses were a concern about viruses, and the cost of advertising. Neither of these in the author's opinion are concerns that directly affect the issue at hand. There was concern shown about the instituitional recognition of publishing in electronic journals. A mathematician wrote 'for academics interested in promotion there is doubt that the University will take elctronic publications seriously.' The most revealing answer was from a Biotechnology Lecturer, 'Most academics (senior) do not use it and therefore do not contribute.'[4] This is possibly one of the main reasons

4 This is quoted exactly as written.

many of the respondents would not consider publishing on the Internet, although there was not a question in the survey that specifically targeted that issue. This is a demonstration of the Catch-22 involved in the development of the Internet as a viable publication medium. Scientists will not publish on it until it has some status, and it will not have status in the eyes of scientists until senior academics publish on it.

This survey has shown that not only do academics in science at UNSW have a good understanding of the quality control system in science, they consider this to be a key problem with the introduction of electronic journals.

Electronic Journals compared to Printed Journals

This survey attempted to produce a comparison of attitudes towards printed journals and electronic journals. It has not been as successful as was hoped because of a lack of clarity in the questions (due to unanticipated factors). The responses to question 16(b) about division of time between Printed and Electronic journals, (which are detailed in Table 11) must be treated with some caution because it became apparent that the respondents were answering the question in relation to their use of CD Roms, and other electronic search methods. The only two people who claim to have an electronic journal as one of their five most used journals, had very different answers to question 16b. They are both electronic journal users, but one claims to use 100% Printed and 0% Electronic, and the other claims to use 25% Printed and 75% Electronic.

The question that asked respondents to tick which terms they associated with printed and electronic journals showed some clear results. As is noted on Table 10, the question was not answered by all respondents. Many said they had no experience of electronic journals, and subsequently only answered for printed journals. Overall (looking at percentages), more agreed to the statements for printed journals than for electronic journals. Most of the statements were positive in relation to status and convenience of use.

Where electronic journals received high scores was in ease of publication and ease of location of articles. The statement with the highest response rate for electronic journals was 'Time taken between submission and publication is satisfactory' (57%). This elicited the second least number for responses for printed journals at 18%. This indicates an awareness on the part of the academics of the administrative advantages of a switch to electronic journals.

In general those statements that received higher scores for printed journals, received lower ones for electronic journals. The question about refereeing received 86% (second highest) for printed journals and only 13% (second lowest) for electronic journals. The statement 'There is status involved with publication', received the most responses in relation to printed journals (93%) the same statement only elicited a 16% response for electronic journals. This does show a change from the results of the 1989 NREN study, as then all participant groups generally asserted that sending research results out on the network 'cheapens' the status of the researcher. Electronic journals, therefore, have gained some perceived status since 1989.

These results imply that the inconvenience of the current system is tolerated because of the refereeing system and subsequent status involved with publication in a printed journal. Until electronic journals are able to demonstrate the ability to provide similar status, scientists will not change over, despite the administrative advantages. This is reflective of the results of the NREN survey, that concluded as part of its results 'the reward structure of science is based on formal publication history . . . electronic publication does not enhance one's status or image; in fact it may very well harm them.'[5] It appears that, as in 1989, it is still the case that

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5 McClure, op. cit., (note 1), p. 103.

network communications do not have the same legitimacy as print communication in terms of resolving disputes regarding priority of discovery or intellectual property. Therefore they do not have the status to resolve questions involving scientific reward.[6]

Ergonomics

Question 23 asked about the way the respondents used journals, how and where they read them and how they searched for the articles they wished to read. The summary of the results is in Table 14. There were four statements which elicited a high response rate (between 75% and 62%). These were, in order, 'I search for particular articles', 'I generally scan regular journals', 'I read articles at home' and 'I read articles in the office'. The two statements that received the lowest responses (10% and 12%) were, 'I only read abstracts', and 'I scan all the available literature'. The remainder of the statements received medium results (between 38% and 21%).

There appears to be reasonably low usage of alternatives to printed journals, which was to be expected in light of the discussion in Chapter 2. The citation index is used to find particular articles by only a third of scientists. Only 10% of respondents read only abstracts, and of these people, two are from Physics and six are from Engineering. This is, to a certain extent, expected, as both Physics and Engineering are 'fast moving' sciences with high publication rates. The remainder of this group are a mixture of Geology, Biological Science, Optometry, Wool & Animal Science and Biotechnology.

The low usage of alternatives is offset by the high response to the statement 'I generally scan regular journals' (68%). This result confirms the results obtained by Jan Olsen in her 1994 study on electronic journal literature[7], where 'all scholars

6 Ibid., p. 131.

7 J. Olsen, Electronic Journal Literature, Implications for Scholars, Mecklermedia, Westport, CT, 1994.

remarked that the use of parts of an article to decide whether to read the article is accompanied by skimming or scanning the entire article, even when an abstract is available'.[8] This is one of the difficulties with electronic journals as it is difficult to scan journals on a screen, as Olsen's study showed, 'many of the scholars interviewed emphasised over and over the importance of [flipping and scanning] and stated that scrolling on a screen does not support this mode of reading and information processing.'[9]

Only 27% subscribe to the main journals they use. This implies a high usage of the library as the source of articles, although only 27% actually read articles in the library. The high response to questions about reading articles in the office and at home (62% and 64%) implies a high usage of photocopying of articles to read, as journals are not able to be borrowed from the library. It is possible for users of electronic journals to print out any article which they are interested in reading. This allows for scanning and reading in a conventional way, away from the computer screen. It would also allow reading at home (where there may not be an Internet connection), and on public transport (which appears to be a common place to read articles, given that although the survey did not actually ask that as a question, four respondents wrote it in).

The difficulty with scanning on a screen, however is not simply for reading the article, but choosing it in the first place. This is because scanning is to gain a sense of the whole context[10], and the difficulties of moving back and forth between pages on a screen was a major problem for the scholars in Olsen's study. While the question about ergonomics of journal use was not extensive, the results support Olsen's findings.

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8 Ibid., p. 24.
9 Ibid., p. 36.
10 Ibid., p. 36.

Conclusions

In general, the attitude of scientists at UNSW in 1995 towards electronic journals, does not differ much from that of scientists in the United States in 1989, despite the general media coverage about the Internet over the past 2 years, and the introduction of the Campus Wide Network, allowing all academics access to the Internet. It could be argued that the United States has a higher diffusion of technology and that the technological state there in 1989 was equivalent to that of Australia in 1995. Without numerical studies this is impossible to ascertain.

Almost all academics use e-mail as a form of communication, and for most of those it is one of the main forms of communication with their colleagues. However, use of the Internet to search for academic information has not been attempted by 25% of the academics under 50 years of age, and by half of those over 50. The reason for this is a mixture of a perceived lack of quality control on the Internet, which in turn affects the perceived status of publication on the Internet, and lack of knowledge about how to use the resource.

Quality control is a big issue with the introduction of electronic journals. As it supports the whole reward structure of science, this is not surprising. Until electronic journals are able to demonstrate the refereeing structure in place, academics are unlikely to use them. It is interesting to note the type of language that was used by the academics in their comments at the end of the survey. Comments such as:

From what I have read (eg: New Scientist) they are a sloppy substitute for refereed journals (Biotechnology)
[Electronic Journals] encourage publishing of trivial work (Geology)
Not part of the culture of my field (Mechanical Engineering)

These demonstrate a use of the normative description of science. The tone of many of the comments demonstrated an unwillingness to even consider electronic journals on the basis that they do not 'fit' the current stringent (although unwritten) ideology of science . This supports and reflects the discussion in Chapter 3 of the use by academics of the normative structure of science to validate current behaviour.

Training is very important if electronic journals are to be introduced. The Internet contains a myriad of sources of information most of which is irrelevant to scientific work. The only way that scientists will begin to use the Internet as a regular source of information is if structures are developed that allow for easy location of specific information. Examples of these that are in existence, are the World Wide Web, which has allowed 'point and click' software to be written to create Netscape and Mosaic[11]. There are also many people working both in information systems (for example, libraries), and computing professions who devote a large amount of their time to assimilating information into useable form. The Chemistry Internet Guide discussed below is an example of this. These structures are meaningless, however, if the user is unaware of them. In the past scientists have learned in their student years how to use a library effectively. Today scientists must learn how to use the Internet as a resource if electronic journals are to advance. While training is available at UNSW, most of the respondents have not taken advantage of it, which implies an unwillingness to use it or a lack of awareness of the service.

The other major issue is that of ergonomics. While ultimately scientists may change the way they search for and use information, the period of transition from printed journals to electronic journals must incorporate the methods scientists currently use. This is an awkward situation, as the problems with ergonomics are not easy to overcome. (Note comments made towards the end of Chapter 1 about dismissing the concept of pages in a document.)

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11 Both of which are intuitive, user friendly interfaces.

Eight respondents claimed that there were not yet many electronic journals in their field. Choosing Chemistry as an example, I went to the Internet, and conducted a search. At the (somewhat cumbersome) Uniform Resource Locater (URL)[12] http://lib4.fisher.su.oz.au/Branches/Chemistry/CIG.html, is the Chemistry Internet Guide. The first page, and the page about Chemistry Electronic Journals and preprints, comprise Appendix 4. This indicates quite clearly that not only are there at least eight electronic journals in chemistry, but they are compiled together with a myriad of other relevant information for chemists at the one address. Hypertext will take the browser to any of the underlined addresses there. Similar organisational projects have been undertaken for most disciplines, so the claims made by the respondents that the Internet is unorganised, and that there is no relevant information on it, are more likely to be based on ignorance that experience.

Scientists are aware of the advantages electronic journals have over printed journals. However there are many issues that must be resolved before it is reasonable to expect a large increase in their use of electronic journals. While overall, there is a more positive attitude towards electronic journals than was demonstrated by the 1989 study, the changes in attitude are slow. The move to electronic journals can be expected to take some time.

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12 This is like an individual telephone number for each document on the Internet.

CONCLUSION

In the quest to look into the future to see whether electronic journals are a realistic possibility, it has been necessary to turn around and look back into history. By following the development of journals from their original form - the 'journals' of amateur scientists- to the modern scientific periodical, the electronic journal can be placed in historical perspective. The debate about electronic journals has opened up many areas of interest, as this has, and will continue to be, a period where the system of science as it stands is under the microscope. Whole components of the system, previously unquestioned, are now being looked at and assessed as the electronic journal offers new ways of doing things.

Why has this particular alternative to journals sparked so much debate? When I embarked on this project, I was concerned that there would not be enough literature to enable me to write a thesis. What I found was a longstanding, active, and voluminous debate. But why now? What has happened that now is the time the debate has come to a head? Which way does the causal arrow point? On one side, there is the technology that has made the possibility of an electronic journal a reality, on the other, the ever mounting serials crisis. It is more likely a causal equilibrium sign than a causal arrow. The Internet has been in existence for over 20 years, and the serials crisis goes back to 1830 when abstract journals began publishing in prolific numbers. Each has been moving forward along its own path, and it is now that their paths are crossing. The question is whether they will start to run parallel, where we will see the introduction of the electronic journal on a major scale, or whether they will continue along in their own directions, the serials crisis intensifying until another innovation attempts to resolve it.

The point is that nothing really new is happening. Some authors are arguing that the serials crisis is so critical that something must happen now or the whole system will collapse under its own weight. But this is not the first time such claims have been made. Others are saying that electronic journals offer solutions to most of the problems the system of science is experiencing. But this is not the first proposed solution. There is no guarantee that the Internet will be in existence in 20 years time. With increasing use of bandwidth[1] by general users, it too may collapse under its own weight. What would distinguish electronic journals from all previous attempts, both to solve the serials crisis, and streamline the academic publishing industry, would be a willingness on behalf of academics to abandon the publish or perish syndrome. And this means a move away from the use of the Mertonian normative structure of science as a justification for not changing.

Repeatedly throughout this work, the argument for not changing to electronic journals has been based on a fear that the system would collapse. It has been argued that a move to electronic journals will result in a reduction of the quality control mechanisms in place. Quality control serves two functions. Firstly, and most importantly, it ensures that the information that is recorded in the annals of science is verified and genuine information. Secondly, it allows verification for people to obtain tenure, promotion, and so on. But by the time the information is printed (and therefore becomes a record), most scientists in the field would already know of it through informal channels of communication. So (it can be argued) the peer review system only operates for recording purposes. If that is the case, the use of the quality control issue as a fundamental argument against the introduction of electronic journals is a red herring. It exemplifies the suggestion that the normative structure of science is used to justify a given situation, which, in this case, is a resistance to change on the part of academics.

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1 The Internet runs using optic fibre networks, and so there is a finite amount of 'space' to send information along. This space is the bandwidth.

It is possible to say that surrounding events are moving science towards the use of electronic journals which is a technologically deterministic point of view. And there is evidence to support this. On another side of the coin, it is possible to argue from a technological momentum standpoint. There has been an increasing use of electronics as a medium for communication, and with innovations such as sophisticated word processing, CD Roms, electronic mail and so on, we are moving closer and closer towards a society that relies on electronic communication for survival. Given that (it can be argued) it is merely a matter of time before science makes what will then be a small jump to electronic journals.

While not denying that technological momentum exists, it is important to distinguish between technological momentum and technological determinsim. Technological determinism places no power in the hands of the agent (individual) to stop what is 'inevitable'. Technological momentum, on the other hand, recognises that there are both agencies and structures involved in any change such as this, and either or both have the ability to prevent it happening. What cannot be ignored in this situation is the power of the system of science. This system has built up over the last 300 years and is extremely complicated. Like the Internet itself, it has no written rules, nor any controlling agency. And, like the Internet, it runs the risk of overloading itself to the point of not being able to function.

Because of the complexity of the factors involved in the debate, it is not possible to come to a definite conclusion as to the outcome. However, it is possible to make an educated guess. Changes will only occur if people are willing to allow them to do so. Librarians are already making preparations to deal with a move to electronic journals. In general, they do not argue that the move should not occur. Unless academics seize this opportunity to assess the current system of science, and make positive steps towards choosing which elements to change and which to keep, the issue will be taken out of their hands. What is likely to happen is that publishers will work out some way to gain revenue from publishing electronically, and will begin doing so in earnest. They have the power and the resources to force a change by simply phasing out printed journals. Unfortunately, (for a myriad of reasons) this whole issue could become economic. How academics would react to this is an unanswerable question. However, this is merely one of the possible outcomes. Regardless of the eventual outcome, now is an exciting and dynamic period in the history and sociology of science.

APPENDIX 1

Covering Letter and survey

THE UNIVERSITY OF
NEW SOUTH WALES

SCHOOL OF SCIENCE AND
TECHNOLOGY STUDIES

20 September 1995

Dear Sir/Madam,

Below you will find a survey that is looking into the level of support electronic journals have amongst the scientific community at UNSW. It comprises part of an honours thesis being completed this year by Danny Kingsley within the School of Science and Technology Studies.

The results of this survey will appear in her honours thesis and possibly a summary of results will appear in Uniken. Please note that anonymity is assured.

The survey is being sent to all postgraduate students and academics in the sciences at UNSW. It should take you 10-15mins to complete. Please complete the survey and return it through the internal mail by

Friday 6 October 1995 to:

Danny Kingsley c/- School of Science and Technology Studies.

For the purposes of this survey an **electronic journal** is defined as:

A journal that appears in electronic form and is available on the Internet (which includes BITNET), including journals that are exclusively electronic, and those that appear in both electronic and printed forms. This definition does not include mailing lists, discussion groups or e-mail. An electronic journal has articles with identified authors and some form of page or other reference system (eg: lines).

This research has the endorsement of the School of Science and Technology Studies

(Professor W. R. Albury, Head)

Thank you for taking the time to complete the survey and assisting me in my research.

(Danny Kingsley, SID 2101637)

SYDNEY 2052 AUSTRALIA
Facsimile: +61 (2) 313 7984
Telephone: +61 (2) 385 2356

ELECTRONIC JOURNALS SURVEY

Part A: Subject Details

1. Name:

2. Department:

3. Professional Rank *(check appropriate box)*

- ❑ Professor
- ❑ Assistant Professor
- ❑ Lecturer
- ❑ Tutor
- ❑ Postgraduate Student

4 Sex: ❑ Male ❑ Female

5. Age Group:

- ❑ 18-25
- ❑ 26-35
- ❑ 36-50
- ❑ 50+

6. *(Please fill in the blanks)* I regard myself as working in the discipline of
within the research specialty of

7. PhD obtained from:
(university):
(country):

Part B: Computer Use and Access

8. What access do you have to a computer?
(check all appropriate boxes)

- ❑ Desk
- ❑ Computer Room
- ❑ Home
- ❑ None
- ❑ Other

9a. What sort of computer do you use most?

- ❑ IBM Compatible PC
- ❑ Macintosh
- ❑ Unix Workstation

9b. Is your computer at UNSW connected to the Campus Wide Network?
❑ Yes ❑ No

10. What applications do you use computers for?
(check all appropriate boxes)

- ❑ Word Processing
- ❑ Library Catalogue
- ❑ Programming
- ❑ Statistical Analysis
- ❑ E-Mail
- ❑ Specialised Programmes

11. What percentage of your research time is devoted to computer use? *(please estimate)*

- ❑ Nil
- ❑ 1-20%
- ❑ 20 - 50%
- ❑ 50 - 80%
- ❑ 80 - 100%

Part C: Electronic Journal Use

12. What type of training (if any) have you had about the Internet?

- ❑ A formal course
- ❑ Documentation
- ❑ Demonstrated by colleague
- ❑ Self-taught
- ❑ Other

13a. Have you ever searched for academic information on the Internet?
❑ Yes ❑ No

13b. If no, why not?

(If you need more space please attach a separate sheet)

14. What, if any, are your concerns about the quality of information gained from the Internet?

15. What is your understanding of 'quality control' (with regard to scientific publications)?

16a. What percentage of your research time do you spend researching the literature?

- ❑ 0-20%
- ❑ 20-40%
- ❑ 40-60%
- ❑ 60-80%
- ❑ 80-100%

Survey Continues Overleaf...

APPENDIX 2
Results (from the survey)

Table 4
Breakdown of surveys sent to and returned from schools:

473 surveys in total were sent out, 116 were returned (24.5%) These were divided between 4 faculties, and in turn into Schools within those faculties.

154 to Faculty of Science: 39 Returned (25.3%)

School	Sent	Returned	%
Chemistry	34	9	26
Mathematics	62	17	27
Physics	39	9	23
Optometry	17	4	23
Misc	1	0	

173 to Engineering, 35 returned (20.2%)

Geomatic	11	3	27
Mechanical	40	4	10
Civil	39	10	26
Biomedical	7	2	28
Computer Science	40	9	23
Electrical	36	8	22

118 To Applied Science, 36 returned (30.5%)

Fibre Technology	15	5	33
Chemical Engineering	22	3	14
Biotechnology (incl Food Sci)	21	8	38
Materials Science	11	2	18
Applied Geology	24	8	33
Geography	15	5	33
Safety Science	5	3	60
Petroleum Engineering	3	1	33
Misc	2	2	

28 to Biological & Behavioural Sciences, 4 returned (14%)

Biological Sciences	18	3	17
Biochemistry	8	1	13
Misc	2	0	

Table 5

Breakdown of respondents according to professional rank.

Professor	19
Associate Professor	33
Senior Lecturer	17
Lecturer	43
Associate Lecturer	3
Tutor	0
Postgraduate	1

Table 6

Breakdown of respondents according to age and sex.

Age	Male	Female	Total
18-25	1	0	1
26-35	12	2	14
36-50	48	11	59
50+	41	1	42

The sample space is too small to take results from males 18-25, and females 26-35, and 50+.

Table 7(a)
Training on the Internet according to age.

Type of Training	Age	Number	% of age group	% overall
Colleague	26-35	3	21%	
	36-50	10	17%	
	50+	14	33%	
TOTAL		27		23%
Documentation	26-35	1	7%	
	36-50	4	7%	
	50+	4	10%	
TOTAL		9		8%
Formal	26-35	4	29%	
	36-50	9	15%	
	50+	5	12%	
TOTAL		18		16%
None	26-35	1	7%	
	36-50	4	7%	
	50+	9	21%	
TOTAL		14		12%
Self	18-25	1	100%	
	26-35	5	36%	
	36-50	32	54%	
	50+	10	24%	
TOTAL		48		41%

Table 7(b)
Formal training on the Internet according to Department.

Department	No. of respondents
Applied Geology	1
Civil Engineering	2
Food Science & Technology	2
Geography	2
Optometry	2
Wool & Animal Science	1
Biotechnology	1
Chemical Engineering	2
Electrical Engineering	1
Geomatic Engineering	1
Mechanical Engineering	1
Safety Science	1
TOTAL	17

Table 8(a)
Respondents who have/ have not searched for academic information on the Internet according to age.

Sex	Age	Searched?Y/N	No.	% of age group
FEMALE	26-35	Y	2	100%
	36-50	Y	8	73%
	50+	Y	0	-
	26-35	N	0	-
	36-50	N	3	27%
	50+	N	1	100%
MALE	18-25	Y	1	100%
	26-35	Y	9	75%
	36-50	Y	36	75%
	50+	Y	23	56%
	18-25	N	0	-
	26-35	N	3	25%
	36-50	N	12	25%
	50+	N	18	44%

Table 8(b)
Reasons given for not looking for information on the Internet.

Females 36-50:
No training, no time, no perceived need (Optometry)
Too busy doing admin work (Safety Science)

Males 26-35:
Initial scans revealed it was largely rubbish (Geography)
Too much to get through in the journals (Geography)

Males 36-50:
Couldn't be bothered, that's what I do in the library (Applied Geology)
Don't know how (Materials Science)
Have not yet needed to (Naval Architecture)
Not enough skill, plus not felt the need (Naval Architecture)
Most is available in Library (Food Science & Technology)
Need not apparent (Biological Sciences)
Not part of the culture of my field (Mechanical Engineering)
Plenty of information elsewhere (Mechanical Engineering)

Males 50+
Have not yet found time to learn how to use it (Mining Engineering)
Insufficient time (Geomatic)
No need (Biotechnology)
No need (Civil Engineering)
No time (Applied Geology)
Not adequately trained (Chemistry)
Not yet trained (Wool & Animal Science)
No training (Wool & Animal Science)
Poor capability on computers, no interest (Civil Engineering)
Too hard (Civil Engineering)
Read latest journals in field (Physics)
Shortage of time plus incompetence/inefficiency as a net user (Materials Science)
Still learning (Electrical Engineering)

Table 9
Responses to the question about concerns of quality of information gained from the Internet.

Quality of photomicrographs (Biological Sciences, Associate Professor)
Not a primary source (Biomedical Science, Associate Professor)
Most academics (senior) do not use it and therefore do not contribute. (Biotechnology, Lecturer)
Authenticity (Chemistry, Lecturer)
Not refereed (Chemistry, Lecturer)
Variable quality, unrefereed (Chemistry, Senior Lecturer)
Peer review (Civil Engineering, Senior Lecturer)
Lack of quality control. Need to work out for yourself which sources are reliable. (Computer Science, Lecturer)
Most Internet information is of dubious quality except where explicitly sourced. (Electrical Engineering, Professor)
Variable - but most of what I have specifically searched for has been good quality. (Geography, Professor)
Lacks critical review (Geology, Lecturer)
Lack of accuracy, lack of refereeing (Chemical Engineering, Professor)
So far have only had high quality information (Mathematics, Lecturer)
Very difficult to gauge the quality unless you trust the source or know the area (Mathematics, Senior Lecturer)
How much is advertising? (Dept unknown, Senior Lecturer)
Non-refereed, what can you trust? (Optometry, Lecturer)
Lack of refereeing of information (Physics, Lecturer)
Viruses (Mechanical Engineering, Senior Lecturer)
Unverified, not organised (Wool & Animal Science, Lecturer).

Table 10
Division of time spent researching the literature.

Answer	No. responses	% of responses
100% Printed 0% Electronic	59	51%
75% Printed 25% Electronic	34	29%
50% Printed 50% Electronic	16	14%
25% Printed 75% Electronic	6	5%
0% Printed 100% Electronic	0	0%

Table 11
Frequency of use of e-mail to contact other members of research area.

Frequency	Age	Rank	Number	Total
DAILY				
	26-35	Lecturer	5	5
	36-50	Lecturer	12	
		Senior Lecturer	8	
		Associate Professor	9	
		Professor	5	34
	50+	Lecturer	1	
		Senior Lecturer	1	
		Associate Professor	7	
		Professor	8	17
Daily Total				56
WEEKLY				
	18-25	Associate Lecturer	1	1
	26-35	Lecturer	5	
		Senior Lecturer	1	6
	36-50	Lecturer	7	
		Senior Lecturer	1	
		Associate Professor	3	
		Professor	2	13
	50+	Lecturer	2	
		Senior Lecturer	1	
		Associate Professor	3	
		Professor	1	
		unknown	1	8
Weekly Total				28
MONTHLY				
	26-35	Lecturer	2	2
	36-50	Lecturer	2	
		Senior Lecturer	2	
		Associate Professor	3	7
	50+	Lecturer	4	
		Senior Lecturer	2	
		Associate Professor	5	
		Professor	1	12
Monthly Total				21
E-MAIL NOT USED				
	26-35	Lecturer	1	1
	36-50	Lecturer	1	3
		Senior Lecturer	1	
		Associate Professor	1	
	50+	Lecturer	2	6
		Associate Lecturer	1	
		Associate Professor	2	
		Professor	1	
Not used Total				10

Table 12(a)
Ranking of e-mail within the seven choices of forms of communication.

E-mail first (of seven)	42
E-mail second	22
E-mail third	18
E-mail fourth	12
E-mail fifth	6
E-mail sixth	5
E-mail seventh	1
E-mail not used at all	6
No answer to question	4

Table 12(b)
Those that use e-mail as their primary form of communication, by age:

Age	Number	% of age group
26-35	2	14%
36-50	28	47%
50+	12	28%

Table 13
Agreement to statements referring to Electronic and Printed Journals

(Note: 13 respondents did not answer this question, so the percentages of the respondents for Printed Journals are out of 103 responses. As discussed in the problems section of this chapter, some people (36) did not answer this question for electronic journals, so the percentages for respondents for Electronic Journals are out of 67 responses.)

Statement	Printed Journal	% of all responses	Electronic Journal	% of all e-journal responses
Publication of original work is easy	21	20%	29	43%
Time taken between submission and publication is satisfactory	19	18%	38	57%
Refereeing system is adequate	89	86%	9	13%
There is status involved with publication	96	93%	11	16%
Articles are easy to locate	71	69%	29	43%
Articles are difficult to locate	17	17%	11	16%
Have a high opinion of academics published in the journal	73	71%	6	9%
The breadth of distribution of the journal is adequate	77	75%	17	25%

Table 14
Agreement to statements about journal use.

Statement	No. Agree	% of whole
Î search for particular articles	90	78%
I generally scan regular journals	79	68%
I scan all the available literature	14	12%
I use the citation index to find particular articles	40	34%
I rely on recommendations from my colleagues	24	21%
I only read abstracts	12	10%
I read articles at home	74	64%
I read articles in the office	72	62%
I read articles in the library	44	38%
I subscribe to the main journals I use	31	27%
I prefer to use articles written in the last 3 years.	31	27%

Table 15
Comments written in the space provided at the end of the survey.

In all 37 people chose to add comments to the end of their surveys.[1] In general these can be split into 5 categories: that there are not many electronic journals yet in their field; positive comments; negative comments; ergonomic concerns; and comments about the current journal situation.

1) Not many electronic journals

These were from the Schools of Chemistry, Geography, two from Wool & Animal Science and, surprisingly, two each from Electrical Engineering and Physics. This is especially surprising in Physics, as the literature suggests that it is the areas of Physics and Mathematics that are leading the way in instigation of electronic journals. One possible reason for this is the exact definition given for electronic journals.

2) Positive comments

I believe them to have great potential
Chemistry

All but the most prestigious journals will move to electronic publication in the next 10 years.
Computer Science

As with paper journals there's a lot of variation in quality. Good electronic journals are better than average paper journals. Computer Science

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1 The most 'vocal' group were mathematicians, of the 17 replies from mathematicians, 6 added comments.

I believe the electronic medium is the answer to many of the problems I have experienced in the past.
Electrical Engineering

The library could more efficiently provide access to electronic journals, and the (small number of) relevant articles could be printed on a needs basis.
Mathematics

Key aspect of electronic journals is rapid, but still refereed publication plus cheap distribution
Mathematics

I can see benefits in pre-publishing on the net to get comments from other than the appointed referees. Papers should be published after review and identified as such.
Mechanical Engineering

Problems arise with the slow speed of which recent journals arrive at the library. Also it would save time in photocopying etc.
Wool & Animal Science

3) Negative Comments

From what I have read (eg: New Scientist) they are a sloppy substitute for refereed journals.
Biotechnology

[Electronic Journals] encourage publishing of trivial work, [There is] loss of control over length, [they[force inclusion of all original data and could further fragment disciplines.
Geology

I lack experience, but feel sceptical as to their 'reliability' and certainly as to their value as an avenue for my own publications.
Materials Science

For academics interested in promotion there is doubt that the University will take electronic publications seriously.
Mathematics

Electronic journals are crap.
Safety Science

4) Ergonomic concerns

Time is needed to study and digest apart from the threat of eye strain and the long term effects of continual use of computers on health.
Chemistry

I have a great dislike of not being able to scan paper copy of journals. The ability to browse the complete text and graphics, not just abstracts is very important.
Chemistry

Hardcopy is better to read. It is bound etc.
Computer Science

The paper version is easier to read.
Mathematics

I hate reading complicated papers on a screen, so I usually print out.
Mathematics

5) Comments about the current journal situation

I believe that libraries are 'cluttered' by journals of which only 5% are used-and then only once or twice. A large amount of paper and storage space is used up in storing a large number of journals, all of which need to be kept pending the time one or two people will use them.
Mathematics

With control of commercial scientific literature in relatively few hands the potential for overcharging or agreement between publishers seems very high.
Chemistry

Electronic publication is common in Computer Science and Engineering.
Chemical Engineering

Outrageous costs of some journal publishers (usually commercial ones, not those associated with learned societies) is forcing users/librarians away from those journals into electronic form.
Mathematics

Electronic journals have considerable future, mostly because of the cost of paper journals.
Mathematics

I am concerned about the long term archival availability - an important aspect of material published in paper journals.
Mathematics

I am concerned that the quantity of material published will increase, making it yet more difficult to find the original work amongst the mass of publications designed principally to inflate the author's CV.
Applied Geology

APPENDIX 3
Problems with the Survey

As was to be expected with a survey that did not have a pilot run, there were problems with the survey. These range from mistakes in terminology, lack of inclusion of all factors to not including some obvious questions. The problems will be detailed here to explain why some questions are not being used in the results and to assist any person wishing to use this information as a basis for further study.

Question 3, asking for professional rank had two mistakes, firstly Associate Professor was mistyped as Assistant Professor, and Senior Lecturer was not included. Thankfully most respondents just corrected the mistake, although one survey was returned by an academic with a disparaging comment about the question and nothing else on it.

The question on computer use was badly worded, the use of the expression 'devoted to computer use' was limiting, and the expression 'involves computer use' would have been more appropriate. It was an attempt to establish how familiar the respondent was to using computers in general, but it seems that the respondents either interpreted the question as personal computer use, or technical computer use. As the question was answered from different perspectives, and there is no real way of distinguishing between them, the results of the question cannot be used. Another question which was misworded was Question 22, which asked about 'the following terms'. This would have been better phrased as 'the following statements'.

Question 16a (as one respondent pointed out) would have been more relevant had the categories for percentages been split into the subsections, 0-5%, 5-10%, 10-20%, 20-40%, 40-100%. It was unfortunate that the question was split over the page (16a being the last question on the first page, and 16b the first question on the second page), because it was supposed to flow through. 16b was specifically trying to establish what percentage of journal use was electronic. I was surprised to find that only 51% of respondents used printed journals 100% of the time, with 29% using electronic journals 25% of the time, 14% using them half the time, and 5% using them 75% of the time. However, these results were inconsistent with comments later in the survey, and it became apparent that respondents were referring to CD Rom and other electronic search assistant use as well as electronic journal use. One respondent also pointed out that the question did not distinguish between the means or the mode of journal use.

A couple of questions would have been more rounded had they incorporated more factors. The question about training did not have 'none' as a factor. While most people who had had no training wrote that in the 'Other' section, I suspect that the four people who did not answer the question did not do so because there was no category for no training. The ergonomic question (Question 23) did not have 'reading on public transport' as a choice, but it is quite possibly important as 4 respondents bothered to write it in. This is an important ergonomic issue as it would be very difficult to read electronic journals on public transport. Question 18, asking about e-mail use did not have a category for fortnightly, so some respondents ticked monthly and wrote 'a little more often'.

Question 13, asking whether the respondent had searched for academic information could have explored more. It only asked for further information if the respondent had not done so. There could have been a supplementary question asking in the event that they had searched for academic information, how often they had done so, and what their success rate had been in finding what they were searching for.

The question on concerns about quality of information on the Internet was intentionally vague, as it was attempting to gain a general impression. However 40% of respondents did not answer anything for the question. This implies that either they have no concerns about quality of information (bearing in mind that 11 people replied 'none', specifically stating they had no concerns), or the question was too vague.

Possibly the least successful question overall was Question 17. Nearly half the respondents did not answer the question (which was by far the highest number for any given question). This can be explained by two factors. One is that many of the respondents had had no experience with electronic journals and so did not answer. The other factor is the question was not worded well. It was attempting to gain the impressions people had (be it from experience or media or discussion) of the Internet and electronic journals in particular.

Question 19, which asked about communication with colleagues, would have been more accurate if it had specified which group of colleagues. Many respondents specified that they were referring to their colleagues at UNSW, when the question was actually referring to the wider circle of colleagues (the 'invisible college'). Fax communication was left off the list unintentionally.

A simple administrative mistake was that there was no question 21.

Two questions that were blatantly missing were 'Have you ever published (or tried to publish) electronically?' and 'If so, which journals and when?'. These questions and possibly a couple of other questions along these lines would be included if this study were treated as a pilot, and the study was sent out to a wider audience.

While this section on problems with the survey is long, it is comprehensive. Overall, the survey achieved what it set out to do, which is open the research into problems with the instigation of the Internet as an academic tool.

CHEMISTRY INTERNET GUIDE

Contents

Scope of this Guide

This guide covers various subjects within the scope of Chemistry which are serviced by the collections within Fisher Library and the Chemistry Library. It covers subjects such as Organic, Inorganic, Physical and Theoretical Chemistry.

As with all resources on the INTERNET the guide is being constantly revised. Any comments or suggestions should be directed to Irene Rossendell, Science Librarian, Fisher Library *i.rossendell@library.usyd.edu.au* or Tim Cotsford, Chemistry Librarian, Chemistry School *library@summer.chem.su.oz.au*..

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Chemistry Web Sites

- ACSWeb from the American Chemical Society
  American Chemical Society webserver providing information on ACS products and services including Chemical Abstracts, symposia and colloquia.
  Supporting information for journals (formerly supplementary material) can be accessed via their Publications Division.

- Australian Chemistry Network
  An evolving www site at Chemistry Dept, Univ. College (UNSW).Includes at chemistry at the Univ.College, Aust. Chemistry Olympiad, resources for chemistry, other chemistry sites on www, Royal Aust. Chemical Institute and Aust. Microsale Chemistry Center

- Beilstein Home Page
  Beilstein Information Systems giving detailed informatin about Beilstein including products, help desk and a description.

- Chemical On-line Presentations, Talks and Workshops
  Enables user to contribute URL of any chemically orientated talk, poster or workshop. Then lists various contributions. Also explains preparing html documents, including Chemical Structure markup language.

- Chemistry
  La Trobe University Web Chemistry Connections to Australian and overseas

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Chemistry Electronic Journals and preprints

For an analysis of the development of electronic journals and preprints in Chemistry, together with a listing of journals available, see this article by Henry Rzepa.
Electronic journals include:

- Australian Journal of Chemistry
  Lists contents only of recent issues and notice to authors.
- Bulletin of the Chemical Society of Japan
  An experimental site offering abstracts and full text of the bulletin from vol 66 (1), 1993 to vol 68 (1), January 1995, supposedly until February 1995.
- The CORE Project
  Chemistry online retrieval experiment - a collaborative project of Mann Library, Cornell University; Bellcore, American Chemical Society, Chemical Abstracts and OCLC. Provides networked access to the full text and graphics content of the American Chemical society journals.
- Electronic Protein Science
- Journal of Biological Chemistry
  American Society for Biochemistry and Molecular Biology
- Journal of Computer Aided Molecular Design
- Journal of Molecular Modeling
  The full text of articles is available to subscribers via ftp at **science.springer.de**.
- Mendeleev Communications
  International journal of short communications in chemistry with original and significant work from Russia and other states of the former Soviet Union, in English, 1991+. Produced by the Royal Society of Chemistry and the Russian Academy of Sciences. Has contents with searchable indexes and notice to authors.
- Molecular Diversity
- Multi-Media Journal of Chemical Education
- Network Science
  An electronic current awareness publication in Chemistry
- Russian Chemical Reviews
  English version of Uspekhi Khiimi
- Trends in Analytical Chemistry
- Chemical Physics Preprint Database
  Joint effort by Dept. of chemistry at Brown University and theoretical chemistry & molecular physics group at Los Alamos National Laboratory. It is a fully automated electronic archive and distribution server for the international theoretical chemistry community.

To look at a range of electronic journals or to search for electronic journals on the Internet, click HERE for the Virtual Library's listing.

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