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Electronic Journals and the Transformation of Scholarly Communication: Constraints and Technical Possibilities

Mike M. Sosteric 

A thesis submitted by Mike M. Sosteric to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Department of Sociology

Edmonton, Alberta
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On the turning away
From the pale and downtrodden
And the words that they say
Which we won't understand
"Don't accept that what's happening
Is just a case of others' suffering
Or you'll find that you're joining in
The turning away"

No more turning away
From the weak and the weary
No more turning away
From the coldness inside
Just a world that we all must share
It's not enough just to stand and stare
Is it only a dream that there'll be
No more turning away?
Pink Floyd (1988) DST

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Electronic Journals and the Transformation of Scholarly Communication: Constraints and Technical Possibilities* submitted by Mike Sosteric in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Abstract

This dissertation examines the scholarly communication system. The theoretical perspectives of the political economy of publishing and critical theory of technology and society are utilised to argue that currently available technologies can be deployed in order to enhance scholarly communication and, simultaneously, reduce the cost of distributing scholarly information. This argument is made at a time when current pressures being brought to bear on the scholarly communication system, including a global shift towards the private provision of educational services, the ongoing commercialisation of the scholarly communication system, and the policies and practices of a few large profit orientated publishers, have inhibited fundamental social and technological reform of the system. A brief history of scholarly communication is used to illustrate that at the point of origin of the scholarly journal, the medium was perceived as something that would contribute significantly to the social and economic advancement of society. However, difficulties prevented the system from realising its full potential. To this day, structured inequality in the system prevents the full realisation of the Baconian ideal of scholarly communication. This, coupled with the quantitative expansion of research, the fiscal constraints on universities and libraries, and the extraction of private profit from the public university system, have further eroded the potentials of the system. The dissertation closes with an examination of how electronic publishing might help

enhance the current system of scholarly communication. This potential is contrasted against current attempts of vested interests to ensure that the scholarly communication system remains a site for the generation of private profit. To counter, the dissertation offers an alternative model of scholarly communication that makes a strong case that a non-commercial, low cost, high-valued added, and *open* electronic alternative to the current system is possible.

Table of Contents

LIST OF FIGURES

List of Tables

Introduction

Information specialists, [1] scholars, [2] and governments [3] have been warning about growing strain in the scholarly communication for years. This strain and tension, caused by decades of increased prices for scholarly journals, journal proliferation, and a failing infrastructure, has slowly but inexorably undermined the ability of the academy to cope. For decades academic libraries have seen their ability to maintain adequate collections of journals and monographs eroded.[4] In addition to the fallout experienced by libraries, students pay a price both in terms of declining access to books and monographs, and also because at least a portion of the rising costs of the scholarly literature must be transferred onto their shoulders via hikes in tuition and service fees. Academics and authors pay a price as well as their ability to publish manuscripts declines as more and more of library budgets are taken up with journal subscriptions. In fact, it is not atypical these days to find publishing houses, because of the declining ability of the market to bear monograph publication, focusing on marketable material and rejecting manuscripts that do not have direct relevance to university courses. As David E. Shulenburger, Provost of the University of Kansas notes, after years of ignoring the problem: [5]

> I became actively involved in the scholarly communication crisis because the KU faculty became alarmed by the annual notice that some serials would have to be canceled and because fewer of their requests to purchase new serials and monographs were granted. Faculty alarm grew as lack of access began to limit their ability to access published research and even to assign readings to graduate students. We responded as you did, with some increased funding, increased interlibrary loan activity, cooperative buying ventures, use of electronic document delivery, etc. But these responses were palliatives, not solutions. Access to scholarly communication is being limited by the explosion in cost and increases in sources available.

For a time, it was hoped that electronic publication would bring some much needed relief not only by reducing the cost of distribution of the primary journal literature, but also by introducing enhancements to the system of scholarly communication. Academics argued that electronic journals could circumvent the inefficiencies of the mail system, reduce the need for administrative support, and eliminated the high cost of paper production. Letting loose the bounds imposed by paper production, and fully exploiting the potentials inherent in information technology could, it was argued, result in a scholarly publication that provided up to 80% savings in material and administrative costs. The initially strong assessments of the potential of information technology led to expectations that that paper publications would, as a result of their numerous weaknesses and inefficiencies, gradually give way to a new world of

electronic publication.

This vision of a future of electronic scholarly communication has many things to recommend itself. Unfortunately, the vision has not been realised as rapidly, or as smoothly, as advocates of electronic scholarly communication would have liked. For various reasons, resistance, blockage, failure of vision, etc., reform has been difficult and slow. Resistance to change has come from a number of quarters. Traditional presses, for example, have reacted in a defensive manner to the potentials of electronic publication, as have commercial presses. This, coupled with a vanguard of scholars pushing new forms of scholarly communication but often unwilling to make connections with established presses, has led to stalled reform. This might have also led to the current lack of vision when it comes to seeing the way through the currently stalled attempts to reform the system. Neither traditional presses or the vanguard of scholars pushing new ways of communicating information can realise significant progress in isolation. Both bring to the table much needed elements in any workable formula for change.

However, the causes of our general inability to bring significant reform to the system of scholarly communication lies not only with internal cleavages. There are also political forces that have impeded progressive reform. The resistance of the commercial presses to significant reform is one such factor that has impeded movement forward. It is difficult within the confines of the current monopoly like system of scholarly communication to compete with commercial presses. As is well known, owning an established and prestigious title ensures presses a virtual stranglehold on the market. While it is certainly possible to resist the commercialisation of the scholarly communication system and to turn back the negative impact of a few predatory commercial presses -- after all scholars have ultimate control of the system -- the change takes time. It takes years to build an established and prestigious list of titles and in that time there are many things that commercial presses can do to make reform difficult and time consuming.

There are other forces that work against realising a utopian vision of scholarly communication. The decline of the Keynsian state coupled with the rise of neoliberal politics has meant obstacles that need to be overcome. As various authors have noted, a critical feature of the new political climate is the forceful replacement of public spaces with private opportunities for accumulation and the valorisation of capital. [6] This is a well known shift that has occurred concurrent with globalisation. Practically, this has meant the downsizing of governments (primarily in areas of social spending), the decline of social reform and the welfare state, and the erasure of public space and its replacement with for-profit alternatives (privatisation). In Canada the shifts are well documented and include reduction in social programs, decline of corporate taxes, and the gradual erosion of "profitable" public services like healthcare and education with private alternatives. [7]

Universities, though insulated in many ways from political shifts, are not unaffected by them. Rather than seeing universities and other educational institutions as public spaces under the tutelage of public officials and serving the public interest, universities and schools are more and more being "re-imagined" as spaces appropriate for profit generation and private sector service. As a result of the neoliberal push, universities are being colonised, physically and intellectually, by capital, its representatives, and its ideologies. [8] This has meant the importation of market discourse, [9] including discourses of efficiency, accountability, and consumerism, the shift away from public funding towards private contribution, and the imposition of "market discipline" through various forms of tied financing. [10] In a nutshell, universities have been forced "into the market" by ongoing financial cutbacks and restructuring.

This imposition of a market mentality on the post-secondary system has implications for our ability to reform the system. For example, in this context of neoliberal reform, scholars and other's interested in the health of the scholarly communication system are bucking a global trend when they attempt to resist the creation and extension of a "profitable" journals production system. Governments, steeped in the ideology of neo-liberalism, may acknowledge the "crises" in the scholarly communication system (high cost, delay, etc), but may be unable to actualise reasonable solutions because of the ideological orientation they bring with them. For example, rather than seeing a potential solution in a scholarly communication system controlled by scholars and their organisational representatives (university presses, scholarly societies, etc), governments may set upon further privatisation and monopoly control (consolidation for the purposes of increasing competitive health) as the only viable solutions. While most in the scholarly community now recognise that further consolidation of the journals system hurts the competitive health of the industry, governments, steeped in neoliberal rhetoric, may not perceive the long term damage. As will be seen, the ideological blinders can affect the contours and success of government led initiatives as governments actively pursue strategies that, while conforming to the current received economic wisdom, are often antagonistic to the scholarly communications system as a whole

As a result of all these obstacles, no dramatic shifts in the scholarly communication system have materialised in the last few years. [11] This has led to a certain attenuation of the revolutionary calls for reform as even Steve Harnad, untiring advocate of revolutionary change in the scholarly communication system, has given up predicting the apocalyptic demise of the traditional publication system and now simply continues his advocacy of alternative publication models in the face of continuous resistance to change.[12]

However, stalled reform and inability to progress with alternative systems cannot be the long term fate of the scholarly communication system. Financial pressures have not eased, and serials cancellations lists grow. Indeed, advocates of reform have not given

up and pressure for reforming the system and alleviating the growing fiscal pressure and a mounting sense of crises, is growing. Interestingly, this growing pressure to do something about what some perceive is a crisis in the scholarly communication system is coming at a time when commercial interests are positioning themselves seemingly in an attempt to exert even more control over the system.

For example, some of the more powerful commercial publishing houses have responded to the slow transition and failed attempts at reforming the system by attempting to position themselves in ways that will allow them to more easily exploit what they see as the "attractive" opportunities in the scholarly communication market. Reed Elsevier has recently announced that it will divest itself of IPC Magazines (a distributor of consumer magazines). This divestiture would allow Reed Elsevier to focus on developing a strategy that would enable enhanced ability to exploit the "high value-added areas of 'must have' information" at the same time that it reduces its "exposure to consumer markets." As the cited press release indicates, "The proceeds [of the divestiture] would be used for future development of and acquisitions within Reed Elsevier's core Scientific, Professional and Business Divisions and would provide the company with greater flexibility to respond to attractive growth opportunities as and when they arise." [13]

Elsevier's positioning is only the tip of a move towards consolidation that is causing considerable consternation in the scholarly community. Indeed, an announcement by Reed-Elsevier that it was to merge with Wolters Kluwer, thereby creating a publishing megalith worth 17.5 billion pounds, [14] prompted a the U.S. Department of Justice (DOJ) to investigate the anti-competitive implications of the merger. As Mark J. McCabe, an economics professor at Georgia Institute of Technology and author of the study notes, "...our results for journals sold by commercial publishers indicate that prices are indeed positively related to firm portfolio size, and that mergers result in significant price increases." [15] The conclusion of McCabe's study was simple. In an environment already plagued by lack of healthy competition, even medium size publisher mergers cause competitive harm to the system.

This finding was good news for the scholarly journals community as it gave strong empirical backing to what many have known for a decade or more, that the system was competitively unhealthy. And, not surprisingly, this finding, and similar recent work, has added fuel to an already growing movement calling for active responses to the problems with the scholarly communications system. There is a powerful storm brewing, it seems. In the face of growing movement by the commercial presses to consolidate their strength, there is growing pressure for change. Publications decrying the sad state of the scholarly communication system proliferate, awareness of the difficulties grow and, very recently, positive steps have been taken to reform the system. Early attempts to exploit information technology by pioneers such as The Stanford University's High Wire Press (http://highwire.stanford.edu/) are been

supplemented now with more politically informed initiatives including the recently announced Scholarly Publishing and Academic Resources Coalition (SPARC) initiative.

This dissertation picks up at the same spot as recent announcements and attempts to reform the system. The author of this dissertation has developed one alternative model of scholarly communication. This alternative model of scholarly communication has been realised in its initial phases in the recent announcement of the formation of the International Consortium for Alternative Academic Publication (ICAAP). It is the task of part of this dissertation to outline the historical and contemporary context for the creation of this consortium and to examine how this consortium is working towards the creation of an alternative model of scholarly communication. More importantly perhaps, this dissertation is concerned with examining how, through ICAAP, information technology can be exploited in ways that can potentially transform the scholarly communication system. As will be seen in later chapters, ICAAP has made significant progress in developing the prototype of a new model of scholarly communication based on full exploitation of the imbedded potentials of information technology and with a remarkable potential to lower the cost, and enhance the pace of, scholarly communication as we move into the next millennium.

Chapter Outline

Chapter One begins with a general overview of the literature relevant to understanding the nature and current state of the scholarly journals system. This chapter sets off with a brief examination of the history of scholarly communication and scholarly journals. This examination begins at the enlightenment when science was emerging as an alternative to traditional systems of authority. As will be seen, it was during the scientific revolution that the need for a more efficient scholarly communication system first arose. The traditional system of communication, based on the scholarly book and letter, although it served scholars admirably before the scientific revolution, gradually buckled under the demands and strain of the new scientific approach to scholarship. The emergence of science, its peculiar communication requirements, coupled with socio-economic changes, and the willingness of some individuals to experiment with new methods of distributing scholarly information, led eventually to the emergence of the primary scholarly journal as the flagship of a new and evolving scholarly communication system.

Interestingly, the new forms of scholarly communication based on rapid and public dissemination of original research, were not seen as simply another method of distributing the fruits of scientific research. That is, the shift from letters to journals was not just a quantitative improvement in the efficiency of the scholarly communication system. It was perceived by many as a significant improvement that brought a qualitative shift in potential. Indeed, individuals attached grand historical significance to the emergence of this new form of communication. Commentators as illustrious as

Francis Bacon saw in the new scientific communication system and the new scholarly journal great social and economic potential. Open, rapid and public scholarly communication was to create, according to Bacon and some others, the preconditions for social and economic advance towards a utopian society.

There can be little doubt that the new system of scholarly communication was a significant advance over the previous system of scholarly letter writing and book publication. Indeed, the system was so successful that its subsequent proliferation threatened to swamp the ability of the system to maintain coherence. However, even though the new primary journals system was a huge success, there were problems from the very start. The system was never as open, public and rapid as an ideal typical image of that system would have indicated or desired. The shortfall in the new system becomes apparent only after examining in more depth the nature of the scholarly communication system. As is demonstrated in Chapter One, current awareness is not the only function of the system. This fact is drawn out and analysed through an examination of the informal communication system and its relation to the formal, paper system. Conducting this comprehensive analysis allows us to see problems not normally identified in treatises on the scholarly journals system. This explication of the informal communication system makes explicit the fact that the journals system, though an advance over previous systems, is not as open, rapid, or public as originally intended. This analysis lays essential groundwork for the discussion of current difficulties with journal publication in Chapter Two, and potential solutions made possible by electronic publication, in Chapter Three.

Chapter Two examines current problems in the scholarly communication system. After briefly introducing the significant players in the field of scholarly information, the chapter goes on to outline publication delay, high cost, and journal proliferation as significant difficulties with the current paper based system of scholarly communication. As shall be noted in Chapter Two, these problems, especially high cost, are threatening to undermine the integrity of the system. Cost and exponential growth of the scholarly journal literature is arguably undermining the ability of the system to absorb all available scholarship. As commercial publishers have extracted unreasonable levels of profits from certain segments of the scholarly journals system, and as libraries slash acquisitions, disciplines such as the humanities and social sciences are finding it increasingly difficult to cope. Indeed, some have even argued that, as libraries cut serials acquisitions, entire sub-disciplines may lose their ability to provide a public archive of their information. In Chapter Two these difficulties are examined in detail as are the possible causes of proliferation (both structural and social) and skyrocketing cost.

The problems go deeper that a simple strained ability to purchase and archive the world's scholarship. The ongoing strain in the system throws doubt on the ability of the scholarly journal and the public scientific communication system to fulfil the ambitions

originally envisaged for it by commentators like Francis Bacon. For example, publication delay has forced scholars to push the communication of critical information back into the informal and semi-private communication system. This, in addition to contradicting the original intent of the primary journal system, has implications for scholars at the margins of the scholarly communication system. Arguably, the reliance on the informal and semi-private communication system disadvantages certain groups of scholars and reinforces structured inequalities. As noted in the chapter, this shift is ironic considering that the system originally evolved to ensure widespread and democratic access to scientific information.

Following the detailed examination of current difficulties in the scholarly communication system, Chapter Three examines the electronic scholarly journal and the potential it might bring to overcome some of the difficulties with the current paper based system of scholarly communication. As is argued in the chapter, electronic publication has the potential to increase access, increase distribution speed, and even lower the cost of scholarly communication. Case studies are provided that highlight the almost revolutionary gains in access and speed of distribution attainable by some disciplines. With regards to cost, evidence is also provided to support the argument that cost savings can be achieved when publishing electronic material (this argument is further developed and substantiated in Chapter Six with reference to the technologies developed at ICAAP). Arguably, the greatest benefits accrue when journals are fully electronic; that is, when journals are either initially conceived of as electronic publications, or when journals give up their paper existence and move into the electronic realm. As noted in the chapter, the minimum cost savings associated with going fully electronic is 45% over the original paper cost of the journal. It may even be possible to increase this minimum cost savings up to a maximum of approximately 75% if basic editorial tasks can be automated and if efficiencies in the textual markup of journal submissions are achieved.

However, as noted in Chapter Three, there is also a potential to realise benefits even when journals do not give up their paper existence. Individual editors or publishers may want to provide the value added services (like enhanced distribution speed, enhanced access, and faster peer review) that are only possible with electronic publication without necessarily giving up a paper version. In order to provide these enhancements while retaining the paper version of a journal, the only alternative is to provide both an electronic and a paper version. Despite some evidence that taking this route will increase the cost of scholarly communication, an argument is made that even when journals publish parallel versions, there is a small potential for cost reduction. However, realising this reduction in cost involves reconceptualising the journal production process. It is argued that failure to creatively rethink journal production is a primary reason why many publishers are reporting cost increases.

It is the task of Chapter Four to examine in more detail the political economy of the

scholarly communication system. After first noting that initial calls for reform to the scholarly communication system were largely unsuccessful in motivating significant change, the chapter goes to examine the blockages, both past and present, to significant reform. These blockages include lack of awareness of the extent of the problem, defensive reaction on the part of independent publishers and scholarly societies and, more recently, resistance on the part of the commercial press and wider geopolitical ideological shifts.

The lesson of Chapter Four is simple. It is necessary, in order to avoid continued degradation of the scholarly communication system, that all stakeholders, including sympathetic commercial presses, work together to create a healthy and viable system of scholarly communication that includes space not only for journals, but also for monographs and other forms of publication. As noted in this chapter, the potential of failed reform is high. Higher user fees for electronic access, offloading of the costs of scholarly communication onto individuals, declining access and declining educational quality are only some of the possibilities if steps are not taken to reverse the commercialisation of the scholarly communication system. The question that emerges at the end of Chapter Four is simple – how to bring significant reform to a strained scholarly communication system.

Answering this question is not as easy as it might first appear. While many have argued that there is *potential* inherent in information technologies to reform the system, few have commented at length about the steps needed to realise this potential. Fewer still have actually realised a full program of technological reform. To be sure many attempt to utilise technology in one way or another, but these attempts often fall short of a full spectrum plan to exploit technology (or they fall short in their efforts to communicate the parameters of technological reform). The result is that even though scholars develop learned testimonials to the potentials of information technology, the testimonials often seem strained, out of touch with reality and ultimately unconvincing. What is needed to fill in this gap is, in addition to *statements* about the potentials of Information Technology, actual demonstrations and detailed discussions of the potentials of IT. It is only be demonstrating the potentials of IT, and discussing these potentials, that scholars outside of the technological loop will become convinced of the potential for reform.

Because of this need to illustrate what technological reform will actually look like, Chapters Four and Five leave behind a broader discussion of technology (a definition that encompasses physical technology as well as human activity) and focuses in on the actual technologies that might be used to reform the system. For many readers comfortable with broader definitions of technology, the transition will be abrupt. However, because of the doubt that many scholars have concerning the potentials inherent in information technologies, and because of the rapid advance of technology (which makes it very easy to fall behind in our awareness of the potentials of IT), any

technologically grounded discussion of the social and political implications of new Information Technologies requires that some time be spent outlining the true nature of IT. Otherwise it is all too easy to either discount out of hand, or accept to easily, the statements of technological gurus about the potentials of Information Technology.

Therefore, in Chapters Four and Five the discussion moves to a detailed analysis of new publication technologies that might be turned towards reforming the current scholarly communication system. The analysis presented in these final two chapters follows in detail the technological advances being made by a broadly based, technologically advanced coalition of stakeholders interested in reforming the scholarly communication system. This coalition, named the International Consortium for Alternative Academic Publication (ICAAP) shares intellectual and political space with other recent initiatives designed to resist ongoing commercialisation and degradation of the scholarly communication system.

As noted in Chapter Five and Six, the ICAAP strategy attempts to work around the political, economic, and technological obstacles barring reform to the system. The ICAAP strategy is intended to help create a low cost but high value added electronic scholarly communication system. Key planks in ICAAP strategy include the full exploitation of available open source (i.e., free) software, and the development of a distributed scholarly journals infrastructure and the reliance on "centres of excellence" to provide key services for scholarly journals at no, or reduce cost. Significant cost reduction and notable enhancements in the provision of communication services can be realised even if only these two planks are drawn out. However the linchpin of the strategy is the full exploitation of document handling technology , (i.e., SGML systems), for the creation of a sophisticated, robust, and fully scalable scholarly journals markup language. As noted in Chapter Five, this SGML production system, researched and developed by this author, provides almost inconceivable power over the handling of electronic scholarly articles. Some time is spent in Chapter Five examining the details of the SGML production system used to enhance the electronic publication process.

In the final chapter of this dissertation, the implications of the ICAAP strategy for reducing the cost and enhancing the value of the scholarly communications system is examined. This examination is conducted within the context of the development of a costing model for electronic scholarly journals. As is outlined in Chapter Six, the utilisation of open source software, the exploitation of centres of excellence, and the full realisation of the potentials inherent in the ICAAP SGML production system bring a startling potential for reform and enhancement. In this chapter, the full potential impact of information technology at all levels of the electronic journals production process is examined. From hardware and software infrastructure costs, through to article markup and the provision of sophisticated structured indexing and article location services, there is considerable potential for qualitative and quantitative change. The potentials of the SGML system are most dramatically demonstrated in the easy and

inexpensive deployment of automated indexing, search and location robots that provide the basic high technology infrastructure components for a globally interconnected system of scholarly literature that provides, for perhaps the first time since the creation of the scholarly journals system, true potential for extremely rapid, open, and inexpensive distribution of the world's scientific output.

In the conclusion to this dissertation, the previous chapters are tied together in a reiteration of the Baconian ideal of scholarly communication. Just as the original pioneers of a new scholarly communication saw great social potential in the new technologies for distributing scholarly information (the printing press and the scholarly journal), so today do many students of the electronic scholarly communication system see great potential for social advance. The full potential may not be altogether apparent from the perspective of advantaged westerners use to the benefits of a high degree of access to the scholarly communication system. However, when considered in the context of earlier criticisms of the informal communication system and the ongoing difficulties marginalised groups of scholars have in accessing the system, the potential is very great. Certainly the steps forward could be at least as significant as when the first scholarly journals first appeared. Creating a system that allows more rapid and global access cannot help but contribute to social and economic advance in many areas of the world currently struggling at the margins of science.

Ultimately, then, the dissertation ends with the same sort of utopian dream that many other social commentators first communicated with the rise of the enlightenment and the propagation of scientific thinking. Basically, the dissertation argues that when information technologies are exploited in a knowledgeable fashion, and when the full potential of available technologies is recognised and exploited, there is a potential to create a global realisation (or at least a closer approximation) of Bacon's House of Saloman. The electronic system of scholarly communication prototyped by ICAAP could provide an example for the creation of an high speed, low cost, high value added, open and globally accessible, scholarly communication system. The potential benefits could be enormous. The only obstacles to the realisation of this goal are political. In the end the question is simple. Do we seize the current opportunity provided by information technology to move us one step closer to the realisation of a 300 year old ideal, or do we allow current political trends to close this opportunity and create a system of scholarly communication that benefits only a few privileged scholars, and a few huge publishing houses?

Chapter One: Epistemological Ideals and Historical Realities

> The period from the invention of printing to the invention of the learned journal was a period which the Republic of Letters was handicapped by inadequate facilities of intellectual communication and publicity. In proportion to the increase in authorship and in the multiplication of books the need for communication and cohesion among savants expanded beyond the power of the learned letter, with its defects of privacy, loss of time and irregularity, to fulfill. This need of scholarship combined in the seventeenth century with the rise of the sciences and of intellectual curiosity among the upper classes to produce the learned journal. [1]

> We will obtain a totally misleading view of science if we infer its social attributes from the formal characteristics of the claims presented in articles, reviews and textbooks. Formal knowledge claims have meaning only when they are interpreted by the members of the actual social groupings. The way in which their interpretations are realised depends on the outcome of contingent negotiations among those members. [2]

Introduction

It is the main task of this chapter to provide a descriptive account of the scholarly communication system. This account begins with an examination of the emergence of the primary scholarly journal in 17th century France and Britain [3] and continues with an examination of the causal antecedents that converged to create conditions suitable for the emergence of a new form of scholarly communication. As will be seen from this very brief overview, a wide variety of conditions, from the European enlightenment through the emergence of a new middle class, were necessary before a new form of scholarly communication could emerge and prosper.

This chapter continues with a study of the extant system of scholarly communication. The system of communication has been conceived of as divided into two parts: a formal realm (encompassing the written and archival literature of science); and an informal realm (encompassing everything else that goes on in science). Even though this

dissertation is properly concerned with the formal communication system of science and the scholarly journal, it will look at both the formal and informal system of scholarly communication. The reason for this is twofold. On the one hand, the informal system has been largely misrepresented in previous discussions of the scholarly communication system. The traditional practice has been to clearly demarcate the formal and informal systems and then privilege the formal system of communication as the *sin qua non* of the scientific enterprise. However recent work in the Sociology of Scientific Knowledge (SSK) has made maintaining this demarcation and privileged position difficult. It is in order to contribute to a wider dissemination of the newer understanding of the informal communication system that this material is reviewed here.

A second and perhaps better reason for considering the communication system in toto is that in so doing it provides us a window into what an "ideal" model of scholarly communication might look like. As will be seen in this chapter, the scholarly journal emerged as a way of creating an open system of scholarly discourse. This opening meant not only creating an efficient system for timely distribution of scientific work, it also meant creating the preconditions for expanding access to the disciplines of scientific inquiry. As Francis Bacon, and others, noted at that time, scientific progress could only be attained through co-operative public endeavour and inquiry. Prior systems of communication failed to provide the necessary infrastructure simply because they limited distribution to private networks. Thus, scholarly journals were designed to overcome these limitations and create the conditions for a co-operative international science.

The story about scholarly journals goes deeper than a simple motivation to create the preconditions for wider scholarly communication. Scholars at the time saw great hope that science and public inquiry would create a new society. This notion that science and scientific communication could create a utopian world saw its most powerful expression in Francis Bacon's utopian novel *New Atlantis* (originally published in 1624). This idea that open communication, of which scholarly communication would be an essential component, could provide the basis for a better world has been passed down through the years. It has found expression in the works of authors of more recent lineage. Some of these authors will be examined in this chapter.

Unfortunately, as will be seen in the bulk of this dissertation, the scholarly communication system has generally failed in the task originally envisaged for it. Its primary functions, rapid distribution of scholarly research and open and widespread access to the fruits of science, have been compromised by the explosion of scientific communication and the cost of distributing that information. This has implications , as will be seen from examining the nature of the informal system of scholarly communication, for the stratification system in science. These developments have made the realisation of the Baconian ideal an open society and an open system of scholarly communication a distant one.

A Brief History of the Scholarly Journal

The history of the scholarly journal begins with the foundation of the *Philosophical Transactions of the Royal Society* in London on March 6, 1665 by the Royal Society of London [4] and the *Journal des Sçavans* in France on January 5, 1665 by the private scholar Denis de Sallo. The former journal was founded by members of the *Royal Society of London*, [5] in particular their secretary Henry Oldenburg - the latter by a French dilettante by the name of Denis de Sallo. Following the emergence of the first two scholarly journals, a number of other journals were founded. [6] The first scientific periodical to be published in Germany, modelled after the *Transactions*, was the *Miscellanea Curiosa Medico-Physica*, in 1670. Like most other journals of the time, it was devoted to scientific papers, book reviews, communications and obituaries. Another German periodical entitled *Acta Eruditorum* was modelled after the *Journal des Sçavans*. Other important and influential periodicals included the *Raccolta d'opuscoli scientifici e fililogici* published from Venice from 1728 to 1757, *Gottingische Zeitung von Gelehrten Sachen* published from 1739 to 1752, and *Der Naturforscher* published at Halle from 1774 to 1804. [7]

At the close of the 17th century, there were about 30 scientific and medical journals in Europe. Thereafter there followed a century and a half of relatively slow growth. For example, between 1725 and the end of the 18th century, 74 new journals were started. [8] However towards the middle of the 19th century journal starts began to accelerate. By the end of the 19th century, 700 titles were listed. And since that time, the scholarly journal has grown steadily and exponentially [9] to a world wide body of periodical literature consisting of over some 147,000 journals of which 25,000 are listed as scholarly periodicals. [10] Truly the scholarly journal, and its derivatives, have been global success stories ever since their initial emergence.

What explains the emergence and proliferation of journals? A number of factors are generally offered as explanations. These factors include obvious technological antecedents as the re-invention of the printing press. However social and political precursors are also identified. These include the European enlightenment and scientific revolution, the growth of a literate and informed middle and upper class market for the output of the scholarly disciplines, and the growing need to create a scientific discourse that appeared objective and a-political. All of these factors intertwined to create the conditions for the emergence and proliferation of the scientific periodical.

One of the primary preconditions for the emergence of the scholarly journal was the rapid and accelerating growth of the scientific enterprise. Not that scholarly activity has been unimportant during the medieval era. [11] Indeed, there was considerable intellectual activity (scholarly and otherwise) at all levels of society prior to the Enlightenment. This is reflected in the activity of the clergy, the growth of a literate public (who later became an important support of the scholarly communication enterprise), and the growing demand for books and other materials in the centuries preceding the invention of printing. [12] However scholarly learning before the Enlightenment had primarily focused on retrieving and translating the classic works received from the Roman and Byzantine civilisations, [13] whereas after the emphasis shifted to acquiring new and

"positive" knowledge.

This shift was key. Frances Bacon, who has been taken as the herald of the new intellectual order, criticised the Scholastic emphasis on the retrieval of ancient learning. [14] Bacon, like many of his contemporaries, felt that progress could not be made while slavishly adhering to the dogma of ancient civilisations. He outlined a new methodological program of empirical observation that was designed to move beyond what he saw as the limitations of ancient knowledge. The new mode of scholarship would emphasise the gradual and co-operative accretion of *new* and positive scientific knowledge. The development of this new program signalled a critical intellectual shift away from philosophical thought and exegesis to a more empirical approach with greater emphasis on observation, description, and the accumulation of verifiable (or positive) knowledge.

This did not mean that controversies of the status of knowledge dissipated following the introduction of the journal, or that the new empiricism supplanted all classic knowledge. The shift was more about the development of "positive" and "practical" knowledge than it was about rejecting the entire ancient corpus. And it is likely that many defended the usefulness of the ancient corpus. Indeed, in the first few years that the *Transactions* were published, Henry Oldenburg found it continually necessary to defend the new modes of scholarly activity against charges that they ignored the old learning. It was not, Oldenburg argued, that the new scholars ignored the knowledge of the ancients. Rather, the new scientific attitude emphasised that knowledge be verifiable and positive. If the ancient wisdom could be verified through observation, then surely it deserved to be incorporated into the new sciences. [15] An interesting rhetorical battle waged in the first few years of the journal as the new "positive" knowledge slowly gained ascendancy over the old forms of learning.

> If Aristotle had been so happy, as to have enjoyed our optocks, and other Instruments of Arts, as such Engins as we now employ, He would have been quite of another spirit than these are; and would have acknowledged a greater variety and more curious contexture,....and would have confest the production of our Pyrotechnical Furnaces to excell all, that could be reasonably expected form his own fast Fiery Region. [16]

As this new enlightenment mode of knowledge acquisition grew, those holding to the belief that empiricism and positivism were the way forward began to see scholarly communication in terms of the *public* communication of short observations or experiments rather than fully worked out theoretical or philosophical treatises. [17] This shift was important to the birth of the journal since the old forms of scholarly communication were increasingly seen to be inadequate for the rapid and public communication of the fruits of science. Some scholars eventually concluded that effective and efficient communication required a new form of scholarly literature altogether.[18]

But what were the earlier methods of distributing scholarly knowledge that were no longer adequate? Prior to the advent of the journal, the primary methods for

distributing scholarly communications were learned letters between colleagues, books, and gazettes. However in the context of the new enlightened approach to knowledge acquisition, these were seen to be inadequate vehicles. The book could no longer function adequately as a purveyor of scholarly research for two related reasons. On the one hand, the book was clearly not an efficient method of publishing the results of short experiments or observations simply because it took too long to accumulate enough material to justify a book length tome. Waiting the extra year or two that would be required for development of sufficient material for a book placed an unnecessary delay on the distribution of the early experimental material. The book also became inadequate because scholars who made contributions sought priority for discoveries. Timing here was of course critical and as the pressure to publish quickly grew in the frenzy of scholarly development during the enlightenment, a new outlet was required that could move material rapidly into the public eye at the same time that it dated work closer to the actual discovery.

For a time, the scholarly letter functioned as the preferred means of communicating and establishing priority. In fact, the letter was much closer in spirit than the book to the new modes of scientific inquiry since it provided a medium for fairly rapid exchange of ideas and experimentation. It was also useful as vehicle for providing news concerning the activities of the scholars in distant parts of the world, and was a method of ensuring priority through, albeit limited, distribution (sometimes in encoded form) of the work of scholars. However like the book, the letter also suffered a number of inefficiencies and deficits that would eventually move scholars of the time to experiment with alternatives. Scholarly letters were, after all, mostly private communications; and as such, they had very limited distribution. According to Bacon, science benefited no one, and was slowed in its progress, if scholars all over the world could not access the new knowledge. Letters were obviously limited in their capacity to make research public since they had only a limited field of distribution.

Initial solutions to this dilemma involved quick-fix additions to the existing system. The learned societies of the time, for example, often actively solicited and collected the letters of scholars in order to facilitate their wider distribution. These collected communiqués were subsequently read before society meetings and archived for posterity. This was acceptable for a time. However, as the importance and volume of scholarly communication grew, the academies and societies began to devote resources specifically for the purpose of soliciting, receiving, responding, reading, and archiving letters. They also finally designated a special membership category known as "correspondent" that would be responsible for collecting information on the progress of the sciences at home and abroad. They would then relay the information they collected back to their society where it would subsequently be distributed and read before the membership. [19]

This method of communicating scientific results was very inefficient. Although the method provided fairly rapid communication, there was considerable labour time involved in preparing letters for distribution. As the volume of scientific material grew, these labour intensive activities became a major burden on the resources of the learned societies. This led, by stages, to the development of labour saving devices and attempts

to standardise the communication process. The printing press was solicited and shorthand systems were developed. Even language was effected as the push to communicate science more widely and efficiently forced the elimination of abbreviations and the creation of a simplified and standardised writing style. [20] Unfortunately, none of these solutions proved adequate to handling the steadily increasing volume of scientific material. The letter was simply too inefficient. So in the end, a new form of scholarly communication, the scholarly journal pioneered by the secretary of the Royal Society and Denis de Sallo, was needed. This new format for distributing scholarly work, the journal, "solved" the crisis of communication - at least for a time.

Open Communication

Taking the *Philosophical Transactions* as representative of the journals at the time, it is instructive to examine their early content. Not surprisingly, the new journals were devoted to a wide range of empirical sciences including but not limited to navigation, botany, geography, and astronomy. Their role in the public communication of scholarly material is evident. The early volumes included contributions formally entitled *experiments* like "An Experimental History of Cold" and also *observations* which were just that, observations of some natural or biological phenomenon. Letters, which were a hold over from the previous mode of distributing scholarly communication, were also included. In addition, and much like today's journals, there were notices of new books, summaries of books, and book reviews.

This new system of scholarly communication was unique. Its principle defining characteristic was the fact that it was an open system of communication. This openness extended not only to other scholars who would benefit from being able to read the work of other scholars as it was produced, but also to society as a whole. Indeed, as the public output of the scholarly press grew, science and dabbling in scientific activity became quite popular in the 17th and 18th century as the newly created middle classes became faithful devotees of scholarly activity. Indeed, the emerging middle classes were critical in the early support and continued expansion of the scholarly communication system and the scholarly journal at that time. They organised royal societies and Masonic lodges for the express purpose of collecting and disseminating new knowledge, organised numerous lecture series for visiting scholars, attended society meetings, and generally poured forth their new found wealth into the scholarly enterprise. This fed into the scholarly journal and provided necessary market support.

A mutually productive synergy developed. The middle classes, industrialists, and even the nobility, supported the scholarly enterprise. In return, scholars performed research and wrote about that research in the context of its benefits to industry. As Margaret Jacob points out, "The propensity to link science with application, with trade and industry, was part of the ideology that created the Royal Society in 1662." [21] This tendency is clearly evident in the early volumes of the *Transactions*. In the very first issue there is an article entitled "Of the New American Whale-Fishing about the Bermudas." This is an account of how to kill large whales (2 old-females and 3 Cubs in this article), how to extract oil, how much oil could be expected, and some qualities of

that oil. [22] This information is clearly of practical import to the fishing industry. Similarly, the following "advertisement," is clearly directed towards those industrialists who would most benefit from the work of the scholar Sir Robert Boyle.

> Hearing of great complaints of the Rot of Sheep in many parts of England; [sic] we thought, it would not be unwelcome to the Reader, to be, on such an occasion, directed, for a good and cheap way of preventing the disease, to what the Honourable Robert Boyle hath publisht in this second Tome of the Usefulness of Natural Philosophy, printed at Oxford A.1671. p. 15. [23]

This synergy was important. In fact in many ways the intent was to build this into the system. Scholars of that day saw great potential in a system of scholarly communication that would be open, accessible, and able to fully exploit the minds of all talented people by creating fertile soil for the development of science and society. In fact, there were utopian leanings in the writings of some authors at the time. Sir Francis Bacon, for example, wrote a novel entitled *New Atlantis*. Bacon uses the vehicle of the utopian novel to argue that the new science had the potential to bring unheard of progress and ease to human society. In the novel, Bacon describes an organisation entitled the House of Saloman's. This organisation is essentially a group of scholars charged with discovering the secrets of nature.

> And here I shall seem a little to digress, but you will by and by find it pertinent. Ye shall understand, my dear friends, that among the excellent acts of that King, one above all hath the pre-eminence. It was the erection and institution of an order, or society, which we call Saloman's House, the noblest foundation, as we think, that ever was upon the earth, and the lantern of this kingdom. It is dedicated to the study of the works and creatures of God. Some think it beareth the founder's name a little corrupted, as if it should be Solomon's House. But the records write it as it is spoken. [24]

The House of Saloman consisted of scientists, in other words, charged with the typical scientific function to uncover the cause of things.

> The end of our foundation is the knowledge of causes, and secret motions of things; and the enlarging of the bounds of human empire, to the effecting of all things possible. [25]

Bacon provided a long and imaginative list of the achievements of Saloman's house in his novel including the development of scientific instrumentation and achievements in botany, zoology, metallurgy, chemistry, to name only a few. To be sure, his image is a utopian image of the potentials of science. However, it is not unreasonable to suggest that science could contribute to social and technological advancement. But what is most interesting for our purposes is Bacon's conceptualisation of the bedrock of the scientific enterprise. For Bacon, and for others, scientific progress was made possible through the publication of science in forms openly accessible to others. It was this open publication that facilitated the slow and steady accretion of new knowledge. This is an interesting vision of scholarly communication and one that is shared by authors even to this day. As Karl Popper notes when formulating his basic epistemological principles,

"Knowledge cannot start from nothing – from a *tabula rasa* – nor yet from observation. The advance of knowledge consists, mainly, in the modification of earlier knowledge." [26] Of course, it is only possible to modify earlier knowledge if it accessible. And herein lies the key to understanding the importance of the scholarly communication system. Advance requires a corpus of past research that is easily and openly accessible.

This of course makes perfect sense for scholars and amounts to no earth shattering revelation. However others have extended this notion of open communication further. Jurgen Habermas is one such scholar. In the words of Craig Calhoun, Habermas asks, "what are the social conditions...for a rational-critical debate about public issues conducted by private persons willing to let arguments and not statuses determine decisions." [27] In other words, what makes a functioning democracy possible where class interests and ideologies do not cloud the issues and prevent decisions in the interest of the common good from being made?

The answer to that question is complex. Many factors are involved in the creation of an open society were communicative action along the lines envisaged by Habermas is possible. But one of the critical components was access to information and free communication. In fact, many at that time thought that information and communication were so important that they enshrined the notion in the French constitution of 1791 that, as Calhoun notes, declared that "free communication of ideas and opinions is one of the most precious rights of man [sic]." [28] Indeed, open communication and access to information facilitates the expansion of a public capable of discussing and deciding on social and political issues. There is, according to Habermas, a democratising tendency when information is accessible. With open access to information, it would always be very difficult to totally close access to public debate and decision making. "Anyone with access to cultural products---books, plays, journals---had at least a potential claim on the attention of the culture-debating public." [29] The end result of this would be a vibrant civil society participating in key decisions.

There was a time during the enlightenment when print played a catalytic role in the expansion of public discourse and debate. Indeed, as noted above, the expansion of interest in the printed word spilled over into an expanded interest in the scholarly press and provided essential market support. This created, for a brief period of time, the type of vibrant civil society envisaged by Habermas. As Calhoun notes of the expansion of open communication:

> Merchants needed information about prices and demand, but the newsletters that supplied those needs very quickly began to carry other sorts of information as well. The same process helped to engender both a more widespread literacy and an approach to the printed word as a source of currently significant "public" information....critical reasoning entered the press in the early eighteenth century, supplementing the news with learned articles and quickly creating a new genre of periodical....[and] the greatest contributions of the literary public sphere to the political sphere lay in the development of institutional bases. These ranged from meeting places to journals to webs of social relationships. [30]

First in Britain, then in France towards the end of the 18th century, then in Germany, and in an ever expanding circle, information expanded and a hungry public eagerly absorbed the outlets. Indeed, Calhoun suggests that during this period when the presses were expanding and revolutions were tearing apart countries, there was a realisation of a critical public sphere and discourse as envisaged by Habermas. However this did not last. In the 19th and 20th centuries, the public sphere degenerated, according to Habermas, with the rise of mass politics and the mass media. This vision characterised the public sphere as consisting of mechanisms such as public opinion research, polling, and popular entertainment (the press, movies, the media) that were mostly designed to anaesthetise the masses and divert their attention from issues that would challenge the hegemony of the ruling classes. As Calhoun notes, "...the public sphere was turned into a sham semblance of its former self. The key tendency was to replace the shared critical activity of public discourse by a more passive culture [of] consumption on the one hand and an apolitical sociability on the other. [31] Nevertheless, within scientific communications such critical publicity survived and scientific innovation did not suffer the same fate.

Problems

Habermas has been criticised on a number of key points in his theory including an over idealised version of the 17th –18th century emergence of the public sphere and an overly pessimistic characterisation development in the public sphere since that time. [32] However the general outline of his theory, and especially the key importance given to information and communication in a critical press, is important. Like Bacon's notion that open scholarly communication was necessary for the advancement of science, or Popper's basic epistemological position that stated the importance of a scientific archive, Habermas extended the notion to include the importance of open [scholarly] communication for the advancement of the public sphere. Indeed, "Habermas's own later work suggests...the extension of the idea of science to social science was a key moment in the creation of the liberal public sphere." [33]

However for those who considered open scholarly communication necessary for the advancement of science, and for those who considered science one component in the expansion of the public sphere, disappointment waited around the corner. On the one hand, the system of scholarly communication and the learned journal that emerged at that time, although a significant advance over the previous system of letter writing and book publication, was never a totally open system of communication. There is not much research into this aspect of the early scholarly communication system. But what research does exist generally points, unsurprisingly, to the fact that the early system of scholarly communication was limited primarily to males, limited primarily to those from the middle and upper classes, and limited primarily to those from northern European and American countries. In other words, despite the fact that the system was more open than the previous, there were still elements of closure. One of the more subtle characterisations of the *closure* that occurred is provided by Susan Bordo who discusses the *masculinisation* of thought initiated by Descartes in his *Meditations*, and extended into the normative structure of the scholarly communication system.

> Here "masculine" describes not a biological category but a cognitive style, an epistemological stance. Its key term is *detachment:* from the emotional life, from the particularities of time and place, from personal quirks, prejudices, and interests, and most centrally, from the object itself. The masculine orientation toward knowledge ... epitomized in the modern scientific ideal of objectivity, depends on a clear and distinct determination of the boundaries between self and world...[34]

This masculinisation became formalised into the widely accepted canons of neutrality, objectivity, and the strict separation of the subject from the object, that are currently the essential prerequisites to communication in the scholarly press. Although interestingly, early scholarly journals often included political content, that eventually became sanitised out – potentially to the detriment of the public sphere. Much later it can be seen that the original conception of the scholarly press as an open system of communication with content relative to the public sphere (i.e., industry, politics, and sociality) has been lost. Our current predilection with a masculine system of communication is even now used to reconstruct the early history of the scholarly journal. For example, one scholar interested in the early scholarly communication system draws an evaluative distinction between the *Philosophical Transactions of the Royal Society* and the *Journal des Sçavans*. The former is, according to McKie, a true scholarly journal and the latter a mere political pamphlet. As McKie notes of the Transactions:[35]

> It was almost wholly scientific in content; it did not cater for the interests of a widespread public of amateurs; it was a monthly and not a weekly. It was the official organ of the Society and thus the first of its kind. Its appearance marked a new development; for it was a medium for the publication of new observations and original work in science, mostly carried out the Fellows of the Society, and it became the model on which all other published proceedings of the scientific academies have been fashioned. It reviewed books and gave space for the publication of differing scientific opinions by those engaged in similar experiments and studies. *It was less amateur and more professional*, if the latter term may be applied to the productions of an age when the professional scientists had not yet appeared on the scene [italics added].

McKie's analysis is weak on a number of points. He is correct to question his own attempt to use today's standards of professionalism to evaluate journals of the past. As can be seen from the analysis above, the ridged distinctions between "political pamphlets" and scholarly journals did not make sense during the early years of the scholarly journal. There was no fine distinction as politics, business, and science entered into the scholarly communication system as a matter of course. McKie also fails to recognise the ideological factors behind the creation of the new scholarly journal. But regardless, McKie does point to an important aspect of the development of the scholarly journal. Professionalisation of science did contribute to the closure and

impoverishment of the scholarly sphere and its relation to the public sphere. As Stepan and Gilman note, "The formation of the scientific *text* as a new, standardized cultural genre, [replaced] the more open, varied, metaphorically porous, literary forms of science.... and the possibilities of multivalent meanings being created out of scientific language were thereby curtailed." [36] This closure, although not the only factor, arguably contributed to the decline of the public sphere, even as it may have spurred scientific development.

It is important to remember that even despite early closure of the scholarly communication system it was, and is, an advance over previous systems. It is also important to note that an inaccessible system of scholarly communication is the result of other factors besides the professionalisation of the system. Ironically, one of the key factors that weakened the scholarly communication system was it early stunning success. As noted above, with the expansion of industry and the public sphere went an expansion of the presses and the scholarly communication system. The early exponential pattern of journal proliferation threatened to weaken the new system's ability to serve even those whom it was most directly intended to serve -- the scholars themselves. In an attempt to gain bibliographic control over the explosion of scholarly literature, a secondary journal literature (e.g., abstract, index, and review journals) emerged. [37] The secondary literature began to evolve during the first decades of the 18th century. However since that time the secondary literature has also suffered from exponential rates of growth and expansion. [38]

The strain that this exponential explosion has caused to the system will be examined in the next chapter. Suffice it to note at this point that exponential of the scholarly literature has literally swamped scholars and libraries. This has contributed, in the case of libraries, to financial crises as the world's literature expands beyond the ability of the libraries to purchase it. It has also contributed to fragmentation of science as scholars, attempting to keep up with the proliferation of literature in their fields, move more towards specialisation. In both these cases, the original goals of the system to create an open, accessible and public system of scholarly communication are compromised because, on the one hand, the very existence of certain areas of scholarly research are threatened and, on the other, rank specialisation contributes to an apolitical view of society that in turn reinforces the earlier noted tendency to strip science of its responsibility to civil society as envisaged by Habermas.

In conclusion, then, when the scholarly journal first emerged it emerged in response to a growing awareness of the limitations of the previous system of scholarly communication. There were great hopes for this new system of communication. Not only did Francis Bacon pin his utopian dreams on the back of an open system of scholarly communication, but Popper, Habermas, and others saw in the scholarly communication system and the scholarly journal an essential component in the advancement of a liberal democratic society. Undeniably, the new system of scholarly communication was an advance over the previous system and it did contribute to an opening up of scholarly discourse. However even so, from the start the system faced difficulties. From journal proliferation to the closure of scholarly discourse, the scholarly communication system has never lived up to the ideal typical representation

offered by people like Bacon and Habermas.

The next chapter will examine in more detail the "failures" of the scholarly communication system to live up to its original mandate of providing an open, rapid, and public distribution system for scholarly information. There it will be demonstrated how cost, delay, and a stratified system scholarly communication, impede the development of an ideal typical scholarly communication system. However before it is possible to undertake that task, it will be worthwhile examining in more detail the extant scholarly communication system. The following analysis, that covers both the formal system of scholarly communication and the informal system of scholarly communication, provides some essential groundwork for continuing the analysis of the scholarly communication system in the next chapter.

Formal Communication and its Functions

We begin our examination of the extant communication system of science with a look at the formal system of communication. This pen and paper based communication system includes the publication of research in journals, individual research reports, monographs, and similar forums of publication that cater to the initial *public* dissemination of research results. [39] Here "public" is the key word because word of research activity and preliminary results are often circulated in the informal communication system far in advance of its formal publication. However despite the early availability of research and results in the informal realm, distribution of these early results is limited to a select group of researchers. Hence the formal system remains an extremely important public research outlet for non-active researchers, advanced undergraduates, beginning graduate students, and others not directly plugged into the informal system of scholarly communication.

Currently, authors [40] distinguish three separate categories of formal scholarly communication; these are the *primary*, *secondary*, and *tertiary* distribution systems. Primary distribution channels include periodicals devoted to the publication of original research (primary journals), research reports, patents, official society publications, the publications of standards bodies, published theses and dissertations, diaries, memoranda, the minutes of meetings, and internal research reports. Secondary publications emerged as attempts to control the expanding primary literature and they, along with the tertiary communication system, have grown in importance as the scientific and technical literature has exploded. [41] Because the secondary system is designed primarily as a means of gaining bibliographic control of the primary literature, it consists of guides to primary research and includes such bibliographic items as abstracting, [42] summary and review [43] journals, manual and electronic [44] indexing and abstracting services, references like encyclopaedias, dictionaries, collections of tables and formulas, and handbooks. [45] Secondary sources also include general and multidisciplinary periodicals as well as technical journals devoted to the specific interests of industry. The primary function of industry journals is to reformulate and present information relevant to industry in a form easily and quickly assimilated by practitioners in industry

Finally there are tertiary sources. Tertiary sources attempt to organise both primary and secondary sources of material at the same time that they provide value-added services. These services include things like identifying and locating titles in specific subject areas, guiding researchers to speciality libraries, and providing contact or access information. The most famous of the tertiary publication is *Ulrich's International Periodicals Directory*. This publication, founded in 1932, lists all regularly appearing journals throughout the world and in addition to its comprehensive listing also provides subject, cost, distribution, and contact data for each of its titles. Since this dissertation is primarily concerned with the primary journal, any discussion of secondary and tertiary sources is left for a later date.

As already noted, primary journals perform a number of vital roles for the academy. At the most formal level, they have been the essential tools for disseminating and archiving original theoretical and empirical contributions. Historically they have also had a vital role to play in assisting scholars to remain current in their field (their current awareness function). However the early proliferation of primary literature quickly outstripped any single individual's ability to remain current by relying on the primary literature. This restricted the primary journal's ability to fulfil its original current awareness function. As noted, this difficulty prompted the development of primary and secondary sources and the eventual enlistment of the computer as an aid to scholarly research. As a result, the current awareness function of the primary journal is now widely distributed among the primary, secondary, and tertiary systems.

Primary journals also provide a number of additional functions besides their formal role in the distribution and storage of the scientific record. Perhaps their most important role is their *gate keeping* function. As gatekeepers, primary journals function as the final check at the end of a long [46] process of evaluation and pruning that ensures that only the best science makes it into the public arena. This long process begins with the scholar's first idea. Initial testing of the idea is carried out in the informal realm of communication through various subtle informal exchanges (over coffee, in the hallway, etc.). Peer evaluations continues as the idea gradually takes shape and a research program is identified. The entire scientific evaluation process ends only when the paper passes peer review and is published in a primary journal.[47]

Peer review is certainly central to the primary journal's gate keeping function. Peer review occurs when a small group of individuals assess the methodological, substantive, and technical merit of work presented for publication. By virtue of their being experts in a given discipline or subdiscipline, peer reviewers are assumed to be able to objectively assess the contribution of given works of science to the scholarly communication. Garvey [48] provides a succinct statement of the function of the peer reviewer: "...without rigorous scrutiny by qualified scientists a great deal of such information would be unreliable (both in terms of its replicability and relevance to science) and the foundations of scientific knowledge would become enfeebled by 'unscientific' information. Garvey further points out: [49]

> The scientific article is, and will remain for sometime, vital to the scientific community. It is the basic unit of the scientific journal process which provides a system for formal, public, and orderly

> communication among scientists. Journals are formal in the sense that article manuscripts have been reviewed, revised to near perfection, and then allowed to pass into the formal domain where they may be explicitly cited and unambiguously retrieved. They are public both in the sense that anyone can submit a manuscript for publication in them and that they are available to anyone in libraries or by subscription. The orderliness of journals is founded on their articles being selected on the basis of scientific merit, which means that (a) the research reported is flawlessly conducted and (b) its results are relevant to scientific progress in the sense that they have explicit continuity with previous work and foreshow the future course of work on the research front.

Primary journals also perform a number of social functions that have become extremely important in the highly competitive world of the academy. Journals formalise and record scientific contributions for the purpose of assigning priority to discoveries. They also provide valuable (and rare) publication outlets for scholars who need to contribute regular publications in order to advance and achieve tenure in the academy. This aspect of the primary journal has, as the competitiveness of the academy has increased, come (some would say unfortunately) to be the journals most important function. Robert K. Merton [50] has noted that the extreme importance of priority and originality in the academy, and the failure to recognise the structural and institutional variables that encourage this undue emphasis, has led to pathological attempts to adapt to the demands. Merton [51] has this to say:

> The culture of science is, in this measure, pathogenic. It can lead scientists to develop an extreme concern with recognition which is in turn the validation by peers of the worth of their work. Contentiousness, self assertive claims, secretiveness lest one be forestalled, reporting only the data that support an [sic] hypothesis, false charges of plagiarism, even the occasional theft of ideas and, in rare cases, the fabrication of data, - all these have appeared in the history of science and can be thought of as deviant behaviour in response to a discrepancy between the enormous emphasis in the culture of science upon original discovery and the actual difficulty many scientists experience in making an original discovery. In this situation of stress, all manner of adaptive behaviors are called into play, some of these being far beyond the mores of science.

Still, as Merton notes, such examples of pathological behaviour are deviant anomalies. While it would be difficult to eliminate them entirely, it is reasonable to suggest that by and large their occurrence does not hinder the ongoing advancement of science or the evolution of the journals system. The success of science and the proliferation of journals provides ample testimony to the fact that generally the primary journals system has performed its functions adequately.

Disciplinary Differences in Formal Distribution System

All formal scholarly literatures share the above noted basic functions. However despite the broad similarity in the communication systems of the sciences, a number of substantial differences exist between specific disciplines. One critical difference is in the extent of the literature. Some disciplines, like medicine, have literally thousands of scholarly journals while others have, by comparison, only a handful. This is a critical difference because it bears directly on the analysis of problems with the scholarly communication that will occur in Chapters Two and Three. At that point it will be important to distinguish between various disciplines and their contribution in order to develop a clearer picture of the foundations of the current difficulties. For now suffice it to simply note the difference.

Another difference worthy of note is the differential rejection rates of primary journals. A journal rejection rate refers to the percentage of papers submitted to a journal but that are not published. There are wide differences between scientific disciplines. Journals in the sciences have the lowest rejection rates (ranging anywhere from 20 to 40 percent). By contrast, journals in the humanities have the highest rejection rates with journals in some disciplines, for example history, approaching a 90 percent manuscript rejection rate. [52] In the middle are journals in the social and behavioural sciences (with rates around 80 percent), and journals in the physical (24 percent), chemical and biological sciences. Some commentators [53] have attributed these differences to the ontological status and epistemological security of specific disciplines. For example, authors suggest that there is more agreement in the natural sciences about what constitutes publishable material and that this leads to more confidence when dealing with submitted papers. [54] By contrast, as we move away from hard sciences toward the softer, humanistic sciences, epistemological criteria become less institutionalised, less evolved, and more ambiguous. As Lowell L. Hargens [55] notes: "... the greatly different prospects scholars face when submitting manuscripts to, for example, the *Physical Review* and the *American Sociological Review*, result from structural differences between the scholarly communities to which they belong."

Besides the differences in the extent of the literature and the rejection rates of primary journals, there are also substantial differences in the patterns of information communication and use. Noteworthy are findings that indicate that the disciplines differ in their reliance on the primary journal literature. Studies have indicated that the primary journal literature is more important in the natural sciences than in the social sciences [56] and that scholarly output in the "wet" sciences relies less on the primary journal and more on other methods of distributing information. For example, Anton J. Nederhof [57] noted that in a Norwegian psychology department, only 40% of the departmental output was published in journal articles. The bulk of publishable material went into book chapters (27%), edited books (2%), monographs (1%), research reports (12%), and contributions to proceedings (13%). The same lack of emphasis on the primary literature is also evident in sociology. A citation analysis by Maurice B. Line [58] revealed that sociology journal articles cite other journal articles only 33% of the time.

Finally, there are differences in the speed at which scholarly writing is communicated. William D. Garvey, Nan Lin, and Carnot E. Nelson [59] suggest that certain disciplines have inefficient communication systems. This is so, for example, for the social sciences where it takes the results of research about 4 months longer to reach the primary journal than material in the physical sciences. [60] Their interpretation of the differences in information flow is provided below:

> ...the communication systems associated with the physical sciences, the social sciences, and the engineering sciences differed markedly with respect to the operation and use of these elements. Of these groups, scientific communication in the social sciences appeared to be in an early stage of development. The elements of the social sciences' communication structure were relatively noncohesive; the flow of scientific information through the communication system followed less predictable sequences; and the processing of information for the archives seemed less efficient. This processing of information was more time-consuming in the sense that a considerably longer time period elapsed between initiation of work and its presentation at a meeting or its publication in a journal. It was more haphazard in the sense that the evolvement of information did not follow in an orderly manner from small restricted audiences to large public audiences; and it was more diffuse in the sense that information disseminated in a few days at a single meeting subsequently became published, after some considerable delay, in relatively large numbers of different journals.

As is evident, there is a certain tension when discussing disciplinary differences in communication patterns. In the literature on scholarly communication, there is a very clear tendency to attribute differences in the formal and informal communication system between disciplines to a putative difference in the status of the sciences. In this traditional scheme, physics is considered the exemplar of hard science, relying extensively on empirical evidence, while philosophy would be the exemplar of soft science. Others disciplines, like sociology and psychology, fall somewhere in between. This scheme ranks the sciences and assumes that the goal of all disciplines is to attain the status of hard science.

In the scholarly journal literature, this theoretical schema is used to explain the above noted differences in communication patterns between disciplines. For example, Derek de Sola Price developed something he called the "Price Index," which is a measure based on the age of citations in the reference sections of an article. The measure presumably gives an indication of the *immediacy* of a body of scholarly literature (the extent to which it draws on recent research). According to Price the hierarchy of science is reflected in the *Price Indices* of the various disciplines. Note that devaluation of the soft sciences contained in Prices' explanation below.

> Perhaps the most important finding I have to offer is that the hierarchy of Price's Index seems to correspond very well with what we intuit as hard science, soft science, and nonsciences as we

> *descend the scale*...With a low index one has a humanistic type of metabolism in which the scholar has to digest all that has gone before, let it mature gently in the cellar of his wisdom, and then distill forth new words of wisdom about the *same sorts of questions*. In hard science the positiveness of the knowledge and its short permanence enable one to move through the packed down past while still a student and then to emerge at the research front where interaction with one's peers is as important as the storehouse of conventional wisdom. [61]

As much as the above interpretation may be intuitively appealing, there are other possible explanations for the observed differences in information distribution patterns that need to be considered. Take the example of differential journal rejection rates. Harriet Zuckerman and Robert K. Merton [62] offered one alternative explanation when they noted that "Journals in the sciences can apparently publish a higher proportion of manuscripts submitted to them because the available space is greater than that found in the humanities. Take the case of physics. The article in journals of physics are ordinarily short, typically running to only a few pages of print, so that the 'cost' of deciding to publish a particular article is small, and the direct costs of publication are often paid by the authors from research grants." This is significant and may account for most of the recorded disciplinary differences. A typical physics journal published quarterly and running perhaps 150 pages can publish more contributions simply because the papers are shorter. Compare this to a typical sociological paper that runs to 10,000 words and must invoke in great detail the past sociological literature. Clearly, a sociological journal has much less latitude. If both journals get the same number of submissions, let us assume 25 per issue, and it is assumed all submissions are publishable (but not all of equal quality), then because of length differences physics will be able to publish 15 but sociology only 4. This hypothetical example leaves the physics journals with a rejection rate of 40%. By contrast, the sociological journal must reject 85% of submissions. Significantly, quality never enters into the equation.

These structural constraints may even lead, in the long term, to normative differences between the sciences. If the sciences are able to publish more, then they may develop norms that encourage publication of even questionable papers. Other disciplines may, because of structural constraints, develop norms that discourage the publication of papers. This suggested by Stephen Cole, Jonathan R. Cole and Gary Simon [63] who note that that in the sciences, for example, publication norms presuppose that submitted papers should be published whereas in the social sciences the assumption is just the opposite. Cole, Cole and Simon [64] attempt to explain this difference by suggesting that editors and referees in the sciences prefer to make *Type I* errors (i.e., accepting unimportant manuscripts) whereas social sciences prefer to make *Type II* errors (i.e. rejecting potentially significant publications). These different norms, coupled with the greater space in science journals, can have a significant impact on the rejection rates of journals in the various disciplines. Cole, Cole and Simon provide a supportive example.

> There are much qualitative data to support the publication-norm hypothesis. For example, the most important sociology journal in

> Poland, *Studia Sociologiczne*, published by the Polish Academy of Sciences...accepts a majority of papers submitted. In Poland, sociologists do not subscribe to the norm that articles should be rejected unless they are significant contributions. [65]

It is an open question at this point whether something like the available space in journals and the average length of articles leads to the observed differences in journal rejection rates. The evidence is certainly suggestive and more work in this area needs to be done before a firm conclusion can be drawn. In particular it would be interesting to conduct international studies that compare the national output of disciplines against the available research outlets. For example, we would expect to find, if the Cole's alternative explanation is accurate, that Poland's sociological output does not strain their available publication outlets. That is we could predict that in Poland there are enough journals to support most of the sociological papers that are submitted. As a result, there is no need to develop norms that provide support for the rejection of publishable papers. On the other hand we would expect to find that in countries where the sociological output is high, and the number of available outlets low, norms would develop that provide justification for rejecting publishable papers.

Interestingly, these different publication norms, however they arise, can have a significant impact on the quality of the literature. As Stephen Cole et al note, in the hard sciences there is an informal policy that encourages editors to publish articles *just in case* they turn out to be significant. This. according to the authors, "often leads to the publication of trivial articles with little or no theoretical significance, a reason frequently cited by referees in social science fields in rejecting articles." [66] Indeed, even a superficial glance at the differences of an article in the journal *Science*, and one in say, *Work, Employment, and Society*, reveals significant differences. Articles in the latter publication are much longer, spend more time evoking and explain past theoretical contributions, and spend more time in discussion and conclusion. Even the research notes in the sociology journal be can longer than articles in *Science*.

Other hypotheses for explaining differential rejection rates have been offered. Cole et al [67] note that differences in the diffuseness of the journal system in the different disciplines, and differences in graduate training can also contribute to differential rejection rates. On the former the authors note that in physics over 50 percent of all articles are published in only two journals whereas in sociology the two leading journals publish only a fraction of the literature. Thus in sociology authors can spend more time finding the right journal. As a result, a string of rejections can occur (which do not necessarily reflect on the quality of the paper) before the paper finds its place in the literature.

As for the problems with graduate training, the authors note that in the harder sciences there is a more tightly articulated apprentice system. As many graduate students in sociology have no doubt discovered, "Social science disciplines are less efficient in teaching students how to write publishable articles. Students are more likely to select their own problems, work independently of their sponsors and have relatively little guidance when preparing their first articles. As a result of these differences in training, scholars in the social sciences may be more likely to submit inadequate papers than

scientists in the natural sciences." [68] Of course, this effect is likely to occur most often to young scholars. As they gain experience in publication, the effect will most likely attenuate. Despite that however this would effect journal rejection rates since responsibility for quality control of these sorts of submissions would be pushed up and out.

Besides differential rejection rates, delay in publication was also noted as a significant disciplinary difference. But again, other explanations besides a hierarchy of sciences can be evoked to explain the difference. The expectations about article length, for example, are quite different in the natural and social sciences. As already noted, articles in many social science and humanities journals are long and theoretically sophisticated running upwards of 10,000 words. By contrast, articles in science journals may be as short as 1,000 words. Certainly it takes more time to compose a 10,000 word piece that it does to compose a 1,000 word report on current research findings. Even commentaries on articles in social science journals are longer than many articles published in science journals. This difference in length alone might easily contribute to the four month differences noted by William D. Garvey, Nan Lin and Kazuo Tomita. [69]

To summarise, the formal communication system consists of primary, secondary and tertiary sources. The formal system provides a number of useful functions including current awareness, archival, and gate keeping functions. Disciplinary differences in the speed of distribution, rejection rates, and overall reliance on the primary journal exist. However it is an open question whether these differences reflect the epistemological status of the sciences. While a more formal study of these differences moves us beyond the scope of this work, there will be occasion to provide additional comment when discussing the contribution that electronic journals might make to alleviating current difficulties in the scholarly journals system.

Informal Communication

The opposite of the formal communication system of science is the informal system. Like the formal system that consists of various separate components, the informal (or non-documentary and paperless) communication system of science consists of a continuum of related and interconnected elements. On one side of the continuum are the various oral exchanges that comprise the initial birth of an empirical or theoretical program. Here we have the informal classroom debate, lunch table conversation, hallway meeting, or phone or email discussions with students and colleagues. Also on this side of the continuum are the various informal departmental meetings where faculty learns about the current work of their colleagues. Generally, this early stage of the communication process is taken up with the initial working out of theoretical or empirical research project. Potential authors may use these early opportunities for exchange as a test bed for new ideas by eliciting informal criticism and by being wary of the sometimes subtle cues that indicate to a scholarly whether an idea is worth pursuing. It is in this formative stage that the idea or project is perhaps most amenable to modification or outright destruction (i.e., "it was a dumb idea") based on the input of commentators at all levels.

Somewhere in the middle of the informal continuum is the club meeting, colloquium, and regional. national, and international scholarly conference. It is somewhat of an analytical *faux pas* to toss these various informal settings into the same pile since there is a huge difference between an out of classroom work group on a special topic, and an international conference. Yet they are similar to the extent that they all bring together practitioners for the express purpose of learning about and discussing work already in progress. These informal media serve a number of functions not the least of which is to inform a larger audience of the author's current work in the field. Such meetings can also be useful for the formation of post-meeting informal exchange networks of people working in the same field. [70]

William D. Garvey [71] has suggested that as we move along the informal communication continuum towards formal publication in a scholarly journal, the audience for the scholar's work gradually expands. This is most certainly true since at the very early stages of the game scholars will tend to limit the distribution of their ideas for fear of disseminating poorly conceived material. However in the middle stage authors will presumably have had enough time to construct a presentable project. At this point the work will become interesting to others working in the same subject field. This work will be exchanged at conferences, colloquia, or local meetings where scholars keep abreast of current work.

At the far right of the informal continuum we have the various forms of written reports (i.e. technical reports, thesis or dissertations, in-house publications, preprints, and publication of proceedings). These semi-formal outlets function to pre-distribute work in order to raise general level of awareness of a forthcoming journal article and to allow early use and citation in other projects. These early publication efforts can also provide a preliminary draft of a more formal article intended for submission to a journal. Here the purpose is to elicit final peer commentary before a formal submission. [72] Prepublication reports can also function as the final publication outlet in those cases were the only requirement is to provide terminal reports to funding agencies or to the members of large research teams and the institutions within which the author of the report is employed.

Interestingly, the informal reports provided by the author prior to formal publication can often be more substantive than corresponding journal articles because, as Garvey [73] notes, the author can "...describe his negative as well as positive results. He can include the vast amounts of data which would make his journal article too long to publish .... in the prepublication report the scientist may tell more of his personal experiences and interpretations of his work; in the journal these traditionally must be attenuated." It is not uncommon to find the addition of appendices, figures, photographs, and even large representations of data in these preliminary reports. For this reason, these prepublication reports are often more useful to scholars working in the area than are the papers published in the formal journals.

Though there are differences between aspects of the informal communication process, each of the various aspects of the system share common characteristics and functions that outweigh the differences. In the first place, there is a tentative and ephemeral quality to most informal communication. "In some instances the information exchanges

seem like a series of soundings - putting forth information, testing reactions to it, then withdrawing the feeler and modifying the information for a later probe". [74] Also according to Garvey, their is considerable duplication of results in the informal realm where the goal is not final publication and archival but rather the forging and tempering of scholarly ideas or pre-distribution of material for the sake of the general advancement of the field. There is also an interdisciplinary element to informal communication networks that is often lost when the final product of the research reaches the formal journal in its sanitised version. [75] The strict formalisation and rigid terminology of the formal realm is watered down in informal communications. As a result, these informal exchanges generally tend to be accessible to a larger audience.

Another characteristic of informal communication channels are their interactivity and open-endedness. On the one hand, scholars are much more willing to speculate about their ideas and discuss past theoretical and empirical mistakes when moving in the informal realm. After all, a draft paper is a draft paper. Authors commit hardly anything of their reputations when distributing unfinished work. It is also during the informal communication process that the scholars interact most vigorously. Unlike publication in journals, communication in the informal realm is a give and take of scholarly insight, information, and advice. Such give and take can be obvious (you scratch my back, I will give you my recent preprint). Or it can be quite subtle as in the almost unconscious clues about interests and personal biases that scholars give to other scholars through the content and form of their questions, or the off handed comments that they receive.

Finally, because of the characteristics of formal communication system, i.e., long publication delays, all articles found in journals amount to "old work" for many scholars – especially in the natural sciences. Thus the informal communication system serves a vital function by keeping active researchers current in their respective fields. [76] This is, ironically, a shift in function since the early days of the scholarly communication system where the formal system was capable of keeping scholars informed. As has been noted, however, the strain on early primary journals quickly prompted the development of secondary and tertiary services designed to maintain the current awareness function in the formal realm. However, after a time even secondary and tertiary channels overloaded and became incapable of fulfilling their bibliographic control functions. Because of the structural limitations imposed on formal scholarly communication, and the rapidly increasing rate of scientific discovery, the formal literature has by and large lost the ability to provide a current awareness function. This function has partially moved, for better or worse, into the informal realm.

It would be a mistake to discount the informal communication as relatively unimportant, or as nothing more than an appendage to the *real* system of scientific communication. By some estimates the informal communication system accounts for as much as four fifths of all scientific communication. The reason for this high figure is simple. It is in the informal realm that ideas are worked out, experiments designed and refined, and colleagues hammer at each other's work. The key importance of the informal communication system was recognised over 30 years ago by Herbert Menzel [77] who noted some of the functions of the medium.

> For example, there is a certain level of know-how information about the use and setting up of scientific apparatus that seems to go by preference through word-of-mouth channels, perhaps because this kind of information is regarded as unworthy of being handled in detail in the printed word.... Information that helps interpret results and information that helps a person become acquainted with a new field also seem to make their way differentially, often through personal channels.

Aside from the fact that the informal communication represents the vast majority of scholarly activity, it is important for the fact that within the informal communication networks we find what Price [78] has called the *invisible college.* Invisible colleges are really nothing more than a groups of people who interact with each other on a regular basis either through letter, phone, email, or (less commonly) attendance at select meetings and retreats. But in the highly structured world that is the academy, these colleges can wield a considerable amount of power over the life chances and careers even of those who are not members. For example, informal recruitment networks exist among colleges and universities [79] and every graduate student knows that being able to access these informal recruitment networks, by for example careful selection of thesis advisors, can offer significant career advantages. The benefit may be bestowed through a phone call (or perhaps an email message) to a department advocating a particular candidate over another or through the provision of key job information. Despite the simplicity of operation, the results are tangible and significant.

Informal networks and invisible colleges offer advantages to their members. Informal research networks are essential for academics in that they provide easy to obtain information on the most current, important, and fruitful areas of activity in a given academic field. This later aspect of the informal communication system is a particularly salient consideration for young scholars who may find it difficult, especially early in their careers, to access these colleges. This may hamper career development since failure to access informal networks might make it difficult to keep at the cutting edge of research. There is a significant dilemma here for young scholars who must prove themselves to get access to the informal networks, but who must have access to the informal networks to prove themselves. It is a difficult, but not impossible, contradiction to negotiate. Of course, various factors can impact one's ability to negotiate this labyrinth. As will be seen later, various factors (gender, socioeconomic status, etc.) can have an impact one a scholar's ability to negotiate the informal communication networks.

As is evident, the informal communication system of science is important, indeed critical, to the advancement of science. However given the stated concern of this dissertation with the primary journal system, what is the point of examining the informal realm of scholarly communication? Primarily it is to ensure comprehensiveness. As will be argued later, information technologies offer significant potential for reform in the scholarly communication system. And perhaps it is not just reform but revolution that we speak of. Information technologies may offer the potential to create a system substantially different and, perhaps, better than the current

two tiered system. It may, for example, be possible to merge components of the informal communication system with the formal. It may also be possible to do away with certain dysfunctional components of the current system as we make the transition to electronic communication. Doing more than simply propagating current difficulties will require a detailed analysis of the scholarly communication system.

Besides comprehensiveness, another reason for discussing the informal communication is to highlight a contradiction and failing of the current system of scholarly communication. As has already been argued, a principle reason for moving from the scholarly letter to the primary journal was to ensure a faster, more widespread and democratic distribution of scholarly information. In a sense, the scholarly journal expressed the modernist/enlightenment project initiated by Bacon. As will be recalled, the goal of the enlightenment was to institutionalise progress by institutionalising a system of scholarly communication that would ensure wide access to information for the gradual improvement and betterment of society. The fact that the scholarly journal has eroded its ability to fulfil its original mandate is a significant contradiction and failing of the system. This is so because the main, what might be called, enlightenment functions of the journal - current awareness and public distribution - have been lost to a semi-private system of communication that bears more resemblance to the old system of scholarly letter writing than to the new system of public scholarly communication initiated by the Royal Society.

Conclusion

This chapter has considered the history of the scholarly journal and the scholarly communication system. From the enlightenment and scientific revolution when journals first emerged as attempts to solve the growing information crises caused by inadequate distribution mechanisms (i.e., letters and books), to our current communication system, the scholarly communication system has provided essential and indispensable functions for the academy. These functions have range from current awareness to archival, from quality control to priority. As noted however, the scholarly journal and the communication system of science has not been without its associated problems. Even though the scholarly journal emerged as an attempt to realise a Baconian ideal about open and democratic scholarly communication, the ability of the primary journal to fulfil this ideal mission has been limited. Limitations in the new system emerged early and as has been demonstrated, centuries later the system is still not quite up to speed. The result of the closure of scholarly discourse and the proliferation of scholarly journals has been to push "current awareness" function of science away from the public communication system into a semi-private informal communication network. At our current historical juncture, most of the critical work of science, most of the purification and correction, indeed most of the critical scholarly communication, goes on in the informal realm of science inside invisible colleges. This is a significant failing in the system

This discussion of the scientific communication system has provided the essential groundwork for the analysis in the next two chapters. In Chapter Two the dissertation will take a much closer look at current difficulties faced by the primary communication

system and the primary journal. Chapter two will examine how publication delay, high cost, and journal proliferation have slowly but inexorably weaken the ability of the primary journals system to fulfil its original mandate. Chapter two will also uncover how this inability to fulfil the traditional functions has impacted different groups in the academy. Following this, Chapter Three will examine how electronic journals might alleviate some of the current difficulties with the scholarly communication system by providing a low cost, open, and publicly accessible scholarly communication system.

Chapter Two: Current Challenges

> There are still quite a few individual scientists and engineers who say they think there is no problem. Some are foremost leaders of their fields for whom meetings, visits, and preprint exchanges have short circuited the library network (They spend so much time above the clouds they never see the flood.) Most of the others are so far removed from the main stream that they are in no danger of getting wet at all. [1]

Introduction

As noted in Chapter One, when scholarly journals were first introduced they provided a number of useful services. They were needed as a distribution channel for current research since the old system of scholarly letter writing and book publication was no longer able to keep up with the burgeoning interest in science from scholars dispersed across several continents. Journals also provided a current awareness function that transcended the vagaries and inefficiencies of scholarly letter writing. They also helped provide organisation and control over the burgeoning literature. Also, because of the Enlightenment emphasis on the accretion of knowledge, journals were important for reasons of posterity. Finally as science grew and became institutionalised, publication in journals was used to establish priority of discovery and, later, to provide a mechanism for evaluating and formalising scientific contributions for the purposes of tenure and advancement decisions. Here their role as adjudicators of original contribution took on extreme importance in those highly volatile and vigorously researched areas where the timing of publication was critical and publication speed could mean the difference between an original submission and replicative research.

However, as the pace of publication has quickened and the volume of scientific discovery has grown scholarly journals have, as did books and letters before them, lost their ability to fulfil most of the key functions for which they were originally intended. Initially, the growing inability of the primary journal to fulfil its role in the system had been recognised only by those with a direct stake in the system (i.e., information specialists and scholars with a research interest in the scientific communication system). [2] Since the late 50s and 60s the problem of information growth and the concurrent problems of organisation, dissemination and cost have become sufficiently salient to draw increasing attention both inside and outside the academy.

Of those expressing a growing interest in the scholarly communication system, governments have been one of the more significant players. Their concern has emerged as a result of their role in providing the technological infrastructure for capital expansion and growth. As doubts have emerged about the health of the scholarly communication system in various countries, governments have expressed a concern about ensuring an information infrastructure adequate for maintaining development and ensuring competitiveness. Responding perhaps to the prognostication of techno-gurus

who predict a new information society and new means of production based on information and its distribution, [3] governments in developed and developing countries have become convinced of an economic threat posed by a poor quality and inefficient distribution system. As Margot Montgomery of the Canada Institute for Scientific and Technical Information (CISTI) notes "Canada's success as a knowledge-based economy depends on a strong national information infrastructure that is responsive to the needs of the country's innovation system for industrial development." [4]

Concerned to ensure competitive success on the global stage, and convinced that this depends on a strong information infrastructure, governments have cast about for ways to improve the system. This concern and the attempts to find solutions have been reflected over the years by the establishment of government committees designed to foster development of the system. In the U.S. the Committee on Scientific and Technical Information [5] was established to look into the development of a co-ordinated scholarly communication system. [6] Other industrial countries have also created similar organisations and published monographs detailing the steps needed to develop efficient distribution systems. In the UK the OSTI (Office for Scientific and Technical Information). In Japan the JICST (Japan Information Center for Science and Technology) and JACUDI (Japan Computer Usage Development Institute). [7] In the USSR there has been VINITI (All Unions Institute for Scientific and Technical Information). Finally, international bodies have also expressed concern over the scientific and technical communication system and its relationship to global development. [8]

In Canada, the early torchbearer of the race to develop an information infrastructure was the Science Council of Canada.[9] More recently, concern over information policy and the development of efficient scientific and technical communication systems has been expressed by the Department of Industry, Science and Technology whose members are the key organisers and proselytisers of Canada's new super information highway [10] and also by The National Research Council (NRC) through its Canada Institute for Scientific and Technical Information (CISTI). [11] Most recently, Industry Canada has been directly involved in attempts to create an electronic journals infrastructure. As elsewhere, the equation between global competitiveness, a healthy system, and science is explicitly recognised. David Beattie and David McCallum [12] note that the role of Industry Canada is to foster

> the growth of Canadian business; by promoting a fair, efficient marketplace; and by encouraging scientific research and technological diffusion. A major policy document, *Building a More Innovative Economy* ... recognized the emerging knowledge based global economy and emphasizes the advancement of education and research as essential means of strengthening Canada's competitive position.

Besides government, industry also has an obvious interest. As noted, historically, the scholarly communication system has provided the infrastructure for business development of one form or another. [13] This has been recognised by governments and indeed, enhancement of economic growth and business development have been central

functions of the scholarly communication system since the Royal Society founded the first journal. However, other than a generalised concern and interest in the system, business and industry has, for the most part, played a peripheral role. Herbert Schiller discusses the arms length relationship that business has always held with science and the scholarly communication system. At the end of World War II, public agencies like U.S. Bureau of Census, research labs at universities, and other data gathering facilities produced most scientific data. Significantly, most of this information was made available publicly and free of charge. Business expressed very little interest in the health or long term development of the system. They relied on government to provide a healthy scholarly communication system in the same way that they relied on government to provide other components of a productive infrastructure (e.g., roads and bridges). Schiller summarises this early relationship business had with the scholarly communication system:

> In sum, a good part of the information field a half-century ago was an orderly, routinized, and largely governmental sphere of activity. It was not particularly exciting. All the same, it constituted a vital component of the public sector. Individuals could access great masses of information if they had such an interest. Depending on the locale and character of the specific library, more or less of the information stockpile would be available. [14]

In other words, following World War II, there was not much money to be made in the information infrastructure. Not that business was totally uninterested in the health of the system. Given the importance of infrastructure (roads, telecommunications, etc.) to profit generation, business always pays some attention to the health of society's infrastructure. And, as we will see, a few individuals found considerable opportunity for profit in the scholarly journals system. But by and large the information distributed through the system had a non-profit, social service character and business enjoyed its free ride on the margins.

The relationship of business to the scholarly communication system, and indeed the relationship of business to the academy in general, has changed in recent years. Industry is becoming increasingly interested in the workings of the academy at all levels and this includes a growing interest in the profit potential of the scholarly communication system. This growing industrial interest is clearly seen in the many publications that tout the benefits of expanding the technological infrastructure of society and expanding the scholarly communications system in directions friendly to commercial interests. The preface to Michael Connor's (1993) *Race to the Intelligent State* reads like a veritable who is who of high technology industry. It is not surprising then that many of these publications end up advocating increased information infrastructure development and an increased role for the private sector in the scholarly communication system.

As noted above, part of the increasing interest in the communications infrastructure is related to perceived opportunity for profit. However there are other reasons why business, governments, and their advocates have a heightened awareness of the scholarly communication system and the technological infrastructure in society. Manuel Castells provides an important clue when he points to the deep dependence that a

globalised business environment has on a technological infrastructure and a information distribution system. [15] As he notes, the network infrastructure of advanced capitalist nations has become a critical component in a globally distributed system of production. This is an important consideration if only because it points to the fact that business and government interest in a electronic distribution system may go beyond a mere interest in the health of a scholarly communication system. We may reasonably question whether their priorities can mesh with the priorities of scholars and libraries. This is not an unreasonable question. It is nothing new for sociologists to ask where the interests of capital and the state diverge from the interests of others in society. This becomes particularly clear when we consider that there are others with interests in a healthy scholarly communication system that are just as deep and profound as those of business and the state.

Of course, business and government are not the only ones with an interest in the system. Libraries are also concerned with the scholarly communication system. However their interest is quite different from that of either government or industry who see the scholarly communication system as an essential component in the race for global competitiveness and, in some cases, as a source of profit. For libraries, the concern is primarily with maintaining their ability to provide satisfactory access to the world's information and with the financial health of the journals system. As is argued in the body of this chapter, libraries are caught in a financial crunch as they try to keep up with the proliferating journal literature and the spiralling costs of publication. It has not been an easy struggle and many libraries and consortia have been forced to make difficult decisions and tradeoffs. Some individuals in the library community have blamed the commercial presses almost exclusively for the problems currently being faced by the library communication. As we will see, to a certain extent the commercial presses are culpable.

However, there are complicating wrinkles in this analysis. For example, not all countries have scholarly communication systems that are as highly commercialised as the United States. Also, as Rowland Lorimer rightfully points out, "that part of the serials crises that is attributable to publishers overcharging is fairly much confined to Science, Technical and Medical (STM) journals...." [16] Finally, it is important to keep in mind that cost increases have occurred in the context of a general growth in the scholarly communication system.[17] Thus while it is correct to lay part of the blame for the journals crises at the footstep of the commercial press, it is incorrect to attribute all the difficulties to a predatory commercial press. Other factors, like the general expansion of the journals system, have to be taken into account in order to provide a balanced view. However, it is important to note that even if a handful of profiteering commercial presses are responsible for the current financial difficulties, and even if these presses exist primarily in the United States, the fallout from their action and lack of concern is felt globally (as perusing the rather extensive list of serials cancellations at the University of British Columbia libraries will attest to). [18] Of particular interest may be the UBC cancellation list for the Humanities and Social Sciences (HSS) at http://www.library.ubc.ca/home/serialcan/hss-cancellations.html

Other groups also share a growing interest in the health of the scholarly journals

system. For example, individuals who represent the publishing interests of scholarly societies, [19] journal editors, individual scholars and graduate students all have a stake in the system. In some cases their interest coincide with those in the library world. This is certainly true when commercial publishers charge unreasonably for the service they provide to the academy. In other cases the interests of these academic stakeholders is different - though not opposed. For example, publication delay is much more a problem for individual scholars, and indeed much more of a problem for certain groups of scholars, than it is for libraries. And in some cases the interests of academic stakeholders may even coincide with commercial interests. This is true for example when commercial houses provide high quality publication services at a reasonable cost. In this case, journal editors and scholarly societies may benefit by having the mundane production duties lifted from their shoulders.

The rest of this chapter examines the current difficulties being faced by the scholarly journals system. During this analysis an attempt will be made to balance the interests of the various stakeholders as the dissertation examines in detail the current difficulties faced by the system. As will be seen, current difficulties include publication delay and slow distribution speeds, journal proliferation and high cost. Following the analysis in this chapter, the rest of the dissertation will examine potential solutions. This latter examination will include a look at the potential of the electronic journal to contribute to a reform of the system, an analysis of current blockages to progressive reform, and the examination, in the closing chapters, of a international effort to bring a technologically sophisticated alternative to the current high priced journals system into existence.

Delays in Publication and Speed of Distribution

One of the consistently intractable problems with the scholarly communication system, and in particular the primary journal, and one that has been emphasised repeatedly over the years, is publication delay. As defined in the literature, publication delay is the delay that occurs between the initial formulation of a research program and its final publication in a primary journal. According to researchers, the average time between the initiation of a publishable program and its final appearance in print is 28 months for the natural sciences and 32 months for the social sciences. [20] About half of this time is taken up by the project itself, and the other half (14 months) by the time and effort needed to prepare and submit manuscripts for publication.

At first glance a year between completion of work and final publication may not seem like much. However bear in mind that this is the average delay. In about 10% of the cases an article can actually take in excess of 5 years to appear in print. [21] And, in some disciplines, notably Archaeology, the delay can be as long as 30 years. As Paul F. Jacobs and Chris Holland note, when considering archaeology's emphasise on ancient artefacts, the uniqueness of these artefacts, the peculiar characteristics of the discipline, and the high cost of providing graphical representation of ancient artefacts, "Twenty or thirty years between discovery and publication seems more the norm than an exaggeration of fact." [22]

This chapter is primarily interested in the delays associated with that phase of the

formal communication process that occurs between completion of a project and the final appearance of the results in a primary journal. Here there are a number of factors that impact on the path of the article from author to printed page. The work of preparing a manuscript for publication is the first delay. Garvey, Lin and Nelson [23] estimate the average delay between final completion of a research project, and submission of the results to a journal to be six months for the physical sciences and nine months for the social sciences. [24]

Postal delays also add additional time and here the delay is cumulative since the post is critical at all stages of the traditional journal submission and refereeing process. Manuscripts are initially mailed to the editor who must then mail them to the referees assigned to review the paper. Referees in turn must mail their comments back to the editor who must then inform the author of the decision - by mail. Should the referees require revision of the paper (an extremely likely prospect in some disciplines), an additional circuit will be required. This results in a complete duplication of the delays associated with the first submission round with the addition of the time it takes the author to revise the paper. Assuming that it takes a manuscript one week to reach its destination, the time from author to editor to reviewer and back to editor and then author is approximately one month. However much will depend on the performance of regional postal systems, the geographic location of each of the parties in the review circuit, and the motivation of reviewers. Especially where articles are submitted to journals in other countries, and especially when the journal is overseas, the postal delay can be considerably longer than a single month.

Delays can also be expected to accumulate as the editorial staff processes the manuscript. Garvey, Lin and Nelson [25] found the average time between receipt of a manuscript and its final publication to be about 7 months for the natural sciences and 11 months for the social sciences. Half of this delay is caused by various editorial tasks and the other half by lackadaisical reviewers who, because of numerous academic commitments, tend to give low priority to submitted manuscripts. As Meadows [26] notes, "a referee may only take a short time to assess a paper; but the paper may have been resting in his in-tray for days, or weeks, beforehand, and may not be promptly returned to the editor afterwards. As a result, brown manila envelopes that contain manuscripts for review can often go ignored for weeks." [27]

Perhaps the most frustrating delays associated with academic publication are those that arise from lack of journal space. This is a problem both for prestigious journals or journals publishing in fashionable and expanding fields where many authors compete for limited space, [28] and also for more run of the mill journals. [29] Because of the high production costs of paper journals, there are absolute limits on the number of pages that can be included in each number of the journal. Because of this, it is very easy for backlogs of publishable articles to accumulate and for authors to have to wait for space before their publication can appear in print. The actual length of delays associated with publication backlogs is of great interest but is unknown at this time.

Finally the journal is published. However now the issue will have to be delivered to individuals and institutions and this adds a final post-publication delay. Carson and Wyatt [30] are one of the few who have studied this post-publication delay. They found

that for primary journals, average delivery delay ranged from as little as two weeks within the country of origin, to as long as eleven months for delivery to other countries. Ironically, for abstracting journals (secondary journals that are supposed to enhance the current awareness functions of the primary journal literature) the delays were even longer. Carson and Wyatt found average delays of between 1.5 years for delivery of an abstracting journal to Australia and 2.8 years for delivery to India. The longest delay recorded was for delivery of the *Excerpta Medic*. This journal took almost five years to reach the U.K. and just over 4 years to reach Australia. Unfortunately, the problems associated with publication delay do not end here. For scholars in developing countries, the problem of delay is compounded. In addition to long international delays, scholars and libraries in developing nations must cope with a higher than average rate of missing journals. Paul Nijhoff Asser has noted that as many as 30% of journals get lost in transit to countries such as India! [31]

As a result of these rather extensive delays, it can no longer be said that primary scholarly journals provide a current awareness function. Nor is it possible to trust them for the purposes of assigning priority to discovery. The additive delay of manuscript preparation, postal turnaround, adjudication by referee, rejection and re-editing, and final delivery to the individual or institution is simply too long. The fact of the matter is that ideas in print are not new at all. When the various components and their associated delays are tallied, ideas in primary journals can be as old as 3, 4, or even more years.

The question at this point is, is this long delay a problem? This is a legitimate question since some argue that long publication delay is reasonable and proper and discount concern over the delay as trivial [32] or unimportant. [33] Others even find positive benefit in long delays arguing that the delay reflects a distillation process that is working to purge the system of unworthy scholarly material. Those who use this type of analysis will point out that the entire process is finely tuned to get rubbish out of the system and therefore years worth of delay are a necessary function of the filtering system of science. Furthermore, tampering with the system by, for example, introducing enhancements like the early sixties Information Exchange Groups (IEG), [34] is ill advised and potentially harms the quality control mechanisms of science. As William D. Garvey notes of the 1960s IEG experiments, "As so often happens in scientific communication when media are democratized to the extent that 'all scientists' can use them indiscriminately to disseminate their work, the quality of the average product suffers." [35]

Another objection that may be raised to concerns over long publication delay is simply that the primary journals system has a "relief valve" when it comes to the problems associated with publication delay. This relief system is, as noted in the last chapter, the informal communication system that can, and does, pick up the slack left by an inefficient paper based distribution system. Those pursuing this line of argument often recognise that there are significant problems association with long delay. However they then point to the ability of some to short circuit the formal system by relying on informal contacts and invisible colleges as evidence that the problems are not as significant as some would have it. This is the stance taken by Price, for example, who notes that [36]

> ...one of the great consequences of the transition from Little Science to Big Science has been that after three centuries the role of the scientific paper has drastically changed. In many ways the modern ease of transportation and the affluence of the *elite* scientists have replaced what used to be effected by the publication of papers. We tend now to communicate person to person instead of paper to paper. In the most active areas we diffuse knowledge through collaboration. Through select groups we seek prestige and the recognition of ourselves by our peers as approved and worth collaborating colleagues. We publish for the small groups...

As Price notes above, some scholars are able to rely on a more capricious informal system of communication for current awareness and research development. As he says, "We tend now to communicate person to person instead of paper to paper."

Unfortunately, pushing the current awareness functions of the scholarly communication system into the informal realm is not an ideal solution to the limitations of the paper based system. As others have pointed out, relying on the informal communication system to overcome the limitations and difficulties of the formal system is problematic for a number of reasons. In the first place, using the informal system as a bypass is ill advised because the informal system itself is ill-managed and haphazard [37] and thus open to many forms of abuse. In the second place, long publication delays may also affect the form and content of scholarly discourse in a negative fashion. Steve Harnad has been the principle advocate of this position and suggests that long delay affects scholarly discourse by giving that discourse an inorganic, choppy, and unnatural quality as it moves in fits and starts over a period of years. Harnad explains: [38]

> In a sense there are only three communication media as far as our brains are concerned: The nonverbal one, consisting of oral speech (and perhaps sign language), and the unnatural one, consisting of written speech. Two features conspire to make writing unnatural; one is the constraint it puts on the speed with which it allows thoughts to be expressed (and hence also on the speed with which they can be formulated), and the other is the constraint it puts on the INTERACTIVENESS of speaking thinkers -- and hence again on the tempo of their interdigitating thoughts, both collaborative and competitive. Oral speech not only matches the natural speed of thought more closely, it also conforms to the natural tempo of interpersonal discourse. In comparison, written dialogue has always been hopelessly slow: the difference between "real-time" dialogue and off-line correspondence.

In addition to the problems of an inorganic discourse, the long delay may also have an adverse impact on the continued development of fruitful ideas. As Harnad points out, because of the long delay between completion of a research project and final publication, the author may lose interest in pursuing the original line and thus the idea may become stillborn and never, sadly, achieve its desired or deserved impact.

> ...now the author must wait until his peers actually read and respond in some way to his work, incorporating it into their theory, doing further experiments, or otherwise exploring the ramifications of his [sic] contribution....[this] usually takes several years...and by that time the author, more likely than not, is thinking about something else. So a potentially vital spiral of peer interactions, had it taken place in 'real' cognitive time, never materializes, and countless ideas are instead doomed to remain stillborn. The culprit is again the factor of tempo: the fact that the written medium is hopelessly out of synch with the thinking mechanism and the organic potential it would have for rapid interaction if only there were a medium that could support the requisite rounds of feedback, in tempo giusto! [39]

Social Stratification in Science

Besides inorganic discourse and being subjected to the vagaries of an unorganised system of communication, perhaps the most significant difficulty that arises when relying on the informal system of communication for current awareness is the fact that this imposes systems of structured inequality on the scholarly communication. Basically, extensive resources are required in order to access in a regular fashion the informal communication system. Even in the academy resources are distributed unevenly, not all scholars have equal access to the informal system. Indeed, resources and cost can be a significant factor especially since an essential component of the invisible college structure is the scholarly conference, meeting and colloquia. Regular face to face meetings at various institutions that provide 'summer' seminaries can be used to keep members of the college in touch and informed. [40] Because of this reliance on face-to-face contact, individuals, organisations, and even countries without the requisite financial resources are severely restricted in their ability to remain in contact with their invisible colleges. This can have consequences as Ziman [41] illustrates rather poignantly.

> Not to be able to attend the international conferences in one's subject, not to be able to meet one's scientific contemporaries around the world, is to be condemned to isolation, to provincialism, and eventually to the frustration of all one's efforts to keep up with the moving frontiers of research. This is the plight of so many scientists in developing countries.

It is hard to underestimate the importance of access to invisible colleges. Merton's [42] examination of *institutionalised serendipity* provides some insight. Merton, who was interested to know the twists and turns, antecedents and precursors that led Kuhn to write the seminal work, *The Structure of Scientific Revolutions* in 1962, undertook a historiographic analysis of the career of Thomas Kuhn. In this analysis, Merton found that the intellectual development and stunning career advances of the young physicist were inextricably bound up in his access to key informal, and private, networks like the

Harvard Society of Fellows. As Merton notes, early access to these networks contributed not only intellectual resources, but also helped the young Kuhn get access to such prestigious awards as the Guggenheim Fellowship and to such elite research institutions as *The Center for Advanced Study in the Behavioral Sciences*. Merton concludes that Kuhn's unique perspective on the history of science, and his ability to formulate and publish this perspective, depended in no small measure on his access to key informal networks. Merton [43] puts a class spin on this in the following quote that introduces his famous concept of the *Mathew Effect*.

> The systems of reward, allocation of resources, and social selection thus operate to create and maintain a class structure in science by providing a stratified distribution of chances among scientists for enlarging their role as investigators. Differentially accumulating advantages work in such a way that, in the words of Mathew, Mark, and Luke, 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.

The implication that we can draw from Merton's analysis is that access to the informal communication system is critical. It is also important to note that there is a class dimension to the way the informal networks stratify science. And, if there is a class dimensions to access to informal networks, then there may also be gender dimensions as well. Margaret W. Rossiter [44] has recently criticised Merton's failure to recognise the gender dimensions of institutionalised serendipity. Rossiter notes that the contributions of women are often systematically ignored and down played and even stolen by their male colleagues. Rossiter [45] provides the following example.

> But perhaps the most notorious theft of Nobel credit is the case of Lise Meitner, who worked for decades with Otto Hahn in Germany and who, in 1939, realized that what they had done but could not explain was in fact nuclear fusion. She must have been stunned to learn in 1944 that he alone had been awarded the Nobel Price for one of the biggest collaborative discoveries of the century.

To be sure, part of the explanation for this phenomenon must draw on an analysis of science as a highly patriarchal endeavour. However unequal access to informal networks may also play a role as women may have been excluded from participation in such networks and thus may have been visible only at the margins of science. As the Gender Working Group argues, women have had great "difficulty ... breaking into the formal and informal scientific networks that characterize the workings of the scientific community..." [46] As a result, it may be much easier to lose sight of their contributions. In order to conceptualise this phenomenon, Rossiter suggests that the Mathew Effect should be renamed or complemented with a similar concept that reflects the unfair treatment of women of science. She suggests calling the new concept the *Matilda Effect* after the American scholar Matilda Joslyn Gage who has largely been written out of the history of science. [47]

Besides class and gender disadvantages, other groups of scholars may find it difficult to

access the fruits of science in a timely and democratic manner because of publication delay. One group of disadvantaged scholars lives in developing nations. As Susantha Goonatilake has noted, their relationship with the scientific centre is already highly problematic and their ability to engage in cutting edge research hampered by socio-economic and political difficulties. [48] These systemic difficulties are profoundly exacerbated when delays in publication cumulate to years and even decades and where resources for academic exchange and library material are lacking. [49] Of course, developed countries can also experience international delay in journal delivery. [50] However developing countries must cope with additional disadvantages that include lack of resources, isolation from informal communication networks, an imperialist global economy, and biased information flow. [51] These factors compound and interfere with a country's ability to develop a technological and knowledge infrastructure and a locally relevant scientific program. In short, the long publication and distribution delays give advanced countries a competitive advantage. Developing countries remain behind the *research front*, as Price would say, and they are therefore made dependent on the importation of cutting edge research and technology.

This problem would not be so pronounced if scholars from developing countries could attend all the national and international meetings in order to stay informed and current. This does not seem possible however as resources are limited and access restricted. [52] Goonatilake comments on the results of this inability to access the informal networks: "Lack of informal channels and communications in the form of face-to-face interactions between those working at the frontier of science has therefore led to a marked degree of sterility in output. [53]

This is of course a tension here. The assumption that the knowledge produced in the centre is applicable or desirable to the periphery is far from a given. Relying on the knowledge of the centre tends to increase dependence, create conditions for hegemonic domination, carries forward an ongoing colonial transfer of knowledge and technology, tends to destroy indigenous knowledge systems, and creates a local market for western style goods. [54] Goonatilake recognises this tension and suggests ways to overcome scientific dependency. What is important for our purposes is that because of ongoing dependence, and because of the inability of developing countries to engage with the research front, their ability to strategically and creatively utilise scientific research, and even their ability to set research agendas through cutting edge publication, is impeded.

Publication delay can also have a profound impact on young scholars. This is so not only because delay forces reliance on informal networks, and young scholars may have difficulty accessing these networks because of lack of resources, but also because publication delay can impact their ability to develop an appropriate publishing expertise. It is well known that young scholars are dependent on a good publication record in order to land that first faculty position. As we all know, graduate students are now expected to have published by their third year and certainly no later than their fourth. In this context, a publication delay of three or four years is a significant problem not so much because of the inability to get published in that time (since many students actually do get published), but in the disadvantage that some students will face because of the inability of the system to give appropriate feedback. It has already been noted how

some disciplines have an undeveloped system of apprenticing young scholars. Individuals in these disciplines are often totally dependent on the feedback from the formal peer review process. They do not have the benefit of mentors willing to provide a close apprenticeship on publication. An extremely bright student at a less prestigious university, or one unlucky enough to choose an advisor or committee with little experience in publication or little interest or involvement with the project, will be completely dependent on the feedback from peer reviewers who examine her or his first publication attempts. Not having the benefit of the wisdom and experience of a mentor, that student will have to learn by trial and error what counts as an acceptable effort. Unlike a student who has access to expert advice, the disadvantaged student's first attempts at publication are likely to fail. This may not be any indication of the actual talent of the scholar who, given more time to develop the requisite skills, and given a more supportive environment, may have gone on to a brilliant career. However having to wait 1, 2 or 3 years for feedback before trying again puts the scholar at the end of the graduate program and at a point in there early career where they are expected to have published.

Being on the job market with a poor initial publication record is an undesirable position to be in. In the high stakes game of the academy, scholars with poor initial records are not likely to get hired because they are too much of a risk. Universities and departments are dependent on the money that good research professors can bring to the academy and they are therefore careful about who they will hire. True, it is possible for graduate students to continue to develop their publication record following graduation. But there are absolute limits on the time available to pursue this strategy since, as Ralph Korteling of Simon Fraser University has noted, failure to get hired in the first few years is considered a black mark against you. Hiring committees read into this failure to get hired early "an indication they have not met the standards elsewhere." [55] Obviously with this kind of thinking the graduate is under intense pressure to publish at least a couple of papers before graduation. And, as noted above, long publication delays may disadvantage some young scholars without access to the support of a well developed apprenticeship.

What these various difficulties amount to is the insertion of systemic inequality into the academy. The effects of this inequality are measurable and cumulative and, just as the counterparts in the world outside the academy, impact already disadvantaged groups. Pushing the current awareness system into the informal system means that individuals, groups and countries have to have a certain minimum level of capital and cultural resources before being able to adequately and regularly access the information networks. Because of this, it is reasonable to ask whether or not the current system cannot be enhanced to more adequately serve the needs of all groups that participate in scientific activity. This is a question that the dissertation will try to answer as it progresses into a discussion of electronic journals.

Proliferation of Journals

> God must love the scientific journals because he made so many of them. [56]

Besides long publication delay, another problem with scientific communication that has received considerably more attention over the years is the exponential proliferation of the primary, secondary, and tertiary literature. From its humble beginning towards the end of the 17th century, the scholarly journal has grown to truly gargantuan proportions. Through the years, many have called this proliferation of information a crisis and this section will examine in detail the contours of this crises.

The proliferation of scholarly material and scholarly journals has been perceived as a problem for a number of years. As has already been noted, the secondary and tertiary literature that emerged in the 19th century was in response to difficulties of maintaining bibliographic control over a burgeoning scholarly literature. Through the years, various individuals and groups have commented on the proliferation. Indeed, the steady stream of commentary and concern over the growth in the scholarly literature prompted Price at one point to suggest that the journals proliferation was a "perceived" problem that arose because of the exponential growth patterns of the scholarly literature.[57]

There is no doubt some truth in Price's explanation. However despite this, it is still difficult to discount outright the problems associated with perpetual exponential growth. Exponential journal proliferation has made it difficult to locate material, difficult for scientists to keep informed, difficult (and costly) for libraries to keep up, and almost impossible to maintain bibliographic control over the primary literature. [58] J. C. R. Licklider's summarises the problem from the perspective of the individual scholar.

> Sixty years ago.... the 3,000-character-per-minute reader needed only 25 minutes a day to keep up with everything in his field. Eleven years hence, he will have to read continuously, every hour of every day. Of course most of us do not read so fast and so persistently. Of course most of us make do with less than total scrutiny of less than one one-thousandth of the corpus. Give or take a small factor in speed; give or take a small factor in size. The essential point is that an exponentially increasing requirement is passing a constant capability. It is our unique experience to live and work through the period in which individual mastery of a field turns from possible to impossible - in which the depth of the water exceeds the height of the banks. [59]

What has caused this proliferation of scholarly material? King, McDonald, and Roderer identify a number of structural factors that have contributed to the proliferation of scholarly material. They explain the growth in journal publication as the result of 1) the growth and maturation of science, 2) the founding of new disciplines, 3) the ongoing fragmentation within disciplines, 4) and the increasing output of other countries, in particular third world countries. [60] In other words, proliferation of journals has been the natural outcome of the expansion of the scientific enterprise. According to King et. al, point 4 above has been particularly significant in recent years as underdeveloped nations have made concerted efforts to overcome the knowledge/technology gap that keeps them dependent on the beneficence of the developed world.

Besides these structural factors, other factors are implicated in the explosion of the

scholarly literature. One such factor is the well known "publish or perish" syndrome. The publish or perish syndrome emerges as a result of the well understood link between the academic job market and the publication system. Since prestige is enhanced through publication, [61] universities use an individual's publication record as a yardstick against which to evaluate scholars for hiring or promotion. For all scholars there is thus a very real need to establish academic currency through publication. As the academy has grown increasingly competitive over the years, this has resulted in what some have called a pathogenic pursuit of publication. [62] Not only do authors want to publish, they want to publish 'fustest and mostest." [63] According to many this pressure leads to questionable practices like trying to publish the same work more than once, fragmenting material into small pieces and publishing them as "pellets of prestige" [64] or "least publishable units," [65] or engaging in a ridiculous amount of coauthorship. Deana L. Astle provides an amusing example of coauthorship abuse: "An outrageous example of this is a recent four-page article in the October 17, 1988 issue of *Physical Review Letters*, the first page of which is a list of 190 authors from 17 institutions who are given credit for the research; all of them can list the paper in their vitae." [66]

The problems that this abuse can cause are numerous. "Salami publication," or publication of slices of research in order to increase one's publication record, exacerbates the problems associated with the proliferation of the literature by, not only increasing the literature unnecessarily, but also by making it more difficult to track down and utilise key components of the scholarly record. An increased workload can also be expected because of the need to piece together a coherent picture from many papers - some of which are of dubious value. Finally, there is general downgrading of the quality of the scholarly record. [67] This downgrading is reflected, for example, in the growing concerns of many scholars about the quality of available scholarly material and its relevance to their teaching efforts. As Astle [68] notes, instructors in some disciplines are relying on earlier work from the sixties because these early papers provide a more substantive empirical and theoretical treatment of their subject matter. Apparently, current scholarship in some disciplines is too fragmented to be useful in the classroom.

One final cause of journal and information proliferation is the commercial press. Recognising the unique nature of the academic market, some presses have exploited the increasing need for publication outlets and specialist periodicals by artificially splitting their journals to create new titles. In a process known as "twigging," commercial publishers spin off more focused specialist titles from their high prestige journals in order to exploit the peculiar dynamics of the academic marketplace. While at times there may be a real need for the additional journal titles, at others the ploy is a transparent attempt to milk the academic market. Paul Metz and Paul M. Gherman [69] note "The launching by the Hawthorne Press of twelve journals with the work *marketing* in their titles...shows that invention can have mothers other than necessity...." Interestingly enough, the role of the commercial presses in exacerbating the cost crunch has been recognised for a number of decades. Concern over the problems of journal proliferation and commercial malpractice prompted a group of scholars in 1974 to issue a *manifesto* calling for a total boycott of new commercial journals. These scholars encouraged a move away from reliance on commercial houses,

conceived of as unnecessarily contributing to the problem by twigging journals for profit rather than real need, to a system were scholars could have more control of the scholarly communication process. [70]

Above we have noted some of the problems with journal proliferation. For many groups, like governments, industry, and even scholars, the problems are largely bibliographic. As noted at the start of this chapter, governments worry about creating an efficient scholarly communication system. For them, journal proliferation and the associated problems, like salami publication, threaten to weaken that efficiency and make it more difficult to obtain needed information. Similar worries occupy the minds of scholars charged with keeping abreast of development and libraries charged with making science easily available.

However there is one other difficulty that arises partly as a result of journal proliferation and this is the rising cost of maintaining comprehensive library collections. There are two components to the rising cost of the primary literature. One is related to journal proliferation and results simply from the expansion of the literature and the twigging of journal titles. As each new journal emerges and finds its scholarly niche, libraries are responsible for making this material available. Over the years the exponential growth of the scholarly literature has made it increasingly difficult for libraries to fulfil their principle mandate. This is the problem of journal proliferation as separate from the problems of the rising cost of information. Arguably, it could be argued that handling this increasing volume of scholarly material is an occupational hazard of the business. However, it is important to recall that some practices (i.e., journal twigging, salami publication, etc.) unnecessarily add to the volume of scholarly information.

However there is a component of rising cost of scholarly information that remains separable from the contributions of journal proliferation. This component, as will be argued in the next section, revolves around the predatorial pricing policies of a handful of large commercial presses. As will be seen, the practices of a few commercial presses have put intense strain on the scholarly communication system. This has compounded many times over the problems associated with journal proliferation and is the root behind the increasingly vociferous calls for reforming the scholarly communication system.

The Serials Cost Crunch

> I set up a perpetual financing machine through advance subscriptions as well as profits on the sales themselves. It is a cash generator twice over. It's no use trying to compete with me in scientific journals, because I publish the authoritative journal in each field. [71]
>
> Faculty need to be informed in order that they can see these publishers for what they really are, not partners in the dissemination of information but profiteers who, through their outrageously high prices, are restricting the flow of scholarly knowledge. [72]

As noted in closing the previous section, the problems for the scholarly communication system caused by the proliferation of journal titles has been compounded by the decades long rise in journal prices. The earliest statement of the problem was by Paul L. K. Gross and E. M. Gross [73] who, in their now classic citation analysis of chemistry journals, argued that in the face of growing financial restraint and the inability of small and medium size libraries to maintain comprehensive collections, library acquisitions policies had to be rationalised. Interest in the cost crunch has been expressed periodically over the years since the turn of the century. [74] Despite ongoing concern, ninety years later, libraries are still unable to keep up with the exponential growth and skyrocketing cost of scholarly material. However in recent years the situation has worsened. [75]

All of the early examinations of the health of the scholarly publication system were equally grim about the potential long term impact of rising costs is something was not done. White and Fry [76] conducted a major longitudinal study (under the auspices and with the financial support of the NSF in the USA.) of journal proliferation and cost increases for the years 1969 to 1973. They concluded that the extant model of scholarly communication was "unhealthy" and that "neither librarians nor publishers demonstrate any real ability to cope with the funding imbalance through innovative or cooperative techniques." The long term result of this, according to the authors, would be that certain disciplines like the humanities would be unable to sustain their formal communications networks without government subsidy - an especially disconcerting conclusion given the growing unwillingness of governments to subsidise scholarly activity. They further argued, prophetically, that should government subsidy be reduced or eliminated, the results would be disastrous to the academy. Richard de Gennaro [77] makes a classic statement when he discusses the declining effectiveness of the scholarly communication system, its lack of responsiveness to the needs of those who it serves, the increasing difficulty experienced by libraries in keeping up with cost increases and journal twigging, and the growing need for scholars and librarians to do something about the crisis.

McCarthy [78] gives a number of anecdotal examples in an attempt to convey the magnitude of the problem. As he notes, between the years of 1989 and 1992, the price of the journal *Gene* almost doubled from its 1989 price tag of $1,874 to $3,508. And the journal *Tetrahedron Letters* moved from $2,715 to $5,289. And if you think that $5,000 dollars is high for a journal, consider the *Gmelin Handbuch der Anorganichen Chemie*, published by *Springer*. Its 1994 yearly subscription price was a whopping $19, 756. At that price, a library could buy over 130 journals at the more modest price of $150.00 annually. Robert Hauptman [79] provides similar anecdotal evidence about the rising cost of publication. He notes that *Brain Research*, which had cost only $1100 a year in 1983, jumped over 600% to $8,000 in 1994.

Useful empirical analysis of general trends have been conducted and the picture they paint is equally harsh. Paul Nijhoff Asser provided data for years 1971 through 1977. [80] He found price increases of between 14.5% and 34.2% for the years 1971 through 1974 and increases of between 18.7% and 43.5% for the years 1974 through 1977. Asser attributes the higher average increases in the later period to the oil crisis and its

impact on the costs of paper, manufacture and distribution of journals. However inflation does not appear to be the sole cause of the increase. Data provided by De Gennaro [81] for the years 1970 and 1975 indicate that journals published by houses like Elsevier, Springer and Plenum outstripped inflation by as much as 400%.

Since these original analyses, steady and high annual price increases have continued despite fluctuating inflation and commodity prices. Between the years 1986 and 1996, the Association of Research Libraries [82] recorded an average serial price increase of 147% (well above inflation rates). [83] For comparison, the same data indicates monograph prices rose 63%. In some cases, especially in the sciences, the annual increases can be particularly high. For physics and chemistry journals, the year 1989 was an extremely bad year with an average increase of 25.1%! [84] The impact of these price increases on library budgets is described in the following example provided in a recent (1997) Association of Research Libraries (ARL) discussion paper.

> The Provost of the University of Kansas recently told the Kansas faculty that the University library would need an acquisitions budget of $9.4 M to purchase the same proportion of published scholarship as it did in 1986. This is 2.5 times more than its current acquisitions budget. To have achieved this total the acquisitions budget would have had to increase by 9.6% a year during a time when the university's operating budget increased by only 2.6% a year. [85]

Whatever else we might think about the limitations of the scholarly journals system, there can be little doubt that ongoing cost increases is putting intense pressure on academic and specialist libraries. While before 1988 there had been some discussion about the seriousness (or actual existence) of a crisis, [86] by 1988, the crisis was simply understood and attention turned to investigating retroactive coping mechanisms and proactive strategies. In 1988, Dougherty and Barr, [87] editors of the *Journal of Academic Librarianship*, conducted a survey of ARL members libraries to determine their strategies for coping with the situation. They found a number of reactive steps that libraries were taking in order to cope with rising costs while at the same time attempting to retain a comprehensive serials collection. The coping strategies included elimination of duplicate subscriptions, caution in acquiring new titles, a decline in monograph and book purchases, and even a shift of funds from salary to acquisitions!

Since these early discussions libraries have moved with vigour away from reactive strategies towards proactive strategies that target little used or lower prestige journals, or seek to target and eliminate the publications of commercial publishers that are considered predatory. [88] In Canada, the picture has been the same and even the prestigious and well funded *Canadian Institute for Scientific and Technical Information (CISTI)* has been forced to eliminate duplicate and superfluous subscriptions, and reduce monograph purchases. [89]

Libraries have responded in other ways. Strategies, reported by Taylor, [90] have included an increase in external fund raising activity, a re-evaluation of the library as a free-for-service institution and the initiation in some instances of actual fees for borrowing, and, a move towards an extension of the interlibrary loan practice known as

resource sharing whereby individual institutions co-ordinate their acquisitions policy so as to avoid duplication. Most interesting is Taylor's discussion of the introduction of a management-administrative ethos and the subsequent re-evaluation of library acquisitions and operations. The shift represented here has resulted in a reduction in personnel and the deskilling of library jobs. "Every library with which I am personally familiar has recently undergone some reduction in personnel. Tasks formerly within the domain of professional librarians are likely to have been shifted to paraprofessionals; tasks carried out by support staff are now done by student assistants in an effort to reduce costs." [91] There has also been talk of automation and the benefits of that technology can bring to managers seeking to streamline the process. "Most important, the automation of acquisition and circulation functions has provided for the first time a significant body of data for use by library managers in planning". [92]

In terms of material acquisition, the net result of the librarian's push to cut corners is that holdings stay steady or decline, and that very little new acquisition occurs. Metz and Gherman [93] note that the percentage of the total serials universe held by member libraries of the ARL dropped from 33% in 1973 to 26% in 1987. And, as libraries reduce their acquisitions budgets, publishers feel pressure as well and drop lines that had formerly been subsidised by more profitable titles. This has resulted in the elimination of specialist lines of literature that, although useful to small academic communities, cannot regain the cost of their publication. [94] Mary Case, Director of the ARL Office of Scholarly Communication, notes that a result of ongoing price increases "libraries have had no choice but to cancel significant numbers of journal subscriptions and to reduce monograph purchasing, decimating collections." [95] The cumulative effect of all this is vividly illustrated by 1996 ARL data that indicates that in member libraries, monograph purchases have declined by a 21% and serials by 7%. [96]

Herbert White [97] points out the long term implications of continued cost cutting and retrenchment when he notes that that there is a danger that some disciplines, especially those in the humanities, will lose their ability to publish scholarly material altogether. As White notes:

> Of perhaps even greater concern is the uncertain support entire subject disciplines would be able to provide for journals published under a laissez-faire system. Journals published in applied science and technology disciplines are the only ones demonstrating continuing operating surpluses of profits. Pure and social science journals hover at the break-even point, while publications in the humanities consistently and increasingly report operating deficits across the disciplines which comprise them. Clearly, a system without subsidies or other buttressing devices would have devastating consequences for research and scholarship in the humanities and could even lead to the demise of all journal publication in certain humanistic specializations. It seems unthinkable that something like this should be allowed to happen. [98]

Unthinkable perhaps. But more likely as time passes. Libraries are being forced to devote their resources to the popular and high cost Scientific, Technical and Medical

(STM) system. Other areas will necessarily be sacrificed as libraries gradually reduce their coverage of fields and hang onto only the most popular titles. Perhaps the clearest indication of this is provided by Brian L. Hawkins [99] when he notes that the real buying power of libraries in relation to the total output of our intellectual endeavours has declined dramatically since the early 80s. He projects current trends into the year 2001 and concludes that when the combined impact of inflation and the growth of information is considered, the end result will be that libraries will only be able to purchase two percent of the total information available. This would, says Hawkins, seriously jeopardise societies ability to capture all information produced by our societies.

In what can only be described as a vicious circle, everyone loses. At first, and as monograph purchases decline, those hit hardest would be undergraduates who rely on the book literature much more than graduate students or faculty. [100] However with the more serious retrenchment that is represented by elimination of duplicates or outright elimination of titles, scholars have begun to feel the pinch. Consider that in 1994 alone, the University of Arizona eliminated 1,761 titles valued at $590,000. [101] There can be no doubt that such deep cuts are felt throughout the university community. Indeed, some have argued that a serious crisis has been averted only because of co-operative arrangements, increases in interlibrary loans, and co-ordinated cutting strategies between regional libraries. However as the ARL points out, these strategies can only achieve a short term reprieve. In the long term the problem is exacerbated "as publishers raise prices to replace lost revenues." [102] If current trends continue, it is unclear how long the earlier predictions of White and Fry about the demise of whole segments of the scholarly communication system can be avoided.

What has caused this staggering increase in cost? Part of the explanation lies in the inflationary pressures that effect all aspects of the journal production process. The overall costs of journal production can be broken down into three components - prerun costs, runoff costs, and, optional costs. [103] The initial or prerun cost includes the work of editors, peer reviewers, copy editors, compositors, proof-readers and typesetters. These prerun costs often include hidden costs such as office space or editorial time and expertise "donated" by academic organisations. The second cost category, or runoff costs, include paper, printing (presswork, binding, and wrapping) and distribution costs (mail). Finally, there are what the Task Force calls "optional" costs or "costs of operations that are not necessary to the publication of research results, but that are considered desirable adjuncts." [104] These include preparation and printing of advertisements and promotional material, production of reprints, the storing of back issues and the processing of orders for these back issues. King, McDonald & Roderer [105] outline the rises in these production costs in the period up to and including 1977. For example, they note that between 1960 and 1977, editor's salaries rose 142%, typesetting costs rose 179%, printing costs skyrocketed 175%, paper 52%, and postage and handling by 113%.

However as noted above, inflationary costs are not the only reason for the increases. In his extremely caustic editorial, James Thompson [106] places much of the blame squarely on the shoulders of the commercial publishers who, according to him, have discovered

the Elysian Fields of total monopoly production. As Thompson points out, the market for academic journals is extremely inelastic and there is little potential for competition between titles. If a publisher owns the prestigious or pace setting journals in a particular field, that is the end of the story since libraries and scholars must have access to it in order to remain current. Joyce and Merz [107] explain:

> The factors most heavily influencing elasticity of demand are the number of substitutes for the product and the percentage of income spent on the product. The greater the number of substitutes, the more elastic the demand. From the standpoint of substitutes an individual always has the ability to use the library's copy of a journal, whereas the reverse is hardly practical. Also, individuals can drop or switch subscriptions to journals as their professional interests change with little inconvenience. But the decision to cancel a particular journal or switch to another is entirely different for a library. A major objective is chronological completeness in a collection since the library cannot anticipate future faculty interest in particular journals compared with currently expressed interest. Also these cancelling or switching decisions involve the political influence of particular faculty members on the allocation of a library's serials budget. Remote acquisition of material contained in academic journals is sufficiently bothersome to make it an extremely poor substitute for the journal itself. Thus, with fewer substitutes, a library will have a more inelastic demand than an individual for academic journals. [108]

Others even inside the commercial world recognise the dynamic. Joseph S. Esposito, president of Encyclopedia Britannica, makes the following comment about the monopoly like nature of the scholarly segment of the publication marketplace. [109] "This segment, as we know it today, was essentially invented by the late Robert Maxwell, whose entrepreneurial insight was that libraries would pay almost any price for premier publications. He was right, and he was hated for it."

This privileged position of academic journal publishers has led some of them to engage in predatory behaviour. Thompson accuses commercial publishers of price gouging and other practices designed to eliminate smaller, less fit organisations in order to leave only the big corporate publishers still in the game. Robert Maxwell of Maxwell Communication himself suggests this scenario. "I am determined that Maxwell Communications Corporation will be one of what I expect will be only ten surviving global publishing companies." [110] Thompson characterises these publishers as spoiled children whom, when libraries resist and talk boycott, "use ... legal bluff and bluster to squelch it [the resistance]. Martin Gordon, of Gordon & Breach, has written irate letters to librarians who have canceled his titles, including at least one threat to sue for complaining to an editor that issues of a certain journal are now being labeled as volumes." [111]

In the early days of the cost crunch, a few authors tended to give the commercial publishers the benefit of the doubt. Michael E. Koenig [112] for example argued that the

pricing policy of commercial publishers is actually beneficial to libraries and individual subscribers. In the same vein, White suggested that commercial publishers were not making inordinate profits and that when cost per page was taken into account, the sharp differentials between commercial and other types of publishers disappeared. [113] Most recently David W. Lewis [114] figured that all the fuss was the result of a misunderstanding (mostly on the part of librarians). While he seems to indicate that both librarians and publishers have gaps in their knowledge of the workings of the other, in the last analysis he places the blame squarely on the shoulders of librarians: "Librarians feel exploited, and publishers feel misunderstood. Neither side seems to be able to see the other's point of view. This lack of comprehension occurs, at least in part, because librarians are not knowledgeable about the economics of the scholarly journal."

Now however there can be little doubt that at least some commercial publishers do make the best use of their monopoly position. [115] For example, there is evidence to suggest that publishers (3 or 4 of the very largest in particular) assess the market carefully while considering price raises. Consider the observation by Dougherty and Barr [116] that journals with high demand (informally operationalised as journals that are regularly duplicated in a library's acquisition strategies) tend to be those whose prices rise the highest and fastest. Then there is the study conducted by Economic Consulting Services for ARL that concluded, "'each targeted publisher has increased subscription prices for the sample of titles examined at a much faster rate than the rate at which their costs have increased.' The differentials cited for the four most intensively studied publishers (Elsevier, Pergamon, Plenum, and Springer-Verlag) indicated that prices per page had risen from between half again to more than double costs per page." [117] Kenneth E. Marks, Steven P. Nielsen, H. Craig Peterson, and Peter W. Wagner confirm these studies with their own data and conclude that "95 percent of the titles from these three [Elsevier, Springer, and Pergamon] foreign commercial publishers are in the top 40 percent of price increases." [118]

It is worth looking in detail at a study by Sandra R. Moline [119] in order to get a clearer picture of the underlying reality. While carefully controlling for the amount of material published, [120] Moline found strong evidence to suggest that commercial publishers, and in particular commercial publishers in the STM segment of the scholarly market, price their periodicals not on some reasonable requirement for profit, but rather based on what the market will bear. Moline has differentiated between commercial publishers, society publishers (e.g., the APA or ASA), and "other" publishing houses that include universities, departments, university presses, research institutions and museums. She has also made a distinction between three broad categories of scholarly endeavour. Table 1 below summarises her findings.

Table One:

Prices and Sizes of Subject/Publisher Categories

Publisher Type/ Factor	Arts/ Humanities	Social Sciences	Science	Total
Commercial				
Mean Subscription	$40.04	$83.96	$283.18	$188.69
Mean kchar/year	1681	1942	5755	4063
Mean cents/kchar	3.04	5.27	7.23	5.94
Mean pp/year	475.4	557.3	1316.3	973.6
Association/Society				
Mean Subscription	$33.11	$57.20	$129.64	$96.21
Mean kchar/year	1995	2731	6944	5103
Mean cents/kchar	2.16	2.82	2.73	2.66
Mean pp/year	529.2	633.0	1155.7	925.3
Other Scholarly				
Mean Subscription	$25.33	$46.13	$138.00	$63.11
Mean kchar/year	1489	1999	5966	2901
Mean cents/kchar	2.30	2.72	2.89	2.58
Mean pp/year	430.4	588.5	1263.9	711.0
Column Total				
Mean Subscription	$32.81	$64.66	$137.46	$127.16
Mean kchar/year	1700	2287	6327	4274
Mean cents/kchar	2.53	3.70	4.71	3.96
Mean pp/year	474.4	595.9	1236.6	904.7

Source: Sandra R. Moline (1988), *The Influence of Subject, Publisher Type, and Quantity Published on Journal Prices.*

There are a couple of things about the data that strike one immediately. First of all is the clear price differential between arts and humanities journals, social science journals, and science journals. In each category of publisher (Commercial, Society, and Other), the journals of the sciences cost more than those of the social sciences which in turn cost more than the journals of the arts and humanities. Two factors make up this difference. On the one hand, science journals publish more pages (or more characters per year) than either the social science or humanities journals. We would thus expect those categories of publication that average a greater number of pages to cost more.

On the other hand, science journals publish more graphic, tabular, and mathematical information. This also effects the average price of the journal since when compared with the cost of handling and printing straight text, graphics, mathematical equations, and tabular data are quite expensive to reproduce. [121]

Another striking feature of Moline's research is the unmistakable differential pricing policy of the commercial publishers. In addition to the fact that commercial publishers invariably charge more for the material they help produce (a fact noted again and again in the past 25 years), they also seem to be charging differentially based on the presumed status of a particular scientific field. Notice that for the categories of "Association" and "Other," the Mean Cents/Thousand Characters remains remarkably stable across disciplinary boundaries. For example, Association and Society publishers average 2.16 cents per 1000 characters for Arts and Humanities journals, 2.82 cents per 1000 characters for Social Science journals, and 2.73 cents per 1000 characters for Science journals. Compare this with the 3.04, 5.27, and 7.23 cent cost per 1000 characters charged by commercial publishers. Surely there are no aggregate differences in the content of Commercial vs. Association journals. That is, we can reasonably expect that the ratio of graphic/tabular/mathematical data to text would be the same for each category of publisher. Were we cynical, we might think that the comments of major commercial publishers like Robert Maxwell actually reflected an industry policy of exploiting the inelastic demand of the library market.

A final interesting feature of the above data is that commercial publications cost more in all disciplines and not just scientific publication. For example, the cost per character for humanities publications is 2.3 cents for Association and 3.04 cents for commercial. The cost per character for social sciences is 2.82 cents for Association publications and 5.27 for commercial publications. And finally, the cost per character for science based publications is 2.73 cents for Association, and 7.23 cents for commercial. This means that commercial publication is 1.32 times more expensive than society publication in the humanities, 1.87 times more expensive in the social sciences, and 2.65 times more expensive in the natural sciences.

Moline provides further evidence of market gouging (Table 2 below) by demonstrating that commercial publishers increased their prices in the years between 1973 and 1985 by almost twice the amount that Association publishers did. Although she enters a caveat that the data provided by Fry and White [122] on which the 1973 figures are based is not strictly comparable to her own, the data remains highly suggestive.

Table Two:

Average Cents Per Page, by Publisher Type

Publisher Type	1973	1985	Approx. Increase
Commercial	3.7-4.0	19.3	400%
Association/Society	2.9-3.2	10.4	240%
Other Scholarly	3.0	8.9	200%

Source: Sandra R. Moline (1988), *The Influence of Subject, Publisher Type, and Quantity Published on Journal Prices.*

Other analysts have demonstrated similar patterns as those uncovered by Moline. For example, in his study of 17 major mineralogical, geochemical, and petrological journals, Paul Ribbe [123] found that the commercial variants cost anywhere between 3 and 20 times more than their society counterparts.

Clearly, some commercial publishers get a very good deal from the current academic journals market. However it is important to not over generalise. In the first place, the commercial STM publishers are clearly the principle culprits in the attack on library budgets. As Moline's data in Table One indicates, the average subscription cost for commercial journals in the STM segment of the market is almost 3 1/2 times the average subscription cost for commercial journals in the social sciences segment, and over 7 times that of the same commercial journals in the humanities.

The STM system is also implicated as the major culprit in the cost crunch for another reason. In addition to the high cost of the scientific and medical literature, there are critical differences between disciplines in terms of the size of their literature. In purely quantitative terms, the STM system is larger - in fact much larger - than the HSS system. As Table 3 below indicates, scientific, technical and medical journals are far and away the most numerous journals in the scholarly communication system. This sheer number of STM journals, coupled with the fact that they are as much as 7 times the cost of journals in other fields, clearly implicates the STM segment of the scholarly literature as the principle cause of the serials crises. Although, as Rowland Lorimer suggests, "publishers in other areas are quickly catching on that they, too, can make higher profits." [124]

Table Three:

Serials Universe for Selected Disciplines.

	Scholarly Serials	Total Serials
Medical Sciences	3,851	13,657
Biology	2,120	6,208
History	1,659	6,997
Engineering	900	6,150
Psychology	796	2,024
Political Science	744	6,979
Physics	621	1,896
Sociology	460	1,804
Anthropology	303	486
Women's Studies	89	242

Source: Ulrich's 1995 Periodical Directory

It is important to keep these caveats in mind. Failing to carefully distinguish the STM market from the social sciences or humanities can lead to an unfair proportion of the blame being laid at the door of journal systems that are simply not responsible for the crises. This was the unfortunate outcome for Canadian journals when the Social Science and Humanities Research Council, based on an inadequate understanding of the causes of the journals crises, cut $1 million in subsidies to 130 Humanities and Social Science (HSS) journals. [125] Fortunately the subsidies were later reinstated. However this event highlights the need for a balanced and considered analysis of the situation.

Conclusion

This chapter has examined current difficulties in the scholarly communication system. As has been demonstrated, publication delay, journal proliferation, and high cost have combined to weaken the scholarly communication system and damage its ability to serve the interests of the scholarly communication at all levels. There is a significant and deep irony here. As was noted in Chapter One, scholarly journals emerged in an attempt to make scholarly information public, increase circulation and dissemination, and archive the advances of science. However now, proliferation, high cost and delay threaten almost all of these original functions. For example, publication delay threatens the ability of the primary journal to fulfil its current awareness function in an open and egalitarian manner. This not only hampers the efficient propagation of scholarly discourse, but when considered against the original ideals that the system was intended to achieve (the Baconian ideal and Habermas' expectations for the enhancement of civil society) throws into sharp relief the current limitations of the system.

Even the original archival function of the primary journal is being threatened as the cost crunch undermines the ability for libraries to archive the world's scholarly material with the disturbing potential of loosing entire sub-disciplines of work from the record. When

a sub-discipline can no longer afford to support a journal because libraries are not purchasing it and there are too few individuals to support the publication, then the principle means of archiving that information has been lost forever.

So what is to be done? Many have argued that the solution to the current serials crises lies with electronic journals. Scholars have argued that with recent technological advances, it has now become possible to replace the old paper based system of scholarly communication with a new and better system based on the electronic journal. This new journal would cost less, provide better access, be faster, and generally alleviate or even eliminate current deficiencies in the scholarly communications system. Are these claims accurate? Do we currently stand at the brink of a revolution in scholarly communication similar to that ushered in by the Royal Society centuries ago? Perhaps. However before a reasonable answer to this question is possible, this dissertation will have to examine in more detail how the electronic scholarly journal might contribute to reforming, or perhaps even revolutionising, the system. This is the task of the next chapter.

Chapter Three: Electronic Journals

> It keeps being said, generation after generation, that the then current system of scientific communication is in a dreadful mess, and that something ought to be done about it. Century after century, nothing much does get done about it, except that it swells to ever greater bulk. Our present discontents were originally voiced by Bernal, 30 years ago, and although many other pundits have expressed support for his diagnosis of our ills, and for his proposed remedies, nothing much has been done about these either. [1]

Introduction

In the previous chapter it was noted how the current system is under considerable stress. Primary journals have, it was argued, lost much of their ability to fulfil their original mandate. Towards the end of the last chapter it was noted that a solution might exist. This chapter will explore that solution, the electronic journal, and examine how new information technologies might contribute towards a solution to the current serials crises. The chapter will also examine the limitations of this new medium and provide a cautionary note on the transition from paper scholarly communication to electronic.

Before beginning the exploration is it is probably worth noting that scholars have been talking about the possibility of an electronic journal for a long time. A handful of people talked about the possibility back in the 70s, [2] and a few more actually experimented with the medium. [3] But for them the technology was simply too primitive, the interfaces too crude, and the resulting information too visually limited to be of general use to the scholarly community. A bit more was done by way of experimentation towards the late eighties [4] Again however, progress was slow, [5] largely because of ongoing technical limitations and an uphill social and political battle. [6]

These early limitations have, it would seem, recently been overcome. From its early position as a black sheep of the academic world, the electronic journal has literally exploded onto the academic scene. This is clearly indicated by data provided in the Association of Research Libraries (ARL) *Directory of Electronic Journals, Newsletters and Academic Discussion Lists* (1997). [7] In 1991 there were 110 journals and academic newsletters listed in their directory. This grew to 133 in 1992, 240 in 1993, 400 in 1994 and 700+ in 1995. The most recent edition of the directory (1997) records a total of 3,400 scholarly serials. Of these 1,465 are classed as journals, 1,002 are peer-reviewed, and 708 charge in some manner for

access. [8] As we might expect from our discussion in Chapter Two about the parameters of the cost crises, "Scientific journals constitute the greatest number of entries in the journals section, with 29%. Fourteen percent of the journal titles are categorised as arts and humanities journals, while 28% are social science titles." [9]

What has happened in the electronic realm to cause the recent flurry of activity? There are basically two factors that have contributed to the recent explosion. First, previous technical limitations have largely been overcome. Second, the introduction of the World Wide Web (WWW) has overcome the barriers to usability characteristic of earlier Internet navigation technologies. As a result, the door has been left wide open for the full scale emergence of electronic publication on the WWW.

Let us first discuss the technical limitations of electronic publication. At the present time, it is safe to say that virtually no significant technical obstacles remain in the way of electronic publication. Although historically hardware and software limitations have had a severe impact on the ability of scholars to publish electronically, now "technological progress has pushed the state of what is available with routine off-the-shelf systems far ahead of what is required for scholarly publishing." [10] For example, hard drive capability has skyrocketed while cost per megabyte of storage space has plummeted. [11] The power of central processing units has also increased dramatically. From the early 80s reliance on 8 bit technology and deathly slow (8 mhz) speeds, the technology has move to the point where off the shelf processors operate at 64 or 128 bits and at speeds of up to 500mhz. [12] This increase in power and speed has allowed the development and migration (from the UNIX world) of extremely sophisticated text processing and manipulation packages, database packages and, indeed, all software necessary for the construction of a scholarly journals infrastructure.

Data communications speed has also increased dramatically. When the WWW first emerged in 1994, most regular users where confined to technology capable of a mere 2400 bps. Many users have had some experience with this slow rate of data transfer and most would probably agree that at these speeds, Internet technologies are barely usable. However with new technological advances it is now possible for regular users to cruise the Internet at speeds in excess of 64k per second. In addition, network upgrades at most universities now allow users to browse on networks as fast as 10 Megabytes per second. Similar speed increases have been achieved at the infrastructure level.[13] A 1992 Merit Network press release speaks about the successful drive to increase capacity on the Internet backbone. [14]

> In five years, the communications capacity of NSFNET has expanded almost 700 times through the implementation of leading-edge technologies, growing from 56 Kbps to T-3. Today the network's backbone service carries data at the equivalent of 1,400 pages of single-spaced, typed text per

> second. This means the information in a 20-volume encyclopedia can be sent across the network in under 23 seconds!

The second development allowing for the explosion of electronic publication is the World Wide Web. It is probably safe to argue that this technology has contributed more than any other to the explosion of ejournals. Prior to the development of this sophisticated and consistently evolving interface, scholars and entrepreneurs were restricted to difficult to use line mode ASCII interfaces that were ugly and counterintuitive. [15] Though there were examples of "journals" published via Listserv or Majordomo mailing lists, these were limited and primitive. Now, however, the technology has matured to the point were professional quality publications that serve the traditional dissemination and social functions of the formal journal are becoming practical. The result has been quite remarkable.

All the technical virtuosity does not mean that there are no current limitations. Authors still have had to defend the electronic journal on its ability to provide an adequate aesthetic and professional standard. [16] There is very good reason to pay attention to aesthetics. Not only because, as Pullinger [17] suggests, there is a psychological link between the aesthetic quality of a publication, attention to detail and the perceived quality of the publication, but also because electronic journals are attempts to communicate. It is thus critical we pay attention to the details that facilitate or hamper communication. For example, Martha J. Lindeman, Charles Crabb, John R. Bonneau, and Vera Fosnot Wehrli, [18] note that with poorly designed interfaces and documents, reading speed can decrease by as much as 30%. Reading speed can be further reduced by inappropriate choice of font, a print size too small for the screen, or even bad kerning. [19] Reading speed is also impacted by poorly conceived document structure. [20] As Yu Novikov [21] demonstrated, the structure of a document, its logical organisation from general to more specific, and even the presence or absence of highlighting can facilitate or impede comprehension and reading.

Electronic journals on the WWW have had to struggle with technological limitations that impede the readability of online material. From small monitors with poor resolution to inadequate control over document formatting, the aesthetic standards of electronic information have been barely adequate. Earlier versions of HTML, the standard text markup language used to communicate on the WWW, were quite primitive, [22] providing only basic control of document structure and little control over document appearance. This was an intended feature of the original HTML specification implemented by designers who deprecated presentation concerns and emphasised the structural characteristics of documents. [23] Philip Greenspun comments on the limitations of HTML as a mechanism for publication: [24]

> HTML represents the worst of two worlds. We could have taken a formatting language and added hypertext anchors so that users had beautifully designed documents on their desktops. We could have developed a powerful document structure language so that browsers could automatically do intelligent things with Web documents. What we have got with HTML is ugly documents without formatting or structural information.

Not surprisingly, this emphasis on structure over presentation has raised the ire of many people concerned with creating aesthetically pleasing documents.[25] This pressure has resulted in significant progress towards a more acceptable standard. Recognising the need for control over presentation, the WWW consortium's newest HTML 4.0 specification has resolved presentation issues by specifying a document formatting language known as Cascading Style Sheets (CSS). [26] Although still in the early stages of evolution, current work being conducted on the development of WWW specifications, including the work on stylesheets and a new specification called XML for eXtended Markup Language, will overcome any remaining limitations by providing fine-grained control over document structure and advanced document typesetting features. The potentials of these new developments will be examined in more detail in Chapters Five and Six.

These then are some of the reasons for the recent and extremely rapid growth in electronic publication. With the decline of technical limitations, the evolution of hardware and software, and the emergence of standards suitable for quality electronic publications, the traditional barriers to the electronic publication have evaporated. At this point it will be useful to evaluate the potential of ejournals to overcome some of the problems with the system identified in the last chapter. As we will see electronic journals may be capable of enhancing access, increasing the speed of distribution and even cutting the cost of scholarly publication. Should journals have this impact, it would bring significant advantages to the scholarly journals system. However, as will be noted, certain problems, such as journal proliferation, are less amenable to solution via information technologies. In addition, as Chapter Four will point out, not everyone is anxious to see reform in the scholarly communication system. This resistance interferes with the realisation of the full potentials of electronic communication.

The Benefits of Electronic Publication

Enhancing Access

> More and more of us are becoming familiar with the Internet Syndrome, where one's colleague appears after an unexplained absence of several days, eyes glazed, hair unkempt, clutching an

> empty Pepsi can, and mumbling "I just logged on to check my Email and then it was Thursday."[27]

As noted in Chapter One, open access to scholarly information was a key platform upon which a new scholarly journals system was first built. When the journal first emerged, one of its key functions was to enhance access to scientific research and to distribute this research as widely as possible. As has been seen, access to scholarly literature is effected by a number of factors. Access to journals is reduced as the cost of journals skyrockets and libraries and individuals cancel subscriptions. Access is also reduced when users are not physically proximate with library resources as, for example, when academic courses are delivered at a distance to students in rural or isolated areas. Access is enhanced for those students who attend rich institutions in developed countries. Access is degraded for those attending poorer institutions, those receiving their education at a distance, or those attending in developing countries with smaller library acquisitions budgets. As noted, having easy access to scholarly material is a critical component not in terms necessary for the advancement of science, but arguably also for the advancement of civil society.

One of the principle benefits of electronic journals is that they potentially offer vastly increased access to scholarly material. Indeed, enhanced access is probably one of the more frequently noted benefits of going electronic. Rowland Lorimer, speaking from his experience in launching an electronic version of the *Canadian Journal of Communication*, notes this when he comments on the benefits of electronic publication. In addition to allowing for more frequent graduate student access to the material, Lorimer comments: "You will find, after a while, and after you have registered with search engines, that a great many people are looking at your journal and some of them making good use of it." [28]

In addition to the above example, many projects that have put scholarly material online report how access to material is greatly enhanced when available electronically. One example is provided by the *Perseus Project*. Headed by Gregory Crane, this electronic library of classical Greek culture provides a much more democratic and widely distributed access to classical culture. Crane reports positive experiences with the library, and significant gains in accessibility over a wide demographic profile. His comments are quite interesting.

> Even now, as our modest digital library on ancient Greek culture finds its way into homes, schools and offices where traditional scholarly publications have not reached, we can see by the patterns of use and the mail that we receive the stirrings of a vast audience, hungry for ideas and for that practice of thought to which we, professional academics, have been privileged to dedicate our lives. Ten year olds read about the ancient Olympics; military officers at foreign posts read Thucydides; bankers examine Greek vases during lunch time

> pauses in their work, and adult learners in the kitchens of rural homes look up words in our electronic Greek lexicon as they work their way through Plato. Our experience is not unique: our colleagues with World Wide Web (WWW) sites on Gender in Antiquity, Galileo and other topics report evidence of a similarly widening audience and with it a quickening of society's intellectual life. [29]

Ease of access to electronic information is highlighted by the hypertext capabilities of WWW publication. Not only can you access journals and articles, but you can also potentially access source material and citations used in the journal articles themselves. Authors can simply and easily provide hypertext links to many of the works cited in their papers. Readers are easily able to follow links and check on the accuracy of the citations or even make copies of the complete original texts with their local laser printer. No bothersome copying of references, OPAC searches, or trips to the library to track down material or verify references. There is quick, elegant access to all the material needed to read the article.

A sobering element in the eulogy to enhanced access is the fact that individuals must have a computer to access electronic journals and the computer must be of reasonable power and sophistication. This means that, as Lorimer says, "gains in accessibility favour technological and financial haves." [30] However this is perhaps less of a problem than might be feared - at least when putting aside deeper issues of socioeconomic class and only considering the potential population of post-secondary students, instructors and researchers. For example, almost all students in North America now have access to computers through their educational institutions and virtually all universities and colleges in North America have been fully wired to the Internet. [31] This obviates any concerns that individuals most attached to the journals system, i.e., libraries, individual scholars, and students, would be significantly disadvantaged by a move towards electronic communication. In fact, it is possible to argue just the opposite. Networking scholarly resources makes it much easier to transfer information between institutions. Smaller colleges and colleges in isolated areas are, all other things being held equal, likely to benefit from networked scholarly resources.

A similar argument can be made in relations to concerns that networking scholarly information will disadvantaged developing countries. Again, the opposite, that of enhanced access, is much more likely to occur. Assuming that the move to electronic information leads to a reduction in the cost of scholarly material, developing countries will find it very easy to connect to the Internet and exploit the easy access to scholarly information. In fact, this is precisely what is occurring at this moment. More and more institutions in more and more nations are coming on line all the time. [32] It seems only a matter of time before all institutions (both K12 and University level) are wired into the global information highway. In fact, Andrew

Odlyzko [33] makes the following projection:

> Concern is often expressed that electronic publishing will deprive poorer institutions, especially those in the less developed countries, of access to the scholarly literature. The opposite is bound to be true. Few institutions can afford the $25M per year that Princeton University spends on its libraries. Yet a T1 connection to the Internet (of 1.5 Mbps capacity) costs $20,000-$30,000 per year in the US, and would suffice to bring in all the scholarly information that is generated in the world, if only that information were electronic. In other countries connections are more expensive, but even so, less than 1% of what Princeton spends will pay for a satellite earth station of high capacity....Therefore electronic publication is the most promising route for scholars in less developed countries to become full participants in intellectual life.

Odlyzko overlooks the fact that information on the Internet will probably have some associated cost. That is, in addition to having a solid Internet connection, institutions will also have to pay for access to electronic resources. This may mitigate the positive benefits for many institutions especially if the costs associated with electronic material match or exceed the current high cost scholarly communication system. Still it is a valid point if it is assumed that the move towards paper will reduce the cost of scholarly publication. Under that circumstance, and all other things being equal, electronic publication can contribute substantially to increasing access to scholarly material. Still, a more rigorous study of the enhanced accessibility of electronic publication is needed to determine the potential impact on developing nations. However the anecdotal evidence is extremely suggestive and future research will most likely confirm what has been stated here.

The argument that information available in electronic form enhances access is strengthened when we consider that putting information in electronic form also has the ability to enhance accessibility for people with disabilities. [34] Information that is already in electronic form makes the development of software to accommodate the visually impaired, [35] those with hearing difficulties, [36] and those with motor disabilities fairly straightforward. [37] The structured nature of HTML, and strict adherence to standards, overcomes one of the major difficulties normally experienced by developers seeking to enhance access to information for the differently--abled - namely lack of consistent electronic representation of information. Because HTML is a standard that is hardware and software independent, developers can create interfaces that, for the most part, can handle all information created for the WWW. [38]

Reducing Publication Delay

In addition to the potential for enhanced access, publishing electronic journals also brings with it the potential for a significant decrease in publication delay. As the reader will recall from the last chapter, long delays between the completion of a research project and its final appearance in a primary journal, along with the reliance on the informal communication system for access to science on the research front, was offered as a key mechanism for perpetuating systemic inequality in the academy. To be sure, excessive publication delay is not the only factor contributing to systemic inequality. But it arguably reinforces it since it pushes the cutting edge communication of science into the semi-private informal system of communication. Arguably, accessing this informal realm requires access to a significant reserve of financial and cultural/scholarly resources in the form of institutional financing or accumulated prestige. If, in the current highly competitive and rapidly advancing scientific community, access to the informal communication system is critical if researchers are to lead productive and original scientific careers, then unequally distributed access to the informal realm contributes to ongoing inequality.

The perpetuation of structured inequality is potentially weakened, and might even be overcome in some cases, when material is published electronically. One of the principle benefits of electronic publication is an accelerated scholarly discourse. That is, electronic journals offer the ability to significantly reduce the delay associated with scientific publication. This potential arises because of a number of enhancements to the traditional publication process that are possible when dealing with electronic information. Without a doubt the biggest advantage of full electronic publication is its independence of the postal system at all levels of the communication process. Many electronic journals rely almost exclusively on email to transact the review process. The ability to receive, send, and comment on submissions electronically eliminates literally months of time from the review and publication process. Ejournals also have the added benefit of circumventing the delays associated with production and distribution of paper journals. Electronic production avoids typesetting, the creation of camera ready copy, printing and duplication, and postal delivery. This, coupled with the elimination of postal delays, greatly enhances the speed of scholarly communication. Stevan Harnad has argued that this enhanced speed may even lead to a revolutionary change in nature of scholarly discourse - a revolutionary change he calls scholarly skywriting. [39]

An interesting example of the potential of electronic journals to reduce delay is provided by DigMaster, an online experiment designed to see whether or not electronic publication can overcome the 10 to 20 year delay that archaeology experiences in its publication process. As Paul Jacobs and Chris Holland note, archaeology is hamstrung by its inability to provide reasonable access to the basic archaeological datum - the artefact. [40] Access is hampered for a number of reasons. Artefacts are, rightfully so, the property of nations where they are discovered. In

order to protect a national heritage and preserve the value of artefacts, they are often stowed away in museums or archives where access is denied or severely restricted. The result of this reasonable restriction is that "many of these artifacts can best be presented only in visual or graphic format, a prospect normally much too expensive for traditional publication means." [41] This difficulty is exacerbated, ironically, because many archaeological digs provide an over abundance of samples and artefacts. The authors explain that " a modest season of field excavation will produce far too many artifacts (not to mention architecture, soil layers, and faunal and floral remains) to be managed and studied rapidly and fully and to be presented in a timely way by traditional modes of publication (other than as simple lists)." Jacobs and Holland continue:

> Historically, the lag between recovery in the field and final publication is frequently ten to twenty years or longer. In the interim, data which might have assisted ongoing research remains inaccessible to scholars and public alike. More normally, the "spectacular" or the "unique" find will be published quickly, while the ordinary object represented by numerous examples (which presumably would tell most about activities, practices, values) languishes in the laboratory or in storage. [42]

This extended publication delay has been largely overcome. With new information technologies, managers of the DigMaster project were able to provide rapid online access to graphical and three dimensional representations of artefacts from an archaeological dig. And while the authors admit that graphical and VRML representation of artefacts are not the same as having the artefact in hand, this limitation must be understood in the context of a previous system that provides virtually no access to the vast majority of publishable material. As the authors note, there was a significant and tangible improvement in access and speed of delivery. From the original delay of 10 to 20 years noted by the authors, the DigMaster project was able to make material available within 2 1/2 years of the completion of the field project. As the authors note, this was a precedent setting achievement as a result of which "DigMaster has raised to a new level the obligation to make known the discoveries of archaeology, now with the promise of accomplishing that responsibility in a timely fashion." [43]

Other authors and editors have reported similar experiences with electronic publication. [44] These examples of enhanced speed of publication are supported in part by research conducted by Stephen P. Harter who conducted a citation analysis of a sample of electronic journals. One of the measures derivable from citation databases is a measure called the immediacy index. As Harter explains:

> The immediacy index measures the extent to which articles make a quick impact on readers -- the timeliness or currency of

> the journal. Historical journals would presumably have low immediacy indexes: cutting edge medical journals would have relatively high immediacy indexes. One would expect e-journals to have high immediacy indexes, since speed of publication is one of the most often cited advantages of journals. [45]

Although his samples of electronic journals were limited, and the subsample upon which he undertook an extended data analysis small, his conclusions are suggestive. Of the 3 journals upon which he conducted an in depth analysis, two "ranked well above the median journals in their fields on the immediacy index...." [46]

Of course, the general ability of electronic journals to enhance access and reduce delay will no doubt be mitigated by a number of factors (for example cost, peer review practices, availability of software enhancements, etc.). However the general conclusion seems warranted. Electronic publication enhances access and reduces publication delay. The potential benefits of this enhanced accessibility and reduced delay are considerable. Drawing on the analysis from Chapter Two, were the negative outcomes of long delay were discussed, it is possible to argue that previously marginal groups in the scholarly community stand to benefit considerably from electronic publication. Graduate students just beginning their career would benefit from the speedy turnaround time of electronic publication. This would potentially enhance their ability to develop publication skills and help level the playing field between the elite and the more run of the mill institutions. The faster pace of peer review would allow graduate students to experiment and push the publication boundaries more. The ability of electronic publication to place graduate students in a fast loop may enhance their learning by providing them with a greater opportunity to learn the craft of paper publication through more rapid and regular feedback. This would go a long way towards eliminating some of the difficulties and inequities in the process noted in the last chapter and place graduate students from smaller institutions, or at institutions with less faculty support for their publication efforts, on a more level playing field.

Developing countries can benefit greatly as well. When a new paper goes on line, everyone in the world is able to access it at the same time. Scholars in developing countries need no longer wait while the postal system and poorly operated administrative apparatus deliver them their subscriptions. As a result, scholars in developing nations, and indeed all those at the margins of scholarly discourse, may find themselves less dependent on invisible colleges with all the disadvantages that that brings. The speedier distribution of a scholar's work in the electronic realm, while probably not totally eliminating the existence of invisible colleges, may significantly reduce their importance. This will have obvious benefits for graduate students, underdeveloped countries far outside of the research loop, and others at the margins. While it may be a bit of a leap to say that the speed of electronic publication will democratise the academy, it will at least level the playing field a bit

by reducing the lag between the onset of a project and its final public availability.

Should a more egalitarian scholarly communication system emerge as a result of a shift towards electronic publication, it will be a significant improvement. Arguably, this improvement will move the scholarly communication system and the scholarly journal closer towards realising its original mandate, which was to be a system of rapid public distribution of knowledge. However as noted throughout this dissertation, the potentials of electronic publication are, in the end, only potentials. Many factors must combine to create the preconditions for the emergence of a suitably enhanced system of scholarly communication. Perhaps the single most critical factor is the cost of information. As noted above, if electronic publication does not reduce the cost of scholarly communication, access will not be improved and the system will remain closed. Without a significant reduction in cost, scholars in developing nations and even graduate students in developed nations, will be in a position little better than that provided by the current system. They will still be dependent on the libraries for access. Where libraries are financially strapped, or where resources are limited, even the existence of the very latest Internet technology will not guarantee access. Given this, it is perhaps appropriate to raise an analysis of how electronic journals might reduce the cost of scholarly information. The next section provides a detailed analysis of the potential for electronic publication to reduce the cost of scholarly information.

The Cost of Scholarly Communication

> Is the Net in principle different from a telephone? Does anyone charge for the CONTENT of my phone calls? Ah, but scholarly research reports are not just informal chit-chat, one might reply; a lot of work has been put into them, not only by the author, but by colleagues, referees, editors, etc. Moreover, unlike evanescent telephone conversations, the scholarly literature must be preserved and made accessible to all. All this costs money. Fine. Let the true expenses of using the medium and of producing and preserving its text be made explicitly, and then shouldered either by the "promotors" of scholarly productivity (universities, learned societies, government, society) or by the individual "consumers" of these texts (the scholars themselves). I happen to lean strongly toward the first alterative, [sic] because I think making scholarly information freely accessible to the individual scholar gratis makes for the best scholarship for all of humanity. But even if we do elect to make individual scholars pay for access to one another's work, let us make sure that we do not add on spurious surcharges that are merely holdovers from the obsolete papyrocentric model. [47]

The final beneficial aspect of electronic publication that will be examined in this chapter is the potential for electronic journals to reduce the cost of scholarly communication. As noted in the closing words of the previous section, a reduction in the cost of scholarly information is the critical component in realising the potential for ejournals to enhance and democratise the distribution of scholarly material. It is also worthwhile to recall the strain that libraries have been placed under in recent years. In addition to realising some of the potentials of electronic publication, a reduction in cost is a fundamental step towards bringing financial health back to the academic library.

It is unfortunate, given the centrality of reducing cost, that this is the most controversial aspect of electronic journals. Of all the beneficial aspects of the electronic scholarly journal that have been discussed over the years, the least agreement occurs when discussing cost. As will be seen below, estimates as to the potential savings of electronic publication range from nothing (or even additional costs over and above paper) to as much as 75% of the paper cost of a journal. [48] An important question to raise here is why there is such a wide variation in estimates.

The answer to that question is complex. Part of the problem in determining accurate estimates of price reduction is the involvement of the commercial presses. As the next chapter will argue, the commercial presses are opting for a high cost system of scholarly publication (that uses propriety and over priced software, expensive solutions to add value, etc.) that allows them to retain their current high levels of profit. Unfortunately, in the process of proselytising their interests, commercial presses are creating the mistaken impression that their methods of publication are the only alternatives in the realm of electronic scholarly communication. It is important not to draw this conclusion since technologies exist that can support an alternative publication system without the high cost associated with the commercial model (propriety software, bloated commercial bureaucracies, etc). These potentials will be examined in more detail in chapters five and six where emerging technologies are examined for their potential to add value and reduce the cost of electronic scholarly communication.

Besides this commercial resistance to alternative solutions, however, there is a significant lobby of individuals who suggest that electronic journals brings fewer economic benefits to the academy than many pundits would like to believe. Unfortunately, it is not so easy to dismiss the concerns of this group since they are attached to the scholarly communication system through non-profit organisations and scholarly societies and they do not have an interest in preserving a commercial system that supports excessive profit for a few large publishers. Some of these individuals have seen journals make the transition from paper to electronic and based on this assessment are arguing that no significant cost savings are to be realised in electronic publication. It is difficult to discount these arguments since these arguments are prima facia evidence for the ongoing expense of scholarly

publication even when conducted electronically. Still, this position of this dissertation is that there is potential for dramatically reducing the cost of scholarly publication. Yet to realise dramatic, or even modest, improvements, a radical rethinking of the publication process is required. Without this rethinking it will be impossible to envisage how to actuate the full potentials of information technology.

Before proceeding however it is necessary to examine in more detail the various cost components of the scholarly communication and examine how electronic journals might contribute to a reduction in journal cost. Table Four gives a basic analytic breakdown and an associated series of estimates on the proportion of operating funds taken up by each component of the production model. [49]

Table Four: Estimated costs of Journal Production, 1975

Expense	**%**
Editing Labour	25
Typesetting	25
Printing Labour	25
Paper	10
Postage	10
Other	5
Total	**100**

Source: Metz and Gherman (1991) derived from Economic Consulting Services Inc., "A Study of Trends in Average Prices and Costs of Certain Serials Over Time," report to Association of Research Libraries, 1989.

A quick summary of the various components of journal production is in order. Beginning at the top of Table One there is editing labour. This category includes such components of the journal production process as handling the submission of manuscripts and their routing to relevant reviewers, correspondence with authors and other organisations, etc. When the manuscript has been accepted, then content and copy editing and general preparation of the material for formal typesetting beings. These are included at the top of the table under editing labour. Below editing labour are the typesetting, printing, and paper costs. Typesetting generally involves data entry and layout in a Desktop Publication (DP) program and the creation of camera-ready copy. When camera-ready copy is ready, then the journal goes to the printer where labour, paper, and profit figure into the final cost of the journal. As has been already noted, the postal system enters into the process at all stages from the initial handoff of a submitted paper from editor to reviewer and back to author, to the final distribution of the printed journal.

Producing journals electronically introduces significant efficiencies and cost savings at every stage of the production process. Least controversial about these savings

are those associated with postage, paper and printing costs. Obviously, producing a journal in electronic only format saves postage (10%), paper (10%), and printing labour (25%) costs. Thus a conservative estimate of the reduction in cost of publishing an electronic only journal is 45%.

Epublication may or may not bring savings in typesetting and markup of articles. Just like paper production that requires the author's submitted paper to be translated into a text language suitable for producing publishable documents, electronic publication also requires significant interaction with the text. In the paper realm typesetting involves, as noted above, data entry and layout. In the electronic realm, typesetting involves essentially the same process. However instead of using a DP program to layout text, an authors article is "tagged" with HTML or SGML markup. Depending on the complexity of the system used, the electronic layout of documents in electronic publication can be as time consuming as that required for paper production. Of course, it is possible to introduce some cost savings in the process of typesetting. But these savings apply to both paper and electronic journals. For example, if papers are submitted electronically, then the cost of data entry is eliminated. However for paper publishers, it is not always possible to receive all papers electronically. Aldyth Holmes of the National Research Council of Canada (NRC) notes that about 5% of the papers submitted to their 14 scientific and technical journals are still in paper format. [50]

Besides the above noted typesetting costs which apply both to paper only and electronic only journals, there are also costs associated with editing journals. This category includes the work of editors, peer reviewers, and copy editors. This category also includes the infrastructure needed to support the work of the editors and peer reviewers. However it is important to keep in mind that in general, these costs are very low. Most editorial functions, save copy editing, are traditionally provided free of charge to institutions, societies and even commercial organisations. This holds true for members of the editorial board or the pool of peer reviewers used to assess submissions. However, besides the fact that editorial labour is provided free, there are still costs associated with the provision of this editorial labour. These costs, which include the cost of purchasing technology, the cost of office space, and perhaps the cost of an editorial assistant, are most often born by the host institutions. In the past this part of the editorial cost has also been provided free. However that seems to be changing in recent years as universities, caught in a budget crunch, are forced to shift the costs of supporting journals back onto the shoulders of the publishers. As Aldyth Holmes of the NRC notes:

> AT NRC Research Press, we do not generally pay editors, but we do contract with the editor's institution to pay for the office support necessary to run the peer-review process. The costs of these editorial offices have increased 61% in the last 10 years.... The reason for the cost increase seems, on examination, to be

> that the institutions are unwilling to donate as many services and facilities as they were in the past. Once, the universities would willingly donate free office space, furniture, and postage, but this is changing rapidly; all institutions expect the publishers to cover the cost of postage, computers, and equipment for the office, and an increasing number are requesting that space be rented from the institution. So far we have had two requests to fund editors, either directly or indirectly by funding replacement teachers. [51]

Aldyth Holmes goes on to argue that, when dealing with electronic journals, support for editorial labour also includes the provision of hardware and software to allow editors and peer reviewers to access work. Here the cost is assessed at between $5,000 and $7,400 $US per year per machine. [52]

It is impossible to argue with Holmes that it is unfair to unload these costs onto institution or individuals unwilling to support them. It is also impossible to deny that there are costs associated with peer review. However perhaps some room should be left for variation in institutional and individual response to the requirements for providing support for journals. While many institutions may be unwilling to support journals gratis, some are not overly concerned and may in fact enthusiastically support journals. This was the case when Timothy McGettigan took a proposal for the journal *Radical Pedagogy* (http://www.icaap.org/RadicalPedagogy) to his department chair at Wake Forest University. As he notes, the chair was enthusiastic about providing support for the journal

> The Chair of my department, Earl Smith, was very supportive of my decision to assume the editorship of Radical Pedagogy. Dr. Smith was willing to establish an affiliation between the WFU Sociology Department and RP. In addition, Dr. Smith was instrumental in acquiring a student editorial assistant for RP, and he has indicated that more departmental and campus resources (e.g., office space, server space, professional leave, etc.) could be made available at my request -- and all of this has been made possible without either threat or harm to the departmental budget. [53]

Note that the above is not to discount the fact that many universities find themselves unable and unwilling to support scholarly publication. However it does raise an interesting question especially when the fact that Radical Pedagogy is an independent publication not affiliated with a commercial or society press is considered. It might be reasonable to ask whether or not there is a university backlash against the commercial presses. Certainly they have received a lot of bad press in recent years. The perception may be, among some universities, that journals associated with organisations are unfairly gouging the system and that as a result

they should pay their fair share of infrastructure support. Perhaps this is why organisations like the NRC are being asked to pay for office space and instructor release time. This is of course an empirical question that requires a research effort to determine with any degree of certainty. However it is a significant and reasonable question especially since if this is the case, it represents an unfortunate misinterpretation of the causes of the serials crises and may in fact end up penalising Non-profit journal publishers, especially in the humanities and social sciences.

A second caveat on the cost of editorial services is the cited cost for hardware. The $5,000 to $7,400 US seems a bit of an overestimate of the actual costs involved. First of all, the majority proportion of the cost will be absorbed by the host institution as a normal part of providing researchers and instructors with the computing resources now essential for productive work environment. Most scholars have computers and many have subsidised access. Either up to date workstations are wholly provided by the university, some form of cost sharing is involved, or researchers pay for systems out of their Professional Development (PD) funds. However the machines are purchased, they will primarily be used for research and teaching activities and only part of the time be used for editorial or peer review. A conservative estimate of the time given to activities might be 90% for research/teaching and 10% for editorial or review. Given the fact that a user's machine will be used for many different activities, it seems unfair to suggest that the entire cost of the machine be attributable to editorial or peer review. Second, the $5,000 estimate surely needs to be revised down. The cost of hardware and software has, in the last two years, plummeted. It is now possible to purchase high end workstations for as little as $2000.00 $Can. This would include sufficient memory, a fast CPU, a 17inch computer monitor, and most of the software required for handling electronic documents.

Besides these caveats about the cost of supporting editorial functions, it is also necessary to note that there is an administrative component to editorial and peer review duties. Submitted papers must be "handled" and even if this handling is done via email, there is an overhead cost. For example, someone must notify peer reviewers, collect and summarise commentary, notify authors, keep records, etc. All of this will require time whether or not it is done for free by the editor, or done for a fee by an editorial assistant. Still, there are individuals working on ways to automate and streamline this process. The electronic journal *Conservation Ecology* (http://www.consecol.org/Journal/) exploits information technologies to the utmost by requiring authors to submit their papers with pseudo markup that identifies key components of the article. This pre-identification allows the editors of the journal to automate the handling of papers. Every aspect, from conversion to HTML to notification of peer reviewers to record keeping, is handled centrally by the software. Shealagh Pope and Lee Miller note:

> With the automated peer review system, all clerical steps (e.g. acknowledgement of receipt of a manuscript, nagging and prompting messages) are substantially faster. The machine works on weekends and at night. The sending out of prompts, reminders, and acknowledgements is not constrained to "normal business hours". In an international working environment, immediate response to incoming messages and commands can save several days as delays due to incongruent time zones are avoided. The software has no "time zone"....
>
> Database entry is minimized as the authors and the software do the bulk of this. All standard clerical steps - acknowledgements, nagging, prompt - are automated. No paid staff are required to do these tasks. All correspondance is conducted by email, and is therefore free. Formatting, for both copyediting and publication, are done by software. Printing and distribution costs eliminated as *Conservation Ecology* is published only on line. [54]

The authors report that the software they have developed does allow them to streamline the process and save time and money. And although they admit they are unable to accurately quantify the savings (because the software is still under development), they note that "it is clear that we are realising savings through the software...." Most importantly, they realise savings in handling time even despite the fact that they have had to add 1/4 time system support and 1/2 time production support. And the potential for savings is even great if the automated software they have developed is centrally managed and exploited by many journals. In this way economies of scale could be brought to bear on the entire process.

Finally, it has to be noted that when publishing electronically there are significant costs associated with storage and transmission of electronic texts. These include costs associated with hardware and software purchases, cost of networking, and cost of server software. As for electronic storage and transmission costs, these are now quite trivial. In 1994, Paul Ginsparg [55] noted that cost for a gigabyte of storage was under 700$. This meant that the 25,000 physics papers published each year could be stored for about 3 cents apiece. Since that time the cost for a gigabyte of storage has plummeted to about $100 a gig thus further trivialising the cost of storage. However even in 1994, Odlyzko could conclude that the cost to store all current mathematical publications would be less than the subscription cost for one paper based journal! [56] As to the cost of Internet connects, these are generally shared among all members of an organisation. Odlyzko [57] noted that even with the recent withdrawal of National Science Foundation (NSF) support for the Internet infrastructure and the move to commercialisation, academic storage and transmission should remain trivial because network transmission will have to remain cheap enough for commercial applications (pictures, movies, etc.). He concludes by

noting that the cost of fast Internet connection will remain less expensive than the cost of a good collection of paper journals for only 1 discipline.

Other savings in hardware and software can be realised. A real life case example is provided the International Consortium for Alternative Academic Publication (ICAAP). This consortium aims to provide infrastructure support for small and medium size audience publications that cannot support themselves in the paper realm. ICAAP provides basic infrastructure services (e.g., journal hosting, archival, mirroring, link checking, and a secure server for online credit card subscription, among other services) for member journals. The actual cost of hardware and software for all these services is less than $2,500.

More will be said about ICAAP in chapter five and six where alternative models of publication and collective solutions to the cost crunch will be discussed. At that point, strategies for expanding services to journals, and plans for recovering costs, will be discussed in more detail as the dissertation examines current initiatives designed to reform the scholarly communication system. For now suffice it to note that the cost for operating ICAAP is low enough that all the services noted above are offered free to member journals. It is hoped that this will encourage individuals and journal editors to make the shift from paper to electronic and help alleviate some of the costs associated with making this transition.

Clearly then there is a potential inherent in electronic publication to reduce costs. Even traditional publishers will admit that introducing information technology into the production loop results in substantial savings. Steven B. Silvern, [58] editor of the *Journal of Research in Childhood Education*, notes that the introduction of electronic page processing cuts production time and costs from between 25% and 50%. The editor of the journal *Hispania* noted savings in postage, document processing, photocopying, editorial time (including a more streamlined reviewer selection process facilitated by a key word look up of curricula vitae), costs of manuscript preparation, and space with the move to a completely paperless editorial office. [59] Jane Lago of the University of Missouri Press has also introduced IT into the editorial office. She reports savings of between $500 and $1000 per manuscript. [60] Indeed, the terrain has shifted so thoroughly that journal editors are now providing tips to other traditional paper journal editors on how to use information technologies to enhance the publication process. [61]

So what is to be concluded from the foregoing? When publishing an electronic only journal, it seems reasonable to suggest 45% as a minimum cost saving over the traditional paper version. Arguably, other efficiencies might be introduced. As software and expertise develops, it might be possible to automate many of editorial tasks associated with paper handling. As also argued, in some circumstances institutions may willing provide support for publication - thus eliminating the costs associated with office space, computer purchase, and editorial assistance. As noted in Table One above, editing labour accounts for 25% of the cost of producing a

journal. Given the possible efficiencies noted above, it is perhaps reasonable to suggest that the cost of editing labour could be reduced by approximately 75%. This would bring an additional net savings of approximately 19% to the overall reduction in costs bringing the total savings to 64%. An efficient editor might be able to introduce further savings to where Harnad's estimate of 75% for electronic only journals might seem a reasonable target figure.

Unfortunately, it is unlikely that society publishers or Non Profit Organisations (NPO) would ever be able to achieve Harnad's maximum cost savings. Organisations such as these have considerably more overhead than an independent publisher would have. However we should not begrudge them this. In most cases they provide an essential service that many in the academy are willing to pay for. However, it is important to note that, at least when dealing with electronic only publication, it is possible to realise significant savings. This is not to challenge the estimates of society or non profit publishers, but to provide ammunition to counter the claims of commercial publishers. As will be argued in the next chapter, some commercial presses are anxious to retain a high cost system of scholarly communication. It is important that the scholarly community not buy into the commercial estimates. Otherwise the potential for relieving at least some of the financial pressure will be lost.

There is one further wrinkle in this analysis of costs that must be dealt with. In many cases publishers, although keen to develop electronic versions of their journals, do not want to give up their paper version. Although from a financial and environmental perspective, going fully electronic seems the most desirable solution, various factors impede this transition. These include the feeling among many that full ejournals are too transient, the desire to have paper versions for archives, and the need to distribute information to destinations without network access.

Is it reasonable to expect that IT can reduce the cost of scholarly publication even when editors and societies choose to publish *both* an electronic and a paper version? Generally, authors and editors have argued that it is not possible to reduce costs when publishing both electronic and paper. This is the position taken by the NRC research press after a one year experiment with a dual electronic and paper format. As Aldyth Holmes notes:

> "Based on less than one year of producing electronic versions of only two titles, NRC Research Press has found that the electronic versions, produced in parallel with the paper versions, are costing an extra $20.61 per page, or 6% more than a paper-only journal. This compares with the American Physical Society's figure of U.S. $10 per page..."[62]

As will be seen in the next chapter, some commercial presses argue that a 40% increase in cost is justified. However others, in particular Robert Boyce, argue that a small but not insubstantial *decrease* is possible even when publishing both an

electronic and a paper version. The difference in estimates is relatively easy to explain - at least for Non Profit publishers. The problem essentially revolves around how the journal production process is conceived. As Boyce notes, traditional publishers think of the publication process as moving from paper to electronic. They start with a typeset article in a DP program. This is then printed and converted to electronic format for online publication. When thinking about the publication process in this manner, it makes perfect sense to estimate a modest additional cost. There is no trickery involved.

However, the estimates change when the publication process is reconceptualised to start with an electronic version of the article. Assuming that the electronic system utilises an advanced markup system like the Standard Generalised Markup Language (SGML) or eXtended Markup Language (XML), the first step is to create a tagged electronic representation. If this is done correctly, then it is very easy to produce both an HTML version and a printable version, and even an Adobe Portable Document Format (PDF) version with little additional effort. Thus, even when the publishers wants to produce multiple versions of the same document, this can be done with no significant increase in cost. Indeed, when a fully evolved electronic publication system is in place, it is even possible to realise savings over the traditional paper system even when publishing paper and electronic. This was experience of Peter Boyce who is Senior Consultant for Electronic Publishing American Astronomical Society for the American Astronomical Society (AAS). When the AAS first initiated its publication process, Boyce notes that the cost of paper plus electronic was an additional 10% over the cost of paper alone. [63] However as time has passed, the AAS have reduced the cost of paper plus electronic to below the original cost of paper. Boyce feels that when the complete system is in place, the AAS will achieve as much as a 10% reduction in cost despite the fact that both paper and electronic versions are being produced. As he says,

> I think it is safe to say that the plus 10 percent figure we used for the Serials Review article applies while the system is being developed -- and production must continue. But, after all the components of the new process are in place, we see an overall cost saving which might [approach] ten percent as we continue to refine our process. [64]

Boyce eloquently summarises the above discussion.

> The point is that if you stick with the "paper first" methods adding electronic adds costs. If you go to "electronic first" you should be able to incorporate savings by re-engineering your process starting from ground zero. Most publishers can't step back far enough from the day-to-day production demands to visualize what "ground zero" really is. They can't shed their old habits. I think it says something that the real innovators, (us

> with UC Press, High Wire, Community of Science, the LANL xxx preprint server, etc.) all originated from groups who were not publishers. We were able to start with what it is the users would want and design a system to get there. Professional publishers, even most non-profit publishers, could not, apparently, blaze this trail.[65]

It is difficult to adequately perceive the full potential of a fully electronic SGML based production system to reduce the cost of scholarly publication. However it is interesting to compare Boyce's confident suggestion that it is possible to reduce the cost of paper + electronic by 10% reduction in cost for journals that publish both electronic and paper journals, against the potentials noted for cost reduction for electronic only journals. One wonders what the true potential of an SGML based production system really is when turned to electronic only publication of scholarly journals. This potential will be examined in considerable detail in Chapters Five and Six.

Conclusion

This chapter has examined the potential of electronic technologies and the WWW to help alleviate some of the long standing difficulties of the scholarly communication system. It has looked at publication delay and access and, more importantly, examined in depth the potential of electronic communication to reduce the cost of journal publication. The conclusions are relatively straightforward. Electronic publication can speed the distribution of scholarly material and enhance access unproblematically. Electronic publication can also contribute to a reduction in cost. This reduction is greatest when electronic only publication is pursued. However, given reasonably achievable efficiencies, and a reconceptualisation of the publication process, even those journals that choose to publish both paper and electronic versions can net small but not insignificant savings.

One potential sore spot in the analysis on the potential for ejournals to reduce publication costs is the role of the commercial press. As this chapter has alluded, commercial presses, or at least a small subset of these presses, are not overly anxious to help reduce the financial pressure on the scholarly communication system. The reasons for this reluctance are complex and will be explored in the next chapter. The next chapter will also explore the long term implications if commercial presses are allowed to continue to prey on the scholarly communication system. During the forthcoming examination of the role of the commercial presses in the STM crises, it will be useful to keep in mind the conclusions of this chapter. Savings in scholarly communication can be achieved even when both paper and electronic version are provided and perhaps even more radical savings are possible when paper publication is dropped altogether. This discussion of the potentials for reducing the cost of distributing scholarly information will be picked up and

extended in Chapter Six.

Chapter Four: Obstacles to Reform

> I'm concerned about the way our excitement over the creation of this new information superhighway is clouding our basic common sense and our critical faculties as members of a democratic society.[1]

Introduction

Up until this point, the dissertation has primarily been concerned with outlining the positive potentials of electronic journals. After examining the problems with the scholarly communication system and its failure to adequately realise the Baconian ideal of a fully open system of scholarly communication, the electronic journal was offered as a possible solution to both the cost crises in the scholarly communication system, and the problems of access and distribution. In the last chapter it was suggested that electronic journals could vastly enhance access to, and distribution of, scholarly material. It was also suggested that electronic journals had the potential to alter the cost structure of the scholarly communication system and bring relief to an embattled library system. The potential to reduce the cost of distributing scholarly information is arguably the most revolutionary, and beneficial, aspect of electronic journals.

However, bringing reform to the system will not be an easy or straightforward task. Significant social and political obstacles stand in the way of truly reforming the scholarly communication system. It will be the task of this chapter to examine the various obstacles to reform. This analysis will include a historical overview of past calls for revolution and an examination of why early calls for reform have in general failed to bring about significant change in the system. It will be argued that initial obstacles to reform included, among other things, a lack of awareness on the part of the scholarly community, and an initial antagonism between experimental journals and traditional publishers. This lack of awareness, and the antagonism between stakeholders in the system, has impeded early progress towards alternative models of scholarly communication.

Fortunately, these early obstacles to collaboration and reform have been, or are in the process of, being overcome. It will be the task of the next chapter to outline recent initiatives that promise to bring substantial progressive reform to the scholarly communication system. As shall be seen, scholarly societies, libraries, and independent publishers are more and more beginning to push the envelope of scholarly publication. However as the pressure for reform grows, and as the possibility of substantial change becomes possible for the first time, we can expect that commercial publishers, and especially those with a stake in seeing the current profitable monopoly system extended into the electronic realm, will more and more develop resistance strategies to reduce the possibility of reform. This resistance will probably take a number of forms and will likely include the use of market power and size to achieve competitive advantage and

further entrench their monopoly position.

As shall be seen, the resistance of the commercial presses is not the only current obstacle to reforming the system. In addition to the direct interference of the commercial presses, scholars, societies, and libraries must also fight global shifts in political ideology. As noted in the introduction to this dissertation, a significant trend, with the potential to directly impact the scholarly communication system and attempts to reform it, is the rise of neoliberalism. These new political ideologies threaten to turn university spaces more and more into avenues for private profit and the boundaries between public and private spaces are erased. The broader implications of this have been explored elsewhere. [2] For our purposes here it should be noted that the threat of neoliberalism impacts on attempts to reform the scholarly communication system in at least two ways. On the one hand, new information technologies can be utilised for profit generation much more effectively than older technologies. The ability to precisely meter information flow, an ability provided by the surveillance capabilities of all information technologies, threatens to enhance in an exponential fashion the ability of private industry to charge not only libraries for information, but also individual scholars and even students. This trend, and the impact it might have on the scholarly communication system, is outlined below.

In addition to this enhanced ability to extract surplus by metering information, another significant impact of neoliberalism and its emphasis on turning public spaces into avenues for private profit, is simply governments complicity and perhaps even duplicity in the political and economic shifts. It is a truism to suggest that most governments in developed nations have, in recent decades, made significant attempts to privatise public services and create more opportunities for private property. The active participation of governments in this shift deserves commentary and cautionary notice. As noted in a previous chapter, governments in all developed nations have a stake in a healthy scholarly communication system. However it is reasonable to ask whether a government preoccupied with the ideologies of neoliberalism is capable of seeing past the general desire to privatise public space and whether or not government led initiatives may not, in the current political environment, lead down dead ends. As shall be seen towards the end of this chapter, there is reason to be concerned about this possibility.

The lesson of this chapter will be simple. After outlining past and present obstacles to reforming the system, the conclusion is drawn that true reform has awaited not only wide spread awareness of the difficulties faced by the system, but also meaningful collaboration between all stakeholders. In the final analysis, reforming the cost structures of the scholarly communication system and pushing it towards non-commercial alternatives is bucking a growing trend towards the commodification and commercialisation of not only the scholarly communication system specifically, but the university system in general. As a result, part of the preconditions for reform will be that all stakeholders, including libraries, independent publishers, university presses, and scholarly societies, work together to develop alternative systems. It will be the task of the next chapter to outline some recent initiatives and examine their potential for bringing true reform to the scholarly communication system.

The Revolution that Wasn't

As will be recalled, Chapter Three examined the potential of electronic communication to solve some of the problems of the extant communication system. Many early pioneers of electronic journals explicitly recognised the potentials inherent in electronic journals to greatly reduce the cost of scholarly information. These potentials included an extremely low cost for producing electronic texts, the high speed at which results could be distributed, and the sophisticated access functions that are possible with electronic publication as benefits likely to seriously challenge traditional models of communicating scholarly information. [3] Many were commenting on the likely demise of tradition paper based scholarly publication in the next 10 to 50 years [4] and some [5] even attempted to hasten the day when all academic publication would be done electronically and non-commercially by the scholars themselves.

This early concern to move beyond the traditional paper system of scholarly communication was based on a growing awareness of the limitations of paper based publication. As outlined in Chapter Two, traditional scholarly communication has suffered a number problems including an almost unbearable increase in material, [6] consistent and devastating rises in price, [7] and long publication delays. [8] As was noted, this problem has been exacerbated by the greed of some commercial publishers. [9] Scholars and the libraries that distribute the scholars work have recently, and after decades of not-so-quiet desperation, responded to this crisis by calling for the replacement of the for-profit system by a system controlled by the libraries and scholars themselves. [10] Ann Okerson has this to say about the early dreams of scholars and librarians:

> ...the real hope that many felt had much more to do with the possibility of altering the sociology of journal publication: ownership, control and economics. The new electronic scholarly journals were and still are local industry products. The editors were and still are more or less wholly subsidized by their academic or quasi-academic appointments, hardware, software, and network infrastructure provided at no cost to them by generous colleges and universities. In what we already call the "traditional e-journals," all the usual middlemen of publishing had been eliminated: marketing, subscription, accounting, and fulfillment functions swallowed up by the powerful listserv and distribution programs....The ethos of the new journal seemed to be the widest, freest possible distribution. [11]

These early calls for a revolution were accompanied by calls for solidarity. There seemed to be a gut sense, even before the current landscape of electronic publication emerged, that universities, scholars, and librarians would all need to come together to solve the problem. In 1989 Deana L. Astle made these comments:

> They [universities] must realize the seriousness of the threat to scholarly communication raised by information overload and the high cost of journals. Involvement must spread to all concerned until the issue is perceived not as just a "library problem," but as a

> challenge facing the entire academic and research community. Faculty, especially those who sit on journal editorial boards, must be made aware of the issues and understand how they are both part of the problem and potential players in a solution. [12]

The most forceful statement of the power of a co-ordinated effort to overcome the limitations of the current communication system is provided by James C. Thompson. His comments are based on the recognition that the real stakeholders and the real prime movers are the scholars, libraries and academic institutions. He had this to say in his editorial in the journal *College & Research Libraries*:

> In the long run, though, we hold the most important cards. The raw material of scholarly publishing, the research and writing, originates within the research community, as does the copyright to it. The commercial publishers are in the information conduit for historical and anachronistic reasons; there is no technical or economic reason why they must remain a part of it. Unthinkable as it might have seemed until very recently, the idea of the academy retaking control of the bulk of scholarly publishing is being forced into consideration by the practices of the commercial publishers themselves. Their bills simply cannot be paid indefinitely, and something must give. [13]

Unfortunately, the early calls for solidarity went largely unmet until very recently. Part of the problem, at least in these early years (between 1992 and 1997), has been a general unawareness of the severity of the problem on the part of the scholarly community. This unawareness has led to a general lack of concern over the health of the scholarly communication system. Scholars, busy with their own work, have not had the time or the inclination to become substantially involved with the scholarly communication system. This lack of attention has prompted some to charge scholars with myopia and self interest. As Charles A. Schwartz noted, with discernible frustration, in 1994:

> Scholars apparently do not fully grasp, let alone appreciate, the concept of an interdependent scholarly communication system. That concept is almost completely absent from the literature of the physical sciences, the social sciences, and the humanities. As a rule, scholars have no real interest in the organization or finance of scholarly communication beyond their own immediate needs. [14]

This lack of awareness that Schwartz points to meant that the scholarly community has been unprepared and unmotivated to initiate projects that would compete directly with the commercial presses. To be sure, some scholars, like Steven Harnad and Andrew Odylzko, have blazed the pioneers trail. But by and large these initiatives have been unique and unduplicated and the general scholarly world unaware of the difficulties faced by the scholarly communication system.

This situation has recently changed, however. At the present time it is probably safe to say that the earlier lack of awareness on the part of the scholarly community has been largely overcome. The issue of serials pricing, predatorial commercial publishers, and

the potentials of electronic communication to ease the cost crises, has been placed in the academic mainstream. The issues get regular coverage in, for example, the *Chronicle of Higher Education*. [15] This growing awareness has led, as shall be seen in the next chapter, to the recent initiation of scholarly led projects and consortia with the goal of assisting in a more rapid transformation and reform of the scholarly communication system.

However, another more fundamental obstacle to reforming the system, besides a general lack of awareness, has been the inability of traditional publishing interests (university presses, scholarly societies, etc.), independent journal editors and publishers, and scholars to work together. Ironically, up until very recently, independent publishers and traditional publishing interests have been at odds - each seeing a bit of the enemy in the other. The cause of this antagonism has been a fundamental misunderstanding between parties. Independent publishers, driven by the desire to ease the journals crisis, have overgeneralised the causes of that journal crises by seeing the crises as rooted in the predatorial practices of a handful of commercial presses. Some authors, this one included, have painted all traditional publication interests with the same brush. As a result of this failure to make key distinctions between publication interests, independents have been unwilling to pursue contact with the traditional press. In some cases they have even pursued courses of action directly antagonistic towards publication interests.

However independent publishers are not solely responsible for the lack of communication and inability to form useful and productive working relationships. For their part, traditional publishing interests have also reacted in a defensive manner to the moves of the independent publishers. In an attempt to protect both the integrity of the scholarly communication system, and their own interests in the system, some traditional interests have attacked independent efforts as unscientific and unscholarly thereby creating an enemy of those perhaps most capable of bringing direction to attempts to reform the system. A few examples might serve at this point. In 1995 Ronald E. LaPorte wrote an article in which he proposed the development of a *Global Health Information Server* modelled after Paul Ginsparg's High Energy Physics archive. [16] The details of the service are not relevant here. What is was the fact that LaPorte explicitly called for the development of a system outside of the traditional system of communication in health information and one that scholars themselves would control. The medical establishment did not respond well to his proposal. As Bernard Hibbitts notes [17]

> Laporte's proposal prompted a spirited response from the editors of the prestigious New England Journal of Medicine, who argued that the lack of preliminary peer-review in his system not only threatened to undermine "*time tested traditions*", but might potentially cost lives or cause physical harm to patients whose doctors read inadequately-reviewed literature. At the same time, the Journal moved to pre-emptively stifle any scholarly migration to the Global Health Information Server or other similar electronic archive by issuing an ill-disguised threat: "posting a manuscript....on a host

> computer to which anyone on the Internet can gain access will constitute prior publication" rendering an article ineligible for publication by the Journal itself.

It is unfortunate that the medical establishment reacted so defensively to attempts to reform the system. Yet their response is not unique. Other publishers have responded to the threat of independent publication with similar attacks. Janet H. Fisher [18] of MIT provides another example. Fisher suggests that individual scholars, because of their heavy work loads and multiple commitments, do not have the resources, expertise, time or inclination to successfully publish their own material. As a result of this, Fisher suggests that traditional interests will need to remain centrally involved in the publication process in order to provide the needed publication services to support scholarly research. Fisher develops a quite elaborate argument to justify her position. It is worth quoting at length her arguments vis a vis the independent scholarly press. [19]

> There are a few other problems with circumventing traditional publisher for electronic journals. First, what happens to the system of subsidiary publication of materials in other forms - University Microfilms, Information Access, CARL, Faxon Finder, and so on? The consolidation of licensing for all of these arrangements with the publisher would no longer be possible. Unless the journal editor was willing to handle these requests and get the necessary rights from authors, secondary publishers would have to go to each author for the right to produce the article in another form....The typical journal editor does not have the staff to handle this level of rights gathering. Second, what happens when a very important signal for tenure consideration of a researcher's work - the quality implied by a given publishers' name - is gone? Third, standards of reference citation and style, which are currently maintained by the publisher through the copy-editing process, and which make each discipline at least somewhat coherent, would deteriorate and eventually disintegrate. Fourth, who would do the marketing? Would the journal editor do it? Finally, what about indexing and abstracting sources? How will these services know what to cover in their publications and where to find it, given that currently the publisher is the one who contact them, sends samples, and maintains correspondence? There is no easy way out. The production, marketing, and dissemination of quality research material cost money. Publishers are essential to a coherent, efficient, quality publication process; unless funding is forthcoming from universities or the government, the reader - or at least a portion of the readers - must pay in order for the publisher to recover its costs.

It is worthwhile going over Fisher's arguments since many of them only make sense in the context of an outdated paper system of scholarly communication and as such are misrepresentations of the realm of electronic scholarly publication. Take, for example,

her argument about the need to distribute material in other forms. Fisher argues that collecting together the various article rights and contacting the tertiary distribution houses requires much too much work for individual editors to be able to handle. Certainly there is an element of truth to this. The type of administrative overhead required for the task Fisher identifies is substantial and individual editors could never accomplish the task alone.

However, when information is made available electronically, the type of tertiary distribution of scholarly material identified by Fisher as a requirement of paper publication may be made redundant. Indeed, various alternatives may be developed that can supplement, or even replace, tertiary publications. For example, it is reasonable to suggest that the copyright system that Fisher refers to and which requires complex rights negotiations could simply be loosened. Rather than requiring copyrights for published materials, electronic journals might simply leave the copyright in the hand of the authors and let authors handle redistribution of material. This is the approach suggested by Steven E. Koonin, provost of the California Institute of Technology, who argues that all authors at CalTech should retain full copyright of their material, rather than signing it over to the publishing houses. [20] This would allow authors to redistribute material as widely as possible thereby supplementing tertiary services.

Another alternative is to provide a very wide fair use clause that would, by default, include tertiary publication services. This would obviate the need for tracking down authors that, as Fisher suggests, is a requirement for those publishers who insist on retaining full control over published work. This seems to be the approach taken by the Association of Research Libraries. As the copyright statement on the ARL Newsletter notes, "ARL policy is to grant blanket permission to reprint any article in the newsletter for educational use as long as the source, author, issue, and page numbers are acknowledged...." In this context, authors are allowed to decide the fate of their work. For the ARL and journals with similar policies, the cost of acquiring the rights for published material is pushed out of the publication office and onto those organisations that would profit from the redistribution.

Finally, it needs to be pointed out that the whole rationale for using CARL, or Faxon or any of the other tertiary services, is to increase document access through the redistribution of material in separate mediums. The outcome of a burgeoning scholarly literature, it is no longer possible for scholars to remain aware of the literature in their fields of study without significant assistance from services designed to collate and summarise the recent literature. Because of the size of the literature, various summary services are required to alert authors of relevant material. However, the need for these services may evaporate altogether if scholarly articles are placed online and if sophisticated limited area search engines (LASE) can be developed that index these articles. In this case, any article, anywhere, whether that be on a commercial web site, or a non-profit web site, can be provided in a system of access that surpasses anything available with current secondary and tertiary services.

A good example of the possibility is provided by the Noesis search engine at http://noesis.evansville.edu/. This LASE is a freely available index of philosophical resources available on the WWW. Resources are added, by hand, to the index. An

interface is provided that allows users to search system. Unlike traditional tertiary search engines that, when searched, provided pointers to a locally held abstract and bibliographic summary of the original material, the Noesis LASE provides pointers to the *original sources* on the Internet. In addition to the added functionality provided by indexing the full source of the document, this approach, that indexes the original material, obviates the need for hunting down copyright. No redistribution of copyrighted material is required within this model of tertiary service. Because of this, the nature of the copyright held becomes largely irrelevant for secondary and tertiary indexing. Although it might be argued that publishers would resist being included in LASE engines without some formal procedure, it seems unlikely. No one, as far as this author knows, has yet requested their pages be taken out of search engines like Yahoo. In fact, quite the opposite. It is the desire of all involved in the publication process, authors and publishers alike, to increase the awareness of material. And this low cost, low overhead solution seems ideal from every perspective. The potentials of the LASE solution to bibliographic control over scholarly resources will be examined in more detail in the next chapter.

Other technologies are also available that obviate the need for the type of tertiary service Fisher argues requires additional time and cost. Fisher might be able to respond to the argument about the irrelevancy of redistribution of material by suggesting that tertiary services that collect and collate scholarly material will still be needed in order to continue to provide centralised bibliographic control and current awareness services and that editors would still be required to manage their publications interactions with these services. But again, alternate services are available that challenge traditional presses to rethink their conceptualisation of publication services. For example, services are available on the Internet, like the Url-Minder service provided by net-Mind, or the JournalMinder provided by *The Sociology Corner*, [21] that monitor Internet documents and alert readers when changes have been made. There is no time requirement for the editor and readers all over the world are alerted in the normal course of updating the journals contents. This is a simple, elegant, and completely cost-less and time-less solution to the problem of current awareness. [22]

Fisher also attacks independent publishers by arguing that the name of reputable publishing houses is an extremely important added value of the current system and a key signal in employment and advancement decisions. While this is true, it is important to remember two things. One is that publishers only achieve their reputations by relying on the expertise of editors who are themselves scholars. Who is to say that an independent editor alone, or working as part of a publication team in a university or a library, or in a globally connected collection of editors and reviewers donating their time, cannot achieve the same quality and reputation as a commercial publisher? In the second place, universities are already calling for alternative methods of evaluating published contributions that offer a more direct method of assessing the impact of scholarly contributions than provided by simple publication counts or the reputations of the journals in which the piece is published. [23] Its seems most probable that universities will settle on Citation Analysis. This methodology assesses the quality (or impact) of a scholarly piece by counting how many times the article is used (i.e., cited) by other

authors in the field. This method, although questionable on many grounds as we will see, does not rely on the reputation of a publishing house.

Finally Fisher points to the need to engage in professional marketing as a way of informing the scholarly world of new information. However this argument is questionable on a couple of grounds. On the one hand, it assumes that scholars passively sit back and wait for someone to tell them about what new information is available in their field. This is clearly untrue given what we have learned about invisible colleges and their importance. On the other hand, the argument ignores the power of information technology to automatically inform individual scholars of new developments. In the electronic world, all the "marketing" that an editor will ever have to do is done simply, quickly, and efficiently by submitting the home page of the publication to a service that announces the existence of the publication to *all* available search and indexing services on the WWW. Following this, all the available search and indexing services will extract information from the publication and index and store it in their databases. Subsequently, any individual who wants to know what journals exist in a specific area, or what is contained in their pages, will only have to do a search at any one of the numerous free services available. No effort is required and the scholarly community can benefit by eliminating the completely unproductive, wasteful, and costly practice of marketing scholarly material.

In some ways, then, traditional publication interests have reacted in a relatively defensive manner. This has been unfortunate not only because of the barriers it has erected between independent efforts and traditional houses, but also because in the push to defensively justify old system of publication, traditional interests have field to assess and understand the potentials of new information technologies. It is possible that a less defensive reaction on the part of all interested groups could have put the electronic scholarly communication system ahead of its current underdeveloped and uncoordinated state.

The irony of this early inability to communicate and discuss the potentials of electronic communication should be evident since all interested parties lose when none are able to develop coherent strategies of working together to enhance the system and contain spiralling costs. Libraries are of course hurt by this inability, but so to are scholarly societies who are also victimised by a high cost scholarly communication system. Walter Ludwig provides an example of how scholarly societies are placed at a disadvantage by the current communication system. He argues that it is possible for scholarly societies to publish their own journals and that when they do these journals can actually be significant sources of revenue for them. However, for various reasons, many societies have turned their publications over to commercial presses. After turning publication over to commercial presses, societies are actually forced to subsidise the commercial presses - meaning they lose money! Ludwig gives one instructive example of a commercial publishing house making $150,000 dollars on a society title while "the sponsoring society actually lost money on its own journal." [24]

Obviously, the antagonism between traditional publication interests and independents needs to be overcome. Both traditional interests and early pioneers can make contributions towards a more efficient system - if they chose to speak with each other.

New publishers, i.e., those experienced with the potentials of information technology, can, if they are allowed, significantly overhaul the communications infrastructure. As was pointed out by Peter Boyce in an earlier chapter, and as should be evident after discussing the limitations of Fisher's arguments, traditional publishers have been unable to adequately reconceptualise the publication process and this has hampered, in some fairly significant ways, their ability to fully exploit the potentials of IT. Independent publishers and electronic publication houses can assist in overcoming these limitations. On the other hand, new publishers are, in the final analysis, new. Because of this, they are very likely to make mistakes that would make many in the traditional publication loop wince. Independents and new publishers can benefit from the years of publication experience that scholarly societies and traditional non-profit publishers can bring to the table. Obviously, the best chance for a reformed system emerges when all stakeholders sit at the same table. New initiatives that are attempting to overcome past antagonisms are explored in the next chapter.

Commercial Presses

In the last section it was noted that two of the primary obstacles to the creation of a reformed scholarly communication system have been a lack of awareness on the part of the scholarly community and a misinformed antagonism between stakeholder organisations. As noted, the problem with lack of awareness has been overcome. More recently, the antagonism between independent publishers and traditional publication houses and scholarly societies is also showing signs of crumbling away. These two developments when taken together lend plausibility for perhaps the first time to the notion that significant reform can be brought to the system. This potential future will be explored in the next chapter. Now however there is another obstacle that stakeholders need to be aware of in order to create politically informed and potentially viable alternative publication projects.

This obstacle is, simply, the resistance and initiative of the commercial presses. It is hard to underestimate the gusto with which the commercial presses have approached the task of creating electronic versions of their journal collections. In recent years a stunning amount of commercially viable textual material has been placed on-line for purchase or direct retrieval. [25] In the U.K., the migration of commercial publishers online has been facilitated by the 1993 *SuperJournal* project. This project, funded by the British Library Research and Development Project, was specifically designed to demonstrate the potential of electronic publication to government officials, publishers, and the scientific community. [26] Similar experiments have been set up in the U.S. by such big name publishers as Elsevier (notably one of the villains in the STM journals crises) who have set up a program called *The University Licensing Program* (TULIP) that makes all 1000 Elsevier journals available electronically. [27] Springer-Verlag is also heavily involved on the Internet. They have partnered with the University of San Francisco's health sciences division, a host of commercial and society publishers, as well as major international corporations like Bell Labs and AT&T in an experimental service designed to develop a "business model for electronic journals." [28] Smaller publishers are also placing material on line. John Wiley and Sons plans to place all of its

journals (326 of them) online as does the Academic press; Taylor and France has 16 of its 125 journals online and we can assume that in the future they will place all their journals up for online access. [29]

Commercial interests have not only responded to the opportunities and threats of electronic publication by placing material online. They have also attempted to undermine the legitimacy of electronic publication and, more importantly, they have attempted to retain superfluous publication elements in an attempt to justify a high cost journal system. This attempt to define the nature and potential of electronic publication is, perhaps more than anything else, the most significant threat to reforming the scholarly communication system. If traditional publishing houses are able to convince scholars and libraries that "real" cost of electronic publication (as opposed to the "fake" costing formulas of scholars like Harnad) is equivalent to the older mode, than they will be able to maintain the current costing structures and all the disadvantages that this mode has for the scholarly system of communication.

Would commercial publishers attempt to retain a high cost system? After all, there have been thousands of words written about the potential of electronic publication to reduce the cost of scholarly communication. Successful demonstrations of the benefits of electronic publication in terms of cost, access, and speed of distribution have supplemented these words. Even some traditional paper publishers who are publishing dual versions of their journals note that the "extra cost for the electronic version is rather minimal." [30] In this environment, we might ask how traditional publication interests could even think about trying to justify a high cost electronic publication system? Yet as John Lubans suggested back in 1987, traditional publishing interests are highly motivated to retain their privileged position. Lubans [31] predicted pessimistically that "... electronic publishing may enable us to make gains in space, but not in budgets; publishers will not give up earnings regardless of how many fewer 'pages' they may 'publish' in some giant computer." A few years later, Steve Harnad [32] predicted much the same thing when he noted that the only publications that would report higher costs would be those advocating models of publication that tried to publish via the subscription model (and therefore required a top heavy bureaucracy to administrate the journal), those that offered all sorts of unnecessary frills (that the users would have to pay for), or those publishing in both the paper and the electronic realm.

There is evidence that traditional publishers are adopting high cost models that do not fully exploit the potentials of information technology to reduce the cost of the system and there is suggestive evidence that these publishers are using the high cost models to further gouge library budgets. As noted in the introduction, a recent statement issued by The International Coalition of Library Consortia (ICOLC) [33] suggests that commercial presses are creating systems that require them to charge more than 40% of the cost of paper alone. Additional suggestive evidence of this predicted trend emerging is available. Jack Meadows, David Pullinger, and Peter Such, [34] speaking from their experiences with the UK ELVYN project, make just the claims that Harnad predicted the traditional publishers would undertake. In the extract below, the authors suggest two models of publication and then, for reasons not clearly articulated in their text, suggest that it is the journal with the more varied format (i.e. the model with the

biggest tail fins) that should become the standard for electronic publication. The message is unmistakable. Electronic publication (in the sciences at least) offers no cost benefits.

> One publishing sector consists of individuals or specialist groups; the other of professional publishers. The first sector tends to emphasize electronic journals in the humanities or social sciences: the second is more likely to be concerned with STM (science, technology, and medicine) journals. Publications within the former sector consist primarily of text, whilst those from the latter incorporate graphics, mathematical equations, and extensive tabular material in their text. Creation of the latter type of electronic journal obviously requires more effort; its dissemination to readers, and their handling of it, is also likely to be more complicated. In terms of future electronic journals, it is this more varied format which should provide the prototype.

It would be senseless to suggest that there are not significant cost differences between humanities and scientific/medical journal publication or that STM publication does not cost more because of the need to represent tabular, mathematical, and other forms of labour intensive data, in publication. But it is equally erroneous to suggest that a costly STM model should be adopted for all disciplines. That amounts to a suggestion that social science and humanities publications should subsidise the high cost of the STM system by charging similar high rates. It seems reasonable to suggest that, at the very least, a two tiered system of publication might be appropriate. Conceiving of the journals system in this way would, at the very least, allow the humanities and social science system space for rethinking the journal production process with the goal of fully exploiting information technologies without being hemmed in by the notion that the STM model is appropriate for all journals. STM journal publishers could then be left to develop their models with the big tail fins. Perhaps, down the road, the cost savings and efficiencies that the social science and humanities journal system achieves can then be used as an argument for reducing the cost of the STM system.

Besides failing to adequately distinguish between the requirements of different segments of the scholarly literature, a much more direct threat to alternative publication strategies is possible if the commercial presses feel threatened enough. In order to de-legitimate alternative distribution systems, commercial presses might use their significant market clout to push the scholarly communication system in directions that would unfairly disadvantage alternative providers.

It would be naïve to think that such an eventuality is not possible. There is evidence to suggest that the commercial presses can and will use their monopoly power to reduce the possibility of reforming the system if they feel the threat is great enough. As noted in introduction to this dissertation, large commercial firms have already demonstrated their willingness to merge and exploit their monopoly position to increase their ability to extract profit from the scholarly community. In addition, there is strong evidence to suggest that such actions do indeed increase a firm's market power.[35] However, there are other examples that also suggest that there is a danger to be guarded against.

Dennis P. Carrigan provides one example[36] when he notes that commercial presses can use their market position to push libraries to buy subscriptions to journals even when they do not necessarily wish to. As Carrigan notes, subscription funding is the preferred method of revenue generation for the commercial presses because it guarantees a predictable and regular stream of funds to the journal owners. On the other hand, libraries prefer document delivery in some cases since it allows them to provide cost effective access to the material in low-demand publications without having to purchase a local copy. As Dennis Carrigan explains, [37] the distaste of commercial presses for document delivery may mean its eventual suppression.

> The University of Kentucky libraries recently experienced a publisher's ability to influence the choice between the ownership and access service models. Several library clients asked the interlibrary loan office, which also handles document delivery, to obtain for them articles from the same journal, to which the library did not subscribe. When the office reached the limit of five copies permitted under the CONTU guidelines, it turned to a document supplier to meet the next request for an article from the journal. When the article copy arrived, the interlibrary loan office was shocked at the fee charged by the supplier, and when the office looked into the matter it learned that the copyright royalty fee was $10 per page. The library decided to subscribe to the journal.....Although such experiences may be infrequent at this time, they can be expected to increase, as the shift from ownership to access grows, and to exert an increasing influence on libraries' decisions. [38]

There are other areas where commercial presses can wield substantial power over both libraries and alternative press projects thereby weakening alternatives. For example, commercial publishing houses that have been around for a long time enjoy the competitive advantage of having a large back library of academic content to draw on in order to provide value added service. As Malcolm Getz [39] notes, this may give the large publishing houses, if they choose to use it, a considerable advantage in the online environment.

> Moreover, the present advantages enjoyed by the multititle publisher may well persist and even increase in the electronic arena. Access to targeted mailing lists, multititle advantages in advertising and distribution, and the ability to integrate new publications into the logical context of large databases may give significant advantages to the large publisher supporting titles in many related micro-disciplines. The upshot may be that, after an era of experimentation, the market for scientific publication will be no more competitive than today, and perhaps even less competitive. The gap between market price and incremental cost may be wider in the electronic world than in the print world.

This later threat, that commercial presses will develop online linked libraries, is a

significant threat to the viability of alternative publication projects or even society projects. Unlike the publication of single run journals, the creation of interlinked resources, and the ability to move old material online to enhance accessibility, are incredibly costly. Yet they are ultimately desirable since they increase the utility of the scholarly literature. Independent publishers, and even small societies, are unlikely to have the resource base by themselves to move significant amounts of material online or to create interlinked resource libraries. This inability to leverage economies of scale is a significant disadvantage that is likely to increase the desirability of commercial solutions even if they continue to charge excessively for their resources.

This ability to offer enhanced systems, coupled with their market power, and their ability to leverage economies of scale, may mean that scholarly societies and individual journal editors will be unable to compete with the value added services of commercial presses. This inability may be a critical weakness especially as the predatorial publishing houses move to consolidate their operations and exploit the lucrative potentials of electronic scholarly publication. Indeed, commercial presses seem to have realised that their principle strength comes from the size of their operations and their ability to leverage economies of scale and historical archives and they are currently moving to increase their size. In their own words, the big publishing houses are currently positioning themselves in order that they may exploit "attractive" opportunities in the scholarly communication market. For example, Reed Elsevier plc has recently announced that it will divest itself of IPC Magazines (a distributor of consumer magazines). This divestiture would allow Reed Elsevier to focus on developing a strategy of increasing its ability to exploit the "high value-added areas of 'must have' information" at the same time that it reduces is "exposure to consumer markets." As the cited press release indicates, "The proceeds [of the divestiture] would be used for future development of and acquisitions within Reed Elsevier's core Scientific, Professional and Business Divisions and would provide the company with greater flexibility to respond to attractive growth opportunities as and when they arise." [40]

Certainly, these recent events would suggest that commercial presses are not currently intimidated by the "revolutionary" potentials of electronic publication. And from the foregoing it is easy to see why. The ability of large commercial presses to engage in a war of attrition, and their ability to raise the entrance barrier by leveraging economies of scale and creating models of scholarly communication with "big tail fins," would seem to suggest that the way towards creating high-access and low-cost alternatives may be effectively blocked. However, the picture may even be grimmer than suggested thus far. In addition to the obstacles outlined above, there are broader political and ideological shifts that favour moves away from communalism and low cost, non profit alternatives in the scholarly communication system, and towards commercialised scholarly communication. It is to an examination of these ideological shifts that we turn to next.

Political Shifts

> Already some "bottom-line educators" are wondering whether there is a need for traditional library schools. Who needs librarians,

> educated according to a social ethic, if information can be supplied by entrepreneurs and private business unencumbered by social principles? An opaque word, "disintermediation," is coming into use to obscure a very transparent process by which librarians may lose their jobs in the future.[41]

Thus far this chapter has discussed the antagonism of independent publishers and the traditional presses, and the practices of commercial presses, as significant obstacles to bringing reform to the system. These are, of course, significant obstacles. However as noted in closing the last section, other factors push against attempts to reform the system. These factors, which include a global shift to the political right and the rise of neoliberal politics, threaten to undermine the progressive potentials of information technology. This means, in short, that attempts to strengthen non commercial alternatives will face resistance from unusual quarters. This is of course not to suggest that there are direct links between neoliberalism, commercialisation, and the scholarly communication system. However global trends in the use of information technology, and a general push to expand the arena for private profit and accumulation bring strong indirect pressure to bear on the scholarly communication system. This indirect pressure can create obstacles and barriers to significant reform of the scholarly communication system that, while not totally cutting off the potential for reform, does require we anticipate the obstacles and find routes around them.

This dissertation has spoken at length about the potentials of information technology to enhance the scholarly communication system by lowering cost, increasing access, and providing opportunities for weakening the globally stratified system of science. However, much more than other forms of technology, information technology is an extremely flexible medium. This flexibility makes IT a double-edged sword. Not only is there great potential for reform, but there is also potential to enhance the worst aspects of the current system. To put it bluntly, in addition to providing the opportunity to reduce the cost of information transmittal, IT also carries with it the potential to expand the horizons for making information profitable. As Schiller argues, business interests have largely seen the ability of the computer to store, collate, transact, and record activity as a powerful tool for metering information. This means, essentially, that as IT progresses, capital will have more and more opportunity to generate profit off of information by precisely controlling its flow. As Schiller notes of this development and potential:

> In a very short time, data, if organized, accessible, and capable of being provided in manipulable and discrete units, became valuable....The commercial potential of these new information possibilities was quickly seen. It led in a few short years to the creation of an information industry whose firms produce, process, package, distribute, and retail information products and services such as legal decisions and texts, commodity and stock prices, specialized industrial statistics, government legislation, and increasingly sophisticated programs for business and individual computer use. [42]

This ability to meter information meshes well with the growing emphasis on turning profitable opportunities in the academies of higher learning and may well lead to further difficulties for libraries and other stakeholders. As some authors have noted, government and business have moved increasingly towards the disarticulation of the social norms that underlie free and equitable access to information towards increased legitimisation and acceptance of private sector role in information creation and distribution of information. [43] There are many manifestations of the move to "disarticulate" the social roots of public education and turn it into a private resource. Some of these have been explored elsewhere,[44] however the most powerful recent statement of the political shift and its implications was given at a World Conference on Higher Education at the UNESCO headquarters in Paris in 1998. At this conference, the agenda of UNESCO was pushed aside in favour of a vision of higher education that sees it privatised, restricted, and sold to the highest bidder. In their *The Financing and Management of Higher Education: A Status Report on Worldwide Reforms*, the World Bank states explicitly the roots of reform in neoliberal politics and the long term goals. As the authors of the report state, "The reform agenda of the 90s, and almost certainly extending well into the next century, is oriented to the market rather than to public ownership or to governmental planning and regulation. Underlying the market orientation of tertiary education is the ascendance, almost worldwide, of market capitalism and the principles of neo-liberal economics." [45]

In this report the difficulties faced by the system of tertiary education, and the long term goals and agenda of the World Bank, are explicitly stated. Couched in traditional neoliberal rhetoric that decries the inefficiency of public sector solutions, the report offers "radical restructuring" of the education system, and the move toward private sector solutions, as the only viable alternative. It is worth quoting at length to give some flavour of what "radical restructuring" actually means for students, instructors, and others with a stake in a public system of higher education.

> A radical change in any organization affects its mission, skills and other attributes, as well as the number of workers employed. Radical change, or restructuring, of an institution of higher education means either fewer and/or different faculty, professional staff, and support workers. This means lay-offs, forced early retirements, or major retraining and reassignment, as in: the closure of inefficient or ineffective institutions; the merger of quality institutions that merely lack a critical mass of operations to make them cost-effective; and the radical alteration of the mission and production function of an institution—which means radically altering who the faculty are, how they behave, the way they are organized, and the way they work and are compensated....

The report goes on to note that, of course...

> Radical change tends to be resisted by workers and management alike, quite apart from the need for, or appropriateness of, the change itself. Restructuring is exceptionally difficult because public sector employees tend to be either civil service employees or to be

> political appointees or at least politically active, and they are difficult to persuade. In the case of public universities, the faculty have additional means with which to resist threats of radical change and job loss: the idea of the university as a proper and necessary bastion of continuity and tradition; the tradition of academic freedom; and the army of students, former students, and would-be students, most of whom are articulate, energetic, politically volatile, and generally able to be enlisted in the cause of opposing the government's efforts to radically alter *their* university.
>
> Yet, while public universities resist radical change, they are not immune to the loss of large amounts of public revenue occasioned by the forces listed above. In fact, the very short-term robustness of the university—its seeming ability to "make do" with larger and larger classes, or part time, low-paid lecturers, or without replacing laboratory equipment or replenishing the library, or by admitting more fee-paying students, or by diverting faculty energies to entrepreneurial activities—may be its worst enemy in the competition for increasingly scarce public revenues. These short-term "fixes" sometimes allow the government or the ministry to cut the funds to the public institutions without coming to grips with the need to close down inefficient campuses, or lay off faculty no longer relevant to the needs of the students, the economy, or for that matter of the university. [46]

A full analysis of the impact of neoliberalism and higher education is beyond the scope of this work and the above is included only to demonstrate the extent to which there is a systematic, global agenda at work. Drawing out the implications of this, and the depth to which the education systems of North and South have already been altered by the neoliberal agenda, is left to others. What does concern us here is how these neoliberal shifts are trickling down and affecting the scholarly communication system. The argument is simply that shifts in government policy provide substantial barriers against progressive reform. These shifts are having important consequences as libraries are forced, for example, to shift resources from social use acquisitions (journals, books) towards increased reliance on IT mediated services that allow greater opportunity for commercial profit. The pressure from business to adopt new services is often couched in terms of the need to increase efficiency of library distribution systems. However, these intrusions are more and more being recognised as bringing about a shift of resources to for-profit, user-pay services and towards generating increased reliance on these alternative information sources. As Herbert Schiller notes: [47]

> In recent years, libraries are increasingly being put into the position of adjunct to and facilitator for the commercial information industry. Despite an initial reluctance to become involved in commercial practices - i.e., charging users for information, relying on private vendors for data bases, contracting out functions to private firms, etc. - libraries now almost routinely adopt such

> practices. Meanwhile, the distinction between a library and a commercial enterprise narrows.

The impact of disarticulation of social norms and the neoliberal shift (which makes profit in public spaces acceptable) is trickling down to scholars and libraries in other ways as well. For example, industry is currently seeking out ways to make the distribution of scholarly material more profitable. One of the models that publishers are currently thinking about, and the one that seems the most popular when dealing with institutions like libraries, is one based on site licenses. Site licenses for journals would essentially allow subscribing institutions and their patrons unlimited access to the complete set, or perhaps a subset, of the periodicals that a publisher distributes. Gary Taubes [48] notes:

> Once they begin charging, many of the publishers are currently planning to sell subscriptions to their on-line journals through so-called site licenses, which will allow unlimited and unrestricted access for users who log in from subscribing institutions. To set a price for these site licenses, publishers are contemplating one of two formulas: either offer them free to print subscribers or, as Bob Kelley of the American Physical Society describes it, "charge a little more for both paper and electronic, and a little less if electronic " or paper only.

This model of offering subscriptions has certain benefits. For example, journals will essentially never be off the shelf. Their contents will always be accessible by anyone who logs on with the institutions Internet domain name. However it is clear that this model will not cost the libraries less and it certainly may end up costing libraries more if publishers charge additional fees for access to both print and electronic journals. It is even conceivable that the subscription rates for fully electronic journals (i.e., with no print version) will be higher since publishers will more easily be able to justify higher subscriptions based on the value added brought to the institution by unlimited access, powerful search tools, and comprehensive journal collections. Because of these value added functions of electronic journals, it is conceivable that a journal that costs $1000 per year in the paper realm would cost an additional 5%, 10%, or even 40% or more in the electronic realm. And, it is even conceivable that the big commercial publishers might use their market position to force libraries to purchase both versions of a journal thereby exacerbating current weaknesses in the system.

A recent statement issued by The International Coalition of Library Consortia (ICOLC) [49] confirms what appears to be a widespread concern (the ICOLC statements is signed by over 40 consortia and organisations representing thousands of libraries world wide). The ICOLC statement suggests that some publishers are using their growing monopoly position and control over the scholarly communication system to force libraries against the financial wall. According to the ICOLC, libraries are being forced to purchase both paper and electronic versions of some journals at rates that are higher than the standard print cost and at rates that the coalition fears will eventually add as much as 40% or more to the cost of scholarly material in journals. In a press release that introduced the statement, the ICOLC notes:

> The explosion in electronic licensing, the wide variance in publisher practices, rapidly escalating prices, and a concern about the reduction in the number of independent scholarly information providers all served as the impetus for the statement. The Statement calls for developing multiple pricing models, separating charges for electronic licenses from those of paper subscriptions, and lowering the cost for the electronic information below that of print subscriptions. ICOLC expresses its concern over the growing practice of publishers that levy initial surcharges on electronic information, which is compounded by significant multi-year inflation surcharges and prohibitions against libraries canceling print versions of journal titles. As a result, while libraries may receive access to a larger array of titles by paying the "print price plus electronic subscription cost plus inflation," the total base price for electronic access over the print subscription could increase by 40% or more within as little as three or four years (ICOLC, 1998).

However, it is not only that publishers may be able to corner libraries and force them to buy into subscription arrangements that are detrimental. Commercial publishers also stand to benefit from their increasing ability, brought by advanced information technologies, to shift the burden of payment directly onto the shoulders of the users. Some commentators feel that this is an extremely likely possibility. Gerard M. Van Trier, [50] for example, fully expects publishers to exploit a direct market to consumers of information as it becomes available. Dennis P. Carrigan [51] notes that some form of direct purchase is a definite desire of many information providers because it represents a vastly expanded market for information.

> Moreover, payment for the service can be made not only from a depository account but also by VISA, MasterCharge, or American Express card, another feature that is spreading and that opens the way for individuals to deal directly with document delivery organizations. According to Martha Whittaker, general manager of the UnCover Co: 'We believe that the real growth market in article delivery is the consumer - or 'end user'. We are developing strategies to reach the individual researcher, faculty member, and ultimately, the person sitting in any office anywhere with a computer and modem.

By all indications, this direct market will be upon us very quickly. Marvin A. Shirbu [52] reports on an experiment with the sort of technology required to institute direct user billing being conducted at Carnegie Mellon University. Called *NetBill*, the technology allows authenticated and almost transparent transactions to take place on the Internet. Transaction costs are extremely low (as low as 1 cent per item) and the technology has the capability of charging as little as 10 cents per page and maybe even less. The technology is ideally suitable for scholarly publication in as much as it will allow publishers to charge scholars for individual articles, data files, or any other subsidiary information that they feel scholars might be interested in. NetBill was designated to go

into pre-commercial trials in the fall of 1995 so by now it may even be in commercial experimentation.

This technology, or some variant of it, may be a gold mine for commercial publishers. As Gary Taubes notes, online services provide a wealth of opportunities for shifting the financial burden to the user. [53] "As journals become increasingly interconnected, researchers will find themselves hot-linking from one cited or related article to the next, regardless of who the original publisher happens to have been." People will find themselves buying articles and related sources material from almost every publisher on the Internet. And what is worse, the technology is being designed to be as transparent to the user as possible. Debits are made from a central account and software will have an auto pay function that allows users to set a lower limit (say 20 cents per page) below which information items are purchased automatically.

The major disadvantage with this move is that scholars will be one of the hardest hit. This will be especially true in some disciplines since we can fully expect, given the ongoing trend of libraries to cut subscriptions, that it will become necessary for the individual scholar to support esoteric publications that might be highly relevant to a small group of researchers but that are not fortunate enough to make it into the core periodicals list of the nations libraries. Duane E. Webster and Mary E. Jackson, [54] speaking about the ongoing push for libraries to provide access to material, suggest the likelihood of this scenario.

> Recent studies suggest that institutions acting together to implement the access model may satisfy short-term needs of the faculty and administration but over the long term will damage and weaken scholarly communication. Without collective action the nation's information resources will become more and more limited. The availability of esoteric, foreign language imprints and lesser-used information will diminish and as a result the scope and richness of available collections will decline. If libraries continue to reduce collection development to focus only on local and immediate needs, then the "commons" that scholars rely on will become impoverished.

We may see a two tiered system of publication emerge. The highly popular journals in the sciences will be licensed to institutions and be freely available to faculty and students. Some journals in the social sciences, and many in the humanities, because they do not have a sufficient readership or are not used on a regular basis, will be cut from library acquisitions lists and only be accessible through services like NetBill where scholars can purchase individual articles. A worst case scenario would find those unfortunate scholars in areas that are not that popular unsuccessfully battling for increased per diems for information purchase. At the same time, the inability to support esoteric publication would eventually doom the journals. If a journal cannot secure library subscriptions, and if only a handful of scholars are interested enough to support the publication financially, then the long term financial health of the journal remains in doubt. Literature may simply disappear as Webster and Jackson suggest above.

However, the disadvantages are not just about scholars worried that their subsidy will be eliminated. Moving away from collective information services (i.e., libraries) to individually funded services will have a serious impact on the quality and cost of education. The accessibility of much information will be reduced with the new commercial models since only users who can pay will be able to access it. Universities will almost certainly not subsidise their undergraduate's access to current information in journals not locally held. Moreover, even if universities subsidise the access of their graduate students to the information they need, the decisions are likely to be made on a per-institution basis. Wealthier institutions will be able to subsidise this access while smaller institutions will shift the burden onto the students. This will exacerbate an already existing hierarchy in the U.S. and perhaps even contribute to the creation of a similar hierarchy in countries like Canada. [55]

What is being described here is the creation of market system for scholarly information. Of course, a part of what is being suggested here is purely speculative. The worst effects, like the devolution of payment onto the shoulders of individual information purchases or the evaporation of parts of the scholarly corpus, have not been fully realised. However, the potential is certainly there and nothing about information technology necessarily prohibits the realisation of such a system of information distribution. Indeed, it is possible to argue that given the political agenda that seems to be informing much educational restructuring, there is significant pressure, and support amongst decision makers, for pushing the system towards commercial alternatives and away from non-commercial, low cost solutions. It is worth returning to the World Bank Report cited above since its authors give a clear indication of the "desirability" of market based solutions to the problems plaguing higher education.

> Higher education meets many of the conditions identified by Barr as characteristic of a private good, amenable to the forces of the market. First, higher education can not be treated as a purely public good. That is because it exhibits conditions of rivalness (limited supply), excludability (often available for a price), and, rejection (not demanded by all)--all of which do not meet the characteristics of a purely public good, but reflect at least some important conditions of a private good. Second, the consumers of higher education are reasonably well informed and the providers are often ill informed--conditions which are ideal for market forces to operate. This market orientation has lead to elements of the reform agenda such as tuition, which shifts some of the higher education cost burden from taxpayers to parents and students, who are the ultimate beneficiaries of higher education, more nearly full cost fees for institutionally-provided room and board, and more nearly market rates of interest on student loans, all of which rely upon market choices to signal worth and true trade-offs.

As the above quotation indicates, there is a generalised push to commodify higher education. This generalised shift in orientation makes it extremely difficult to offer viable non-commercial alternatives. Of course, the lesson here is not that progressive

reform is impossible. It is just that in the current environment, progressive reform is difficult and bucks a global shift away from low cost, public sector orientations towards higher education.

A good example of the implications of this for attempts to reform the system is provided by a consideration of actual attempts to reform the Canadian system of scholarly communication. Seeking to develop a journal infrastructure for its member journals to experiment with electronic publication, the Canadian Association of Learned Journals (CALJ) had spent considerable time and effort negotiating with Industry Canada to develop an infrastructure to support the conversion of traditional journals into electronic format. The idea was to leverage economies of scale in a centralised location to offer various publication services to member journals that would ease the transition of member journals to electronic formats. It was a great idea and one fully informed by the awareness of the need to both exploit new technologies and reform an unhealthy system.

Unfortunately, this effort has stalled because, as Alvin Finkel of the CALJ suggests, it was Industry Canada's intent to create a monopoly structure for journal production in Canada. This is an interesting charge and coincides perfectly with the argument made above about the impact of neoliberalism of the scholarly communication system. Clearly, the government of Canada has an agenda that it would like to see realised despite the fact that the agenda is unacceptable to the CALJ and its member journals. As Finkel says in a response to the Director of the Industry Canada journals project, the creation of such a monopoly is counterproductive and not in the interests of Canadian Journals. Finkel notes:

> We found quite insulting your claim that funds given to journals to choose an appropriate e- publisher provide a less acceptable form of public expenditure than the monopoly set-up with a publisher that you propose. Either the intention of this project is to encourage and aid journals to "go electronic" or the intention is to create a monopoly of e-publication in the hands of a single publisher. Your intention at the moment appears to be the latter and, in the interests of our members, we have no option but to oppose the project in the form you envisage. While we understand that Industry Canada has the right to exclude CALJ as a partner, we don't accept that Industry Canada has a right to establish a project ostensibly in the interests of academic journals that in fact enjoys little support within the journal community. [56]

Arguably, the approach taken by Industry Canada to localise expertise and control over the scholarly communication system into the hands of a single publisher is counterproductive and likely to lead to high cost and lack of competition. Logically, it does not make any sense as any librarian who has followed the cost crunch caused by monopoly control of the scholarly journals system will tell you. However, in the context of global attempts to reform the educational system, and in the context of what we know to be the intentions of conservative and powerful institutions like the World Bank, it seems reasonable to suggest that the strategy adopted by Industry Canada, i.e.,

to develop a centralised monopoly production system, is complicit with the broader neoliberal agenda. In this context, the actions of Industry Canada make perfect sense. That is, it is reasonable to suggest that the goal of Industry Canada in creating a centralised journals infrastructure is to create an infrastructure amenable to central monopoly control by a single commercial provider. In this way, the journals system in Canada could more easily be turned towards for-profit, private sector production.

Conclusions

The lesson to be drawn from this chapter is simple. Attempting to reform the system in ways that make sense for those with interests in that system, e.g., students, professors, editors, libraries, is difficult in the current environment. The competitive advantage that large commercial publishers have, the general push towards metering information and making it saleable and profitable (a direction antagonistic to attempts to utilise technology to enhance access), the global political agenda to "radically restructure" higher education, and the apparent complicity and duplicity of government initiatives, moves us in directions where progressive reform of the system will be difficult.

There is a significant irony here. As this dissertation has argued throughout, technology and electronic journals bring considerable power and potential for enhancing and reforming the scholarly communication system. Not only might electronic communication enhance access and lower cost, but the net result of these potential reforms could be a much closer realisation of the early Baconian ideal of an open and widely accessible scholarly communication system. Unfortunately, as we have seen, technology also brings with it the potential to move the system further towards commercialism and private profit. The ability to precisely control and meter information, and the global push to privatise tertiary education and create opportunities for private profit, means that technology can, and is, being used in ways that enhance the neoliberal political agenda. As the experience of the CALJ indicates, these trends are to the detriment of most major stakeholders in the system.

All this is not to suggest that reform is not possible. Indeed, the next chapter will examine some promising attempts to bring positive change to the system. However as noted in the next chapter, these initiatives have potential only insofar as they adequately address the threats outlined in this chapter. That is, any initiatives designed to bring positive reform will fail unless they adequately address the need to provide value added services, economies of scale, and centralised production in order to compete with the commercial presses. Initiatives will also fail unless they admit that a hostile political environment makes reform difficult. Only then will the development of alternative systems stand a chance of pushing the scholarly communication system away from further commercialisation and towards models of distribution that provide more open and equitable access to the world's scholarly resources.

Chapter Five - Bringing Reform to the Scholarly Communication System: Alternative Models

Introduction

In the last chapter it was noted that despite both the need for reform created by a high cost scholarly communication system, and the potential for reform inherent in information technologies, significant obstacles remain to impede attempts to bring change to the scholarly communication system. These obstacles included an inability for various stakeholders to work together, the resistance of the commercial presses to what they most likely perceive as a threat to their continued existence, and a global neoliberal agenda pushing the institutions of higher education away from a public service ethic and towards an ideology that emphasises private profit and market orientation.

The costs of failing to reform the system have also been noted throughout this dissertation. Rising costs for distributing scholarly information, declining access to the world's scientific output (especially in developing nations), the development of a tiered communication system, and a decline in educational quality, are all potentials if the system continues to move towards commercialisation and higher cost. This scenario has not gone unnoticed. Many have chosen to raise their voices against ongoing commercialisation over the years. Appeals for reform have been, over the years, frequent and increasingly resounding.

These appeals have not gone unanswered. For example, Clifford A. Lynch notes that some universities are now turning their attention to revitalising their academic presses. Because academic presses have been traditionally concerned with distributing material that is not profitable enough to find outlets in the commercial press, and because new technology might allow them, through reduced costs, to again offer this vital service to the academic community, the outcome of this growing concern might go a long way towards revitalising the esoteric press. As Lynch notes: [1]

> Ironically, universities, reacting the to increasingly intolerable costs of acquiring scholarly information from commercial publishers, are now asking whether their university presses can play a greater role in making scholarly information available at lower costs to the research and education communities. This is exactly what the university presses were supposed to be doing, before their parent institutions told them to act like commercial publishers.

In order to actuate this scenario, Lynch notes that a co-ordinated effort needs to be developed. University presses, scholars, societies, and libraries all have to become involved in the planning of the new scholarly communication system. And what is

more, there has to be awareness on the part of all concerned that the scholarly communication system should not be designed with profit as the primary goal. This awareness seems slowly to be developing.

The bulk of this chapter and the next will examine a recently announced international effort to bring a politically informed alternative to the high priced commercial presses. This consortium, named the International Consortium for Alternative Academic Publication (ICAAP), has as its explicit goal the elimination of technological, social, and political barriers to reforming the scholarly communication system. As will be seen, the consortium, under the direction of this author, has made progress, primarily technological, towards creating an alternative infrastructure for scholarly communication. It is hoped that the technological progress made at ICAAP will contribute, in turn, to an unambiguous and strong re-evaluation of the potentials inherent of technology. However, before moving into a closer examination of the advances of ICAAP, it is worthwhile examining in more detail initiatives that predated and have informed the creation of ICAAP.

Early Models of Reform

Besides the recent interest of academic presses in reforming the system, there have been other attempts to rethink the scholarly communication system. Over the years, commentators have, in general, emphasised the key role of the central information providers (i.e., authors and societies) and distributors (i.e., libraries) in making meaningful change in the scholarly communication process. That is, commentators have noted that if real reform were to take place, those outside of the commercial mainstream would have to effect that change. This perspective, that pushes responsibility for reform closer to where the actual stakeholders live, can be called a "craft model" or craft paradigm of scholarly reform and publication because the principle emphasise in on eliminating people in the middle and devolving responsibility for distributing scholarly communication onto those most closely associated with the system. In the craft model, the actual producers and consumers of scholarly information are made responsible for its distribution.

Libraries and information specialists have been at the forefront of discussions of new models of scholarly communication. Early models of reform put forward by this group generally focused upon the need to circumvent the regular subscription system and add "access options" that would allow for more flexible purchase and delivery of library material. One early approach emphasised the need to move, because of financial pressure, towards an *access*, as opposed to an *ownership*, model of information delivery. [2] The ownership model emphasises the ability of libraries to purchase the total universe of material in their areas of speciality. However as many commentators point out, with soaring cost and rapid proliferation of all types of content, that is no longer possible. [3] The access model emphasises the exploitation of network technologies and corporate licensing agreements in order to provide "timely, rapid, and electronic assess [sic] to scholarly resources held by other libraries and document suppliers world wide. [4]

There are three alternative approaches to providing "access" to scholarly materials none

of which are mutually exclusive. [5] On the one hand, regional libraries can co-operate to provide document access. This can be done in one of two ways. The first way is to develop consortiums and co-operative lending arrangements between local or regional libraries. [6] Because information technologies make document retrieval and transmission to remote libraries simple, the logistical difficulties of interlibrary loans are eliminated. In the mid seventies to early eighties, this led to the creation of fifty-three regional consortia. [7] More recently, large umbrella organisations have taken a more active role in organising their member institutions in order to develop co-operative lending agreements and ILL (interlibrary loan) services. [8]

Unfortunately, this approach to the serials crisis is not as effective as one might think. As Dennis Carrigan [9] has pointed out, it is a relatively costly solution since the average cost of an interlibrary loan (taking into account administrative and transfer costs to both libraries) is over twenty-nine dollars per article. In any case, given the ongoing concern in the literature with the crisis in scholarly communication, and the decades long experiment in co-operative lending which still has not significantly reduced the literature decrying the scholarly information crisis, consortia are clearly not an adequate solution, in and of themselves, to the library crisis

An additional approach, still well within the access model, that is being investigated and successfully implemented is for libraries to provide access to document delivery services. [10] Although, as Carrigan points out, this approach generally tends to be cheaper than interlibrary loans "especially if delay is assigned a cost," there are still fees for the service and, unlike interlibrary loans were the charges are absorbed as part off the libraries operating budget, document delivery charges show up as fees to be paid out of the capital pool of the library.[11]

The final alternative approach to providing increased access is provided by direct electronic access to entire journal collections. Publishers can provide an arrangement similar to how software is now provided with a site license to major institutions. Software that is licensed to an institution can be used freely by all members of that institution on an unlimited number of machines. SPSSX, the statistics software popular among social sciences, provides such site licenses to institutions. This enables specific institutions to include the software in all their computer labs, and also allows them to provide take home copies for their staff, faculty, and students at greatly reduced rates. The same model can be applied, [12] and no doubt will be applied, for accessing electronic journals. Libraries will be required to pay a fixed fee for unlimited access to a range of electronic material. Putting aside concerns about cost, the potential for better patron access is enormous. Electronic journals are never "of the shelf." A single copy of the journal can be read by numerous patrons in different locations simultaneously. Links in OPAC can be 'live' and the processing of interlibrary loans becomes trivial. [13]

While all these electronic bells and whistles will no doubt enable libraries to improve their levels of service and their ability to provide timely access to material, it is clear now that this new publication paradigm will not result in reduced costs. In the first place, a complete shift to an electronic library is unlikely in the near or even moderately distant future. At least for the next 10 years, [14] and probably for considerably longer, libraries will have to deal with a combination of traditional and electronic document

systems. Libraries may then have the added burden of maintaining traditional collections while purchasing the necessary equipment infrastructure that will enable them to provide electronic access. On the other hand, as we have seen, commercial presses are in fact using access and electronic publication as a way of increasing the cost to libraries. Commercial publishers are, as many have noted, unwilling to give up their hegemonic control over the scholarly distribution system.

Clearly, a more active approach will be needed if meaningful reform is to be achieved. This seems to have been recently recognised by the Association of Research Libraries (ARL) and associated organisations. Frank Quinn and Gail McMillan [15] outline a plan, based on the example of the University of Virginia's text centre, [16] whereby libraries themselves would produce and distribute journal title. Quinn and McMillan suggest that for $200,000 a year, a single library would be able to support up to 200 individual journals. This is a striking figure that puts the cost of each journal at $1000 per title or about $62 per paper if we assume 16 papers a year. Assuming that their calculations are correct, if enough libraries decided to pursue this option, and each library provided free access to its titles, such a strategy might go along way to reducing the cost of the system and increasing access. The authors note that if 50 libraries pursued the same goal, the consortium would be able to provide unrestricted access to all journals in the network for an institutional cost of less than $15 per title.

There is considerable research and development that would need to be undertaken by the library and scholarly community before such a centralised publication strategy could emerge. However, libraries need not attempt to develop such a comprehensive publication strategy initially. Individual attempts to compete with the commercial presses can significantly shift the ground. Significantly, there have been moves in this direction. As noted in the introduction to this dissertation, the ICOLC has recently made its political position vis a vis the commercial presses clear. Following on this announcement, the American Chemical Society and a coalition of university libraries has agreed to publish a journal title that competes directly with the high priced commercial title Tetrahedron Letters. [17] This attempt to replace the high priced Elsevier title sets an important precedent. Not only does it unite societies with libraries in publishing efforts for perhaps the first time, but it unequivocally creates an active role for libraries in the scholarly communication system.

Contours of a Reformed Scholarly Communication System

> The same idea has been bandied about by university leaders and head librarians in the United States for the past year. But the consortium... may be the first large-scale project designed to encourage scholars to publish their work on their own.
>
> Lisa Guernsey writing about ICAAP - Chronicle of Higher Education, 1998

Clearly, for those considering reforming the scholarly communication system, the preference has been for a move away from reactive strategies like providing access options to more proactive strategies. Indeed, as Lisa Guernsey notes in the above

quotation, as the past year has gone by, individuals in top-level positions are beginning to see the need for a co-ordinated and active resistance. The more active approach that has been pioneered by centres like the Virginia Text Centre, and the ICOLC's attempt to compete with Elsevier, prefigures the formation of the International Consortium for Alternative Academic Publication. ICAAP is an international consortium of scholars, libraries, and programmers, based at Athabasca University, [18] and devoted to demonstrating that high a quality scholarly communication system can be created without the high cost of the old paper based system. The vision of ICAAP is simple – create an infrastructure that centralises many, or most, of the technological, R&D and support functions of traditional publishing houses at a central location, and offer ICAAP expertise, services and tools freely and openly to all those seeking to develop a non commercial alternative to the current system of distributing scholarly information. The ICAAP funding will be discussed in the next chapter.

There are several components necessary to successfully implement a strategy for creating a viable alternative structure for scholarly communication. It is envisioned that these components will work in tandem to allow a low cost, but high quality, publication system to emerge. These components, which will be discussed in turn below, include relying on open source software to provide the basic software infrastructure components, leveraging economies of scale when possible, relying on "centres of excellence" to provide some of the basic infrastructure services required for electronic scholarly production, and developing a distributed expertise capable of fully exploiting the potentials inherent in information technology. The overall strategy is to create the preconditions whereby both individual scholars, and scholarly societies, can easily and quickly move from paper based publication, to electronic only or electronic plus paper, with little or no significant cost. Each of the platforms in the ICAAP infrastructure strategy will be explored in more detail below. In the next chapter, the implications of this model of scholarly communication will be discussed in more detail.

Reliance on open source software.

One of the key components in the ICAAP strategy of building a low cost scholarly journals infrastructure revolves around exploiting Open Source software. Open Source software is, essentially, free software developed in a globally distributed software development environment. The phrase "Open Source" means that the computer source code used to compile and create software programs is freely available to all interested developers. Open source is often contrasted with commercial models of software development that "close" access to the source code and copyright it as intellectual property so that only those affiliated with the developing organisations have access to, and can modify, the code. Open source software has been around, under various names, since the late sixties when engineers first conceived of and developed the Internet as a communal research tool.

Open source software has many strengths that place it in an advantageous position vis a vis commercial alternatives. One of the principle benefits of open source is that Open Source software is *always* free for individual or commercial use. This means that open

source software can be used as part of an effective cost-reduction strategy wherever information technology is turned towards the production of some product or server. Interestingly, the free availability of open source is guaranteed in the long term because it is built into the very structure of the open source development process. The free availability of the software follows directly and inevitably from the simple fact that the software code itself is freely available. This free availability means that any individual or organisation can modify and build the software associated with the code whenever, and wherever they please. Under circumstances where any individual can create the original program at any time where ever they wish it is simply impossible to enforce the licensing of software. This structural impossibility is intentionally built into the development process and strengthened with various alternative licensing agreements.

A further benefit, deriving from the distributed nature of software development in an open environment, is the quality and variety of the software produced. Over the years, software engineers have developed a very wide ranging suite of software utilities and applications. This wide ranging suite of applications includes everything from powerful, sophisticated and freely available UNIX operating systems like Linux and FreeBSD [19] through office application suites, free text manipulation languages like Perl, [20] and even complete typesetting systems like LaTeX. In many cases, these applications have become, because of their power and sophisticated, industry standard solutions (for example, Perl is now the de facto text processing language and World Wide Web programming language). The reason for the power of open source applications is well understood. [21] The ability to access an almost unlimited field of intellectual expertise to solve programming related problems creates a development environment that is unique and unprecedented in its ability to solve problems and "evolve" software efficiently and rapidly. The Open Source web site describes the development process in these terms.

> The basic idea behind open source is very simple. When programmers on the Internet can read, redistribute, and modify the source for a piece of software, it evolves. People improve it, people adapt it, people fix bugs. And this can happen at a speed that, if one is used to the slow pace of conventional software development, seems astonishing. [22]

It would be a mistake to discount Open Source as an irrelevant phenomenon or as a trivial project creating trivial software for a small computer collective with socialist leanings. The phenomenon is global and so successful in creating **better** alternatives to commercial products that in recent months, the lofty computer giant Microsoft has admitted that free software has become a threat to its continued domination of the computer operating system market. In an ironic turn of events, a set of internal Microsoft memos, now collectively known as the Halloween Documents, was released at the end of October 1998. [23] In this set of memos, Microsoft admits that Open Source software is a significant challenge and threat to their continued domination of the software market. As John Naughton of Great Britian's Guardian newspaper notes of the principle competitor of Windows, the UNIX clone LINUX:

> Linux is free because it was developed collectively across the Net by skilled programmers working in the Open Source tradition which

> created the Internet and which holds that software should be freely accessible to the community. The name comes from the fact that 'source code' is computer-speak for the original version of a program – as distinct from the version you buy and install on your computer. If you have the source code, you can do whatever you like with it.
>
> Linux is powerful and stable because it was created by clever people working collaboratively on the source code and because it's been tested to destruction by more programmers than Microsoft could ever muster. The Hallowe'en memo warns Gates that Linux and its ilk pose a serious threat to Microsoft. It argues that Open Source software is now as good as – if not better than – commercial alternatives, concedes that 'the ability of the OSS process to collect and harness the collective IQ of thousands of individuals across the Internet is simply amazing', and concludes that Linux is too diffuse a target to be destroyed by the tactics which have hitherto vapourised Microsoft's commercial rivals. [24]

This Open Source revolution is good news for anyone wishing to leverage the power of information technology. For ICAAP, it means being able to provide a very robust and very inexpensive, scholarly journals infrastructure with a level of quality that far currently surpasses comparable, and much more expensive, commercial solution. Indeed, given the grand success of the open source development process, it is reasonable to expect that Open Source will, in very short order, surpass what is commercially available via traditional commercial arrangements.

Thus, utilising the wealth of Open Source software solutions available, ICAAP is able to provide, free of charge to non-commercial journals, such basic infrastructure services as site hosting, journal archival, site management, web mirroring, conferencing services, and secure web server services for financial transactions. All of the software utilised by ICAAP is Open Source and thus freely available. This means that the only infrastructure cost is the cost of the computer hardware and the Internet connections. Hardware costs are trivial. The Internet connection is shared with Athabasca University and comes at no charge, as do backup services. However, the marginal cost to ICAAP even if ICAAP were to pay the university for its share of bandwidth, would still be very low. A more detailed costing model for the provision of electronic scholarly resources will be developed in the next chapter. At this point it is apropos to move on to other planks in the ICAAP strategy.

Reliance on Centres of Excellence

A second plank in ICAAP's reform strategy is to become a central clearinghouse for web-based expertise and services relevant to scholarly publication. Adopting this role as a clearinghouse is based on the recognition that much of the technological expertise needed to publish professional quality journals, and indeed to add value to electronic

journals, already exists in one form or another. The problem is simply that this expertise often goes unrecognised and under utilised and, therefore, remains uncoordinated and un-exploited. A centrally organised publication house like ICAAP, with the ability to recognise distributed talent, and with a non-commercial intent, can quite easily leverage available technological expertise and turn it to the service of the scholarly journals system.

So far, ICAAP has been successful in this endeavour to build a "distributed" production system in two areas. On the one hand, ICAAP has collaborated with H-Net, Humanities and Social Sciences Online [25] in order to provide various forms of conferencing services free of charge to ICAAP journals. These conferencing services allow editorial boards to communicate easily and effectively (and to have archives of their discussions created and stored). They also allow journals to provide an enhanced level of interactivity by providing user forums that can be carefully moderated and controlled. For H-Net, the marginal cost of providing these services to ICAAP is very low. Yet for ICAAP, the benefits are significant. Relying on H-net for these services allows ICAAP to leverage the skill, expertise, and experience of the H-Net without having to duplicate this expertise in house and at a higher cost. It is simply an attempt to leverage economies of scale in order to add value to electronic publication without unnecessarily inflating the cost of that publication.

Another significant partnership has been developed between ICAAP and the Internet Access Laboratory (IALAB) at the University of Evansville. [26] In this project, ICAAP is leveraging the search engine and data base expertise developed over the past few years at the IALAB in order to provide a sophisticated search interface for ICAAP journals. In order to actualise this project in relation to ICAAP journals, ICAAP and the IALAB have initiated a joint search engine project knows as the *Goliath Project*. [27] The mission of this project is to promote the creation and evolution of independent scholarly journals on the World Wide Web by providing a limited area search engine (LASE) dedicated to indexing peer-reviewed on-line content. The search engine is based on DAVID (Dedicated Accrediting Variable Indexing Device) technology that will allow both structured and free form indexing of scholarly resources.

What this project will mean, ultimately, is that the IALAB and ICAAP will be able to provide sophisticated indexing and search technology at no charge to ICAAP journals. There is nothing ephemeral about this technology. It has already been applied to good effect in quality controlled indexing of philosophical resources on the Internet. The two projects that demonstrate the future potential of an IALAB/ICAAP indexing project are Hippias and Noesis. [28] Both of these resources are very popular amongst philosophers as they provide a strict quality controlled method of indexing a wide variety of Internet resources. Both are also, according to Anthony Beavers, very inexpensive to implement.[29]

The ICAAP/IALAB partnership represents both a duplication and extension of this early search engine technology. Rather than focusing exclusively on philosophy resources, the DAVID search engine will index all scholarly journals. And, rather than charging a fee for this indexing (whether through sales of data base software to libraries, by direct billing to the journals indexed, or by collecting advertising revenue),

these sophisticated search technologies are provided free of charge to individuals, libraries, corporations and journals. Anthony Beavers comments on the technological and social developments behind the Goliath Project.

> Its procedures represent a synthesis of the database model used with Noesis and a meta-tag system developed by an ICAAP team headed by Mike Sosteric, a sociologist at the Centre for Global and Social Analysis, Athabasca University. The crawler mechanism used for the Goliath Project goes by the name of DAVID, a dedicated accrediting variable indexing device. It is accrediting in that it can promise users that any item appearing in a return set has undergone a procedure of true peer-review, and it is variable because it uses a database requiring human intervention for pages without the standardized tags and automatically defaults to a meta-tag system for pages with them. It can easily be adapted to accommodate a variety of meta-tagging systems, thereby allowing full-coverage cataloging of independent periodicals on the Internet long before any universal agreement is reached concerning meta-tagging standards....
>
> The hope of the IALab and the ICAAP is that Goliath will stimulate the proliferation of independent journals on the Internet that operate without economic interest. The price of this technology is inexpensive enough to create an Internet in which quality information is disseminated efficiently to the global community free of charge. In a matrix where authors have traditionally not been paid for their contributions to journals, we hope that authors will respond positively to these independent journals as well. Goliath means a wider readership, because access is free and efficient; and because it provides mechanisms for the validation of resources, Internet publication should start to "count" in promotion and tenure decisions. Furthermore, Goliath will work to bridge the gap between the general public and the university, allowing scholars the more traditional role of informing society rather than being subject to its economic whims. [30]

As Beavers notes, the Goliath project is based on both Noesis technology and a header system developed exclusively for scholarly journals by ICAAP. This ICAAP header, that will be described below, is an SGML extension that allows, among other things, sophisticated and robust indexing and handling of journal documents. This development of these HTML extensions is part of the final plank in the creation of an alternative scholarly communication infrastructure – the development of an "open" journals production system.

The ICAAP/IALAB and ICAAP/H-net projects are only two examples of the possibilities. Numerous other national and international partnerships could be developed as software and hardware matures, and as the scholarly community catches on, and catches up, to the potentials of this distributed service provision and open

source revolution. The possibilities are endless even with these two ICAAP strategies. However, the possibilities expand tremendously when coupled with an ICAAP initiative to centralise R&D and develop an open journals production system that would provide the fundamental technology for expanding and evolving an alternative scholarly journals infrastructure. It is to this final plank in the ICAAP strategy to develop an alternative communication system that the dissertation now turns.

Centralising R&D: The Development of an "Open" journals production system.

The final plank in the ICAAP strategy to reform the scholarly communication system draws inspiration from the Open Source software movement. Like the development of Open software, ICAAP has also set as a goal the development of an "open" journals production system. What this means, simply, is that ICAAP makes knowledge gained from its own research and development freely available to all interested parties (including commercial organisations). This might not sound unusual since it is a basic principle of the sciences to publish research results. However, ICAAP goes one step further than this by actually publishing and distributing the software tools used in the ICAAP production process. To the best of this author's knowledge, no other journal production house has taken this experimental step. ICAAP believes that creating an open production environment where expertise and software tools are openly distributed through Internet based communication channels will allow the expertise of ICAAP to be easily and inexpensively incorporated into a wide range of journals projects. It is also hoped that, as with the development of OpenSource software, this will allow the technologies initiated by ICAAP to evolve and grow into a suite of freely available journal production tools that can be used by all parties to create a open and low cost journals production system.

It order to get a better understanding of the implications of this third plank in the ICAAP strategy, the rest of this chapter will examine in more detail the bedrock technological development made at ICAAP that will make the creation of an open journals production environment possible. This examination will examine in detail the ICAAP eXtended Markup Language (IXML). As shall be seen, IXML provides the basic infrastructure upon which to build an extremely sophisticated, but very low cost, electronic journals production system. Following this examination of IXML, the next chapter will describe how IXML fits into a low cost, but high value added, electronic journals production process.

ICAAP Production: Bringing SGML Sophistication to Electronic Publication

Most of the ICAAP production system as it now exists centres around the ICAAP eXtended Markup Language. As noted by Anthony Beavers, [31] ICAAP has developed a meta-tagging system useful for adding value to the DAVID indexing engine. Actually, what has been developed by ICAAP goes far beyond a simple meta-tag system. ICAAP

has developed an SGML production system that that allows ICAAP to introduce sophisticated indexing and document handling capabilities at a very low cost. This SGML system, known as ICAAP eXtended Markup Language (IXML) is based on the new eXtensible Markup Language (XML) specification. [32] XML provides an easier to implement SGML system. In the words Peter Flynn, XML is:

> ...an abbreviated version of SGML, to make it easier for you to define your own document types, and to make it easier for programmers to write programs to handle them. It omits the more complex and less-used parts of SGML in return for the benefits of being easier to write applications, easier to understand, and more suited to delivery and interoperability over the Web. But it is still SGML, and XML files may still be parsed and validated the same as any other SGML file. [33]

The ICAAP XML implementation, IXML, is based in large measure on HTML. Indeed, IXML is both an extension and stripped down version of HTML. It is stripped down in the sense that many of the elements found in regular HTML are disallowed in IXML (e.g., the <FONT> tag, the <EM> tag, etc) because they are irrelevant to scholarly journals and unnecessarily complicate document handling by adding too much complexity and uncertainty. There is good reason to remove complexity – or at least control it. By removing superfluous elements and by increasing control over document structures, IXML makes it possible to streamline and automate the journals production process. With a reduced HTML element set, it is much easier to anticipate document characteristics and handle electronic texts automatically.

Note however that eliminating the ability to include <FONT> and <EM> tags does not disadvantage a journal article in terms of appearance or functionality. In fact, quite the opposite is the case. As is well known, this separation of the logical structure of articles from its presentation is a desideratum of electronic text handling. Not only does this allow tighter control over the logical structure of documents, but by stripping the ability to include discredited and deprecated elements, IXML forces journal authors and editors to handle the appearance of information via cascading style sheets. In the end, this allows journals to enhance both control over logical structure and control over presentation. As can be seen by examining http://www.icaap.org/TheCraft/content/1999/beavers/ with a stylesheet enabled browser, professional results can be achieved even when appearance information is strictly excluded from IXML markup.

As noted, besides being a stripped down version of HTML, IXML is also an extension to HTML designed to more accurately reflect the logical structure of scholarly journal articles. That is, IXML adds element definitions for those types of structures most often found in journal articles. For example, unlike HTML which has only two top level elements (the *head* and *body*), IXML has four. These top level elements include, like HTML, a document *head* and *body*. However in addition to these basic elements, an optional *endnotes* and *references* section is added. Figure One below provides a graphical representation of these document elements. [34]

Figure One: IXML Top Level Document Elements

```
IXML
 |_(head,
 |__body,
 |__endnotes?,
 |__references?
 |__appendices?)
```

The usage of the *endnotes*, *references* and *appendices* elements are self explanatory. There is considerable utility in providing separate IXML containers for these document structures. When automating document handling, having these additional structures allows document *endnotes* and references to be treated in unique ways. For example, providing an IXML container for all references allows ICAAP parsing software to add style commands to paragraphs in the *references* section differently than those that appear in the *body*. Thus while paragraphs in the body section may be styled as double space, paragraphs in the references section may be styled as single space. Providing these additional containers thus provides an efficient way of identifying key structures in journal articles and processing these structures in a unique, but efficient, manner.

Besides adding handling capability, adding these top level elements also allows for a more robust article error control process because the content of the elements can be more tightly controlled. For example, SGML allows ICAAP to make sensible element exclusions based on the position of elements. For example, the *references* section of an IXML document *cannot* contain the full set of IXML or HTML elements. It can contain only an option level one heading (H1) and paragraph content. Similarly, the *endnotes* section can only contain an *endnotetext* container. This *endnotetext* container is an IXML widget that will be described below. Figure Two provides a graphical representation of the allowed content of these two sections.

Figure Two: IXML Second Level Document Elements – REFERENCES and ENDNOTES

```
REFERENCES                ENDNOTES
 |_(h1* |                  |_(endnotetext)+
 |__p)+
```

The benefit of this tight content control is simple. It eases the task of document handling and conversion and creates a less error prone process. In technical terms, it allows ICAAP processing software to anticipate all document possibilities with ease and confidence. Tightly controlling document content means there are fewer surprises that might "break" the ICAAP document conversion process. This allows for the creation of a very robust and virtually error free (so far) production system.

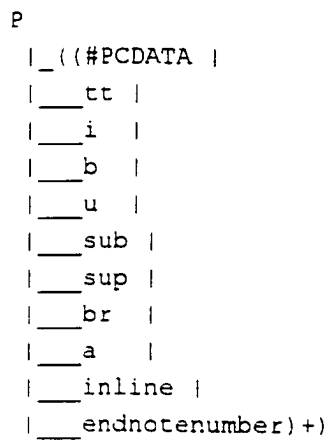
As noted above IXML also allows a *body* and a *head* element. The IXML *body* is pretty much what you would expect to find in a regular HTML body – sans some irrelevant elements. As can be seen from Figure 3, the *body* of an IXML document takes paragraphs, quotations, headings, list structures, tables (not shown) and an IXML widget called a *publicationnote*.

Figure Three: IXML Second Level Document Elements – BODY

```
BODY
 |_((publicationnote)?,
 |__(h1* |
 |___h2* |
 |___h3* |
 |___h4* |
 |___h5* |
 |___h6* |
 |___p*  |
 |___ul* |
 |___ol* |
 |___dl* |
 |___blockquote)+)
```

Most of the items in Figure Three are self explanatory. Headings, ordered and unordered lists are familiar from their widespread use in HTML. However there is one relatively important difference between the HTML body and the IXML body. This difference appears in the content model for the paragraph tag (<P>). As Figure Four demonstrates, the IXML paragraph is both less than, and greater than, the HTML paragraph.

Figure Four: IXML Third Level Document Elements - P



As can be seen, the IXML paragraph contains much of what individuals would expect. Paragraphs contain text (#PCDATA), italic, bold, underline, superscript, and subscripted text. Paragraphs may also contain line breaks (BR) and HTML anchors (A). Unlike HTML however, IXML paragraphs cannot contain the logical formatting elements (EM). Also unlike HTML, the IXML paragraph contains additional elements to mark IXML widgets. Here the IXML widgets include an element for *inline* graphic and textual content, and an element to mark end note numbers.

THE IXML HEAD

So far in this discussion of IXML, we have seen how the elements for *references*, *endnotes*, and the document *body* both add to, and subtract from, regular HTML in order to provide a more intuitive, easier to handle, and more robust, representation of journal documents. A key component of the IXML document language that allows the creation of this integrated production system is the use of an extended IXML head structure. The *head* of the IXML document is reserved primarily for bibliographic and indexing information. This information generally includes the document abstract and author, document web location, keywords, publishers and distributor of the document, etc. Unlike regular HTML where this information in included in an often haphazard manner in the *body* of the document, in IXML all such information is moved out of the *body* and into the *head*.

The benefits to this relocation are almost innumerable. Putting all this information in a location that is consistent and tightly controlled allows for the intelligent parsing and indexing of IXML documents. This means that search engines like the DAVID engine of the IALAB can add structured indexing and sophisticated database capabilities not possible with unstructured HTML. It also means that the documents can be parsed and formatted in a consistent and controlled manner. For example, always being able to

locate the document title and subtitle means always knowing where to output it in output files. This solves a significant problem with online publication – i.e., the lack of consistency and standardisation of web documents. With the IXML head structure, and the use of stylesheets, all a journals articles can be guaranteed to look the same.

There are other benefits. The most important benefit from this author's perspective is that the use of the IXML head structure allows documents to be output in multiple formats, and for multiple platforms, in an easy an efficient manner. Being able to locate and control key bibliographic information means that output programs can be written that provide complex document transformations. These benefits will be outlined in more detail in the next chapter. For now it seems worthwhile to examine in more detail the structure of the IXML head. Figure Five gives a graphical representation of the top level elements in the IXML *head*.

Figure Five: IXML HEAD Elements

```
HEAD
 |_(resourcegroup,
 |__publicationgroup,
 |__seriesgroup,
 |__indexinggroup)
```

As can be seen from Figure Six, the IXML *head* contains four top level elements. Each of these containers is designed to store a logical segment of an article or resources bibliographic information. That is, the four containers provide an intuitive way of grouping information at different levels of abstraction. The *resourcegroup* is designed to hold information useful for describing the individual article. The *publicationgroup* is used to describe the publisher and distributor of the article or resource. The *seriesgroup* contains information on serialisation including volume and issue numbers, special issue title, and special issue editors, if applicable. Finally, the *indexinggroup* contains bibliographic information including Library of Congress subject headings, and the start date of the journal. It will be useful to go into a bit more detail concerning each of the groupings.

As noted above, the *indexinggroup* contains bibliographic and indexing information. The *indexinggroup* includes a list of keywords, an identifier to indicate the keyword scheme, and a *startdate*. The actual realisation of the *indexinggroup* in IXML code would look something like that in Figure Six.

Figure Six: IXML HEAD Elements – INDEXINGGROUP Example

```
<INDEXINGGROUP>
        <KEYWORDS scheme="LCSH">
           <ITEM>Women in Judaism</ITEM>
        </KEYWORDS>
        <IDNO type="ISFN">900.1999.1.1</IDNO>
        <STARTDATE><YEAR>1998-</YEAR></STARTDATE>
</INDEXINGGROUP>
```

As can be seen from Figure Seven, the *keywords* element contains any number of *item* elements which can be used to provide a list of *journal level* keywords. In the above example, these keywords are derived from the Library of Congress Subject Heading (LCSH) Red Books. However different *schemes* could be utilised including the UNESCO subject classification. The *startdate* indicates when the journal began publication, and when (and if) the journal stopped publication.

The *idno* number appears many times in the IXML header. In this case, the *idno* is of type "IUICODE." IUICODE stands for International Standard File Number and is a unique identifier assigned by ICAAP that allows each *article* published under the auspices of ICAAP to be uniquely identified in the DAVID search database. This ability to uniquely identify articles independent of their location on the WWW allows very sophisticated document indexing, maintenance and tracking. This will mean that authors and readers will always be able to track down a journal article **regardless** of its web location simply by citing its IUICODE to the GOLIATH search engine.

The second last element in the *head* is the *seriesgroup*. This IXML element is designed to hold information relevant to serialisation of the journal. As noted in Figure Seven, the series group contains a *description* of the resource. Figure Eight gives the content model for the IXML *description* element.

Figure Seven: IXML HEAD Elements - SERIESGROUP

```
SERIESGROUP
 |_(description)
```

As can be seen, the *seriesgroup* contains only a *description* of the journal series. However this description can be quite detailed. As Figure Eight indicates, an IXML description can contain a number of elements including a *stylesheet*, *graphic*, *web* address, *title* and *subtitle*, *date*, *abstract*, etc.

Figure Eight: IXML HEAD Elements - DESCRIPTION

```
DESCRIPTION
 |_((stylesheet?),
 |__(graphic?),
 |__(web?),
 |__(title?),
 |__(subtitle?),
 |__(date?),
 |__(abstract?),
 |__(language),
 |__(idno?),
 |__(availability?),
 |__(respstmt?))
```

Note that the *description* element is designed to be used in a number of places inside the IXML head – generally whenever a description of the resource is required. This means that the actual content of the *description* offers more options that would normally be used in describing a particular level of the resource in question. For example, inside a *seriesgroup*, most of the elements that are possible inside a *description* are not used. Generally, the *description* of a journal series would look something like the representation in Figure Nine.

Figure Nine: IXML HEAD Elements - SERIESGROUP

```
<SERIESGROUP>
     <DESCRIPTION>
        <WEB>http://www.sociology.org/Vol004.001/</WEB>
       <DATE><YEAR>1999</YEAR></DATE>
      <IDNO type="vol">4.1</IDNO>
</DESCRIPTION>
</SERIESGROUP>
```

The description above indicates that this article belongs to volume four, issue one of the journal. This issue was published in 1999 and is located at http://www.sociology.org/Vol004.001/. As can be seen, this basic description is quite simple and provides only the absolute minimum of information required to identify the location of an article in a journal series. Note however that additional tags can be added to indicate that the issue is a special issue, with its own title and editor. In the case of a special issue, it might also be desired to handle copyright differently.

The second element in the IXML *head* is the *publicationgroup*. This element is used exclusively to indicate who is responsible for the journal or resource. Generally this involves "describing" the journal and also providing information on the publisher and distributor (if any) of the resource. The content model of the IXML *publicationgroup*

element is given in Figure Ten.

Figure Ten: IXML HEAD Elements - PUBLICATIONGROUP

```
PUBLICATIONGROUP
 |_((description?),
 |
 |__publisher,
 |    |_(name,
 |    |__address?,
 |    |__respstmt?)
 |
 |__distributor?)
      |_(name,
      |__address?)
```

As can be seen, the *publicationgroup* contains a *description* (which contains identical element possibilities to the previously discussed *description*), a *publisher* and a *distributor*. The publisher and distributor elements both contain the basic structures you'd expect to find when providing information on organisations. There is a *name* and an *address*. The *name* and *address* tags contain bottom level elements that describe the information that would most often be contained in names and addresses. Like the *description* element, the *name* and *address* tags are designed to be reusable in other structures (e.g., to provide information on authors). Figure Eleven describes the content model for the IXML *name* and *address* elements.

Figure Eleven: IXML HEAD Elements – NAME and ADDRESS

```
NAME
 |_(full |
 |__(honorific?,
 |___first,
 |___middle?,
 |___last))

ADDRESS
 |_(street* &
 |__city? &
 |__province? &
 |__postalcode? &
 |__organisation? &
 |__division? &
 |__email? &
 |__web?)
```

Figure Twelve provides an example of how the *publicationgroup* may be realised in a production environment.

Figure Twelve: IXML HEAD Elements – PUBLICATIONGROUP Example

```
<PUBLICATIONGROUP>
 <DESCRIPTION>
  <WEB>http://www.sociology.org/</WEB>
  <TITLE>Electronic Journal of Sociology</TITLE>
  <IDNO type="ISSN">1198 3655</IDNO>
 </DESCRIPTION>

<PUBLISHER>
  <NAME><FULL>Athabasca University</FULL></NAME>
  <ADDRESS><EMAIL>mikes@athabascau.ca</EMAIL>
         </ADDRESS>
</PUBLISHER>

 <DISTRIBUTOR>
  <NAME><FULL>ICAAP</FULL></NAME>
  <ADDRESS><WEB>http://www.icaap.org/</WEB></ADDRESS>
 </DISTRIBUTOR>
</PUBLICATIONGROUP>
```

Of course, the *name*, *address* and *description* tags are capable of resolving the publisher, distributor, and journal with much more detail if so desired.

The final top level element in the IXML head is the *resourcegroup*. This element is used to describe the resource at the "article" level. As can be seen from Figure Thirteen, the *resourcegroup* also contains a *description* of the resource (this time applied to the article itself), and one or more *author* elements. Each *author* element will contain, not surprisingly, a *name* and an *address*.

Figure Thirteen: IXML HEAD Elements – PUBLICATIONGROUP

```
RESOURCEGROUP
 |_(description,
 |
 |__author+)
     |_(name,
     |__address?)
```

An example of the realisation of the *resourcegroup* tag is provided in Figure Fourteen.

Figure Fourteen: IXML HEAD Elements – RESOURCEGROUP

```
<RESOURCEGROUP>
 <DESCRIPTION>
 <STYLESHEET>http://www.icaap.org/TheCraft/article.css
 </STYLESHEET>
 <GRAPHIC>http://www.icaap.org/graphics/quill1.jpg</GRAPHIC>
<WEB>http://www.icaap.org/TheCraft/1999/sosteric/article.html/
</WEB>
 <TITLE>ICAAP Document Automation</TITLE>
 <SUBTITLE>Standardising the Storage of Electronic
Texts</SUBTITLE>
 <AVAILABILITY status="free">Copyright 1999
ICAAP</AVAILABILITY>
 </DESCRIPTION>

 <AUTHOR>
  <NAME>
   <FIRST>Mike </FIRST>
   <LAST>Sosteric</LAST>
  </NAME>
  <ADDRESS>
   <EMAIL>mikes@athabascau.ca</EMAIL>
   <ORGANISATION>Athabasca University</ORGANISATION>
   <DIVISION>Department of Global and Social
Analysis</DIVISION>
  </ADDRESS>
 </AUTHOR>

</RESOURCEGROUP>
```

At first glance the IXML *head* structures may seem quite complicated. However this complexity is more apparent that real. Most of the information contained in the IXML *head* is consistent across all resources of an individual journal or publisher. Thus tags in the *indexinggroup* and *publicationgroup* remain constant. Tags in the *seriesgroup* change with each new issue of a journal. Of course, tags in the *resourcegroup* change on a per article basis. However it is possible to have authors fill this information in for themselves by providing cut and paste templates, or by providing online forms to fill out. Or, it is possible to have assistants handle the data entry. Either way, the actual task of adding an IXML header to documents is trivial and takes only a few minutes. When compared against the innumerable benefits realisable in a automated document production process, the additional time is hardly worth mentioning.

Conclusion

After having discussed the original potentials of the scholarly communication system,

noting its current difficulties, offering electronic publication as a possible solution, and then discussing the difficulties in actually reforming the scholarly communication system, this chapter examined in more detail actual efforts to reform the system. As argued, early discussion focused on passive solutions that required libraries to explore alternative models of delivery and access. However, as the politics of the scholarly communication system have unfolded, and as the commercial presses have resisted meaningful reform, more and more individuals are realising that passive resistance will not work.

Current thinking emphasises that meaningful reform will only be realised if scholars, librarians, and information specialists actively work together to create an alternative distribution system for scholarly information. Early suggestions for reform have been followed by tentative first steps. The ICOLC initiative to compete with Elsevier press is one example. Another is the formation of the International Consortium for Alternative Academic Publication. As discussed in this chapter, ICAAP is perhaps the first large scale international initiative designed to investigate alternative models for the delivery of document information.

The ICAAP strategy is based on a number of interrelated planks. These include relying on open source software, leveraging economies of scale and centres of excellence, and developing "open" solutions to document processing. As discussed in the section on IXML, ICAAP has progressed in the design of an intuitive and sensible scholarly journals XML application. The IXML language was discussed in considerable detail. The justification for this discussion is simply that the IXML language is the linchpin technological development that makes all subsequent technological breakthroughs in the handling of journal articles possible. These "breakthrough" potentials, how the IXML language fits into a reformed journals production process, and how this will contribute to the creation of a low cost, but high quality, journals production system has only been alluded to in this chapter. It will be the task of the next, and final chapter, to explore in more detail the practical potentials of using IXML and advanced information technologies in the creation, production and distribution of scholarly information.

Chapter Six: The Future of Scholarly Publication on the Internet

Introduction

In the last chapter, the dissertation examined the ICAAP strategy in the context of the current emphasis on active participation amongst all stakeholders in reforming the scholarly communication system. There it was noted that passive resistance or passive attempts to cope where no longer seen as adequate survival strategies. In line with this new awareness, commentators are now calling for alternative strategies that emphasise an active role for libraries, scholars, university presses, and universities. Along with initiatives like SPARC, the strategy of the International Consortium for Alternative Academic Publication was offered as a possible way forward. This strategy includes, as noted in the previous chapter, the reliance on open source software, the development of a distributed production system based on various centres of excellence, and the centralisation of research and development. As part of the R&D activities of ICAAP, the development of an XML application provides the basic infrastructure upon which further technological developments will flow.

This XML application, known as the ICAAP eXtended Markup Language (IXML), provides the basic infrastructure upon which ICAAP will build an extremely sophisticated, but very low cost, electronic journals production system. Chapter Five examined in some detail what the SGML tagging system looked like. There, a part of the long term potential of IXML to add value to the scholarly journals system, and reduce the cost of the system, were alluded to. This final chapter will examine in considerably more detail how the ICAAP SGML system can support the development of a sophisticated and automated document handling system. The emphasis in this chapter will be on a discussion of how this document handling system can be turned towards both lowering the cost of the scholarly communications system and, at the same time, creating significant value added benefits that might make electronic publication a viable alternative for current print journals.

What all this means for Scholarly Publication

The question that is being addressed in this chapter is simple. If, as noted in chapter three, ejournals by themselves have potential for reduced cost and enhanced access, what are the extended potentials of IXML? In other words, what does IXML and related technologies mean for the longer term evolution of the scholarly communication system? The answer to that question is complex and involves taking a more in depth look at currently available IXML applications developed at ICAAP. However a short answer is possible before pursuing a more detail examination. Basically, with IXML it is possible to co-ordinate a sophisticated electronic journals system without the high

cost of supporting a non-competitive and bloated commercial infrastructure. However it is important to recognise that this new scholarly communication system would not be without cost. Just how much the system would cost, and how significant the savings would be, is a question that the dissertation now turns to.

Infrastructure Costs – Hardware and Software

As noted in an earlier chapter, publishing electronically, although potentially much less expensive than print, has significant costs. These costs can be generally broken down into two broad categories. There are infrastructure costs that include the costs associated with the hardware and software purchases, cost of networking, and the cost of server software needed for the storage and transmission of electronic texts. There are also labour costs associated with editing, peer review, and journal production. Information technology has implications for the costing of a scholarly journals system at both these levels. Obviously, the costs normally associated with printing paper journals is eliminated when electronic only publication is pursued.

As noted earlier, infrastructure costs associated with the electronic storage and transmission of electronic text are now trivial.[1] Storage is currently available at the cost of about $100 for 3 gigabytes of disk storage. A gigabyte is defined as 1024 x 1024 x 1024 (or 2 to the 30th power) or about 1 billion bytes of data. A kilobyte is 1024 (2 to the 10th power) bytes or about 1,000 bytes. If it is assumed that the average science paper, without graphics but with tabular data, is approximately 100 kb (this would allow for an approximately 25 – 35 page paper with one or two small graphics), and if 200 dollars buys 6 gigs of hard disk storage, then the average off the shelf hard drive is capable of storing 62, 914 scholarly papers. Compared with the cost of storing print publication in the huge warehouses called libraries, this is inexpensive.

An additional consideration when publishing electronically is archival. Traditionally, archival is done through the purchase of library editions of scholarly journals. However electronic journals may or may not be stored on library computers. Since there is no currently accepted global strategy for archiving the output of scholarly journals, providing safe archival solutions generally falls to the individual journal or production house. However even so, archival, especially when located at a central location, is inexpensive. Various solutions exist that can provide safe archival for under a thousand dollars. Writable CD-ROM drives cost between 600 and 700 dollars per unit. Cartridges, that hold 600 megabytes of data, cost less than 25 dollars a cartridge. Equally inexpensive are removable disk storage devices. These devices, which currently offer 2 gigabytes of storage on a single removable cartridge, cost about 700 dollars for drive, and about 100 dollars per 2 gig storage. As can be seen, even archival of electronic texts is quite inexpensive.

Besides storage and archival, electronic texts must be distributed. Unlike paper production where distribution is conducted via the postal service, the distribution of electronic texts requires a significant technological infrastructure. High speed Internet access must be purchased, along with the hardware routers and connections (software

is generally free) needed to connect an institution to the Internet. For many journals, and indeed consortiums like ICAAP, it is possible to leverage the local Internet connection provided by almost all post-secondary institutions. [2] However even if the connection had to be purchased, the cost would be quite low when compared against the alternatives associated with print. As with almost all components of the Internet infrastructure, software is free. A quick perusal of the Internet indicates that a fast T1 connection will cost anywhere from $1,000 to $2,000. Although this cost is high, it is not so high that even a single journal with a medium size subscription based couldn't afford its own hardware, software and p/t technical expert to handle a full speed leased line connection to the Internet.

A final component of the hardware infrastructure cost is the purchase of server hardware. The cost of this hardware can very widely. For many applications, and for small to medium size journal houses, a typical desktop IBM workstation or two can be purchased to provide the necessary hardware to support the basic connectivity service associated with the Internet. At the current level of technological advance, a fast PC running the Free BSD or Linux operating systems can provide very fast response time for very low cost. A typical PC workstation would range anywhere between $1500.00 and $3000.00 Canadian depending on the level of support required. Other options are of course available. Larger journal houses may purchase systems that are faster or that offer higher levels of availability. But for most purposes, PC hardware and freely available UNIX Operating System variants provide functionality and stability that is more than adequate for the typical scientific publisher.

The final infrastructure cost is the software cost. This cost would include various types of Internet daemon software to serve web documents, handle email, handle secure financial transactions, etc, and it would also include document handling software like SGML parsers and validators, text markup software, and other software components of the journals production process. It is important to apply a degree of knowledge and expertise to decisions made in this area since poor decisions can lead to significant (and spiralling) costs. For example, commercial SGML and XML parsing software can cost organisations upwards of $60,000 per year. [3] This sort of cost however is largely unnecessary. Availability Open Source software can virtually eliminate software costs. As the reader will already be aware from the last chapter, robust alternatives to the high cost Windows family of operating systems are freely available. However it is also possible to leverage Open Source software to provide the daemon software required to serve HTML documents. The Apache HTTPD server, for example, is a free HTTPD server that is widely recognised as being the fastest and most stable web document server available. [4]

Besides operating system software and server software, high quality and robust open source solutions exist for virtually every other software need a journal production house may have. It is possible, for example, to add a secure sockets layer (SSL) to the web server to allow for encrypted financial transactions on the Internet free of charge. [5] For those wishing to add database functionality to web sites, there are various freely available database engines and interfaces that can be utilised without the high cost associated with Microsoft or Oracle products. [6] For journal production, non-

commercial alternatives also exist. For example, the Perl programming language [7] is the world's premier text processing and management software. It is freely available for every conceivable software and hardware configuration. Perl comes with a wealth of software add ons that provide functionality ranging from the robust handling of data base engines through to the creation of graphical user interfaces (GUIs). Finally, for robust handling of SGML documents, including full DTD validation, the freely available, and almost religiously supported, EMACS text processing and programming editor is available. [8] Proper utilisation of the EMACS editor can transform a journals production process form an unprofessional hodgepodge to a tightly controlled, and virtually error free, SGML production system. Significantly, EMACS, like many of these other production, supplant and outperform commercial alternatives costing hundreds or even thousands of dollars.

When all the various infrastructure components are combined, i.e., hardware, storage, software, and connectivity costs, the cost of infrastructure can be surprisingly low. In fact adding up the above totals (computer = $3.000 + storage = $700.00 + leased line = $2,0000) leaves a net infrastructure cost of $5700.00. This minimum infrastructure cost can be raised or lowered in various ways. The cost can be lowered, for example, if the Internet infrastructure at a university is available free of charge. The cost can also be lowered if ISDN or other less than T1 connection speeds are required (a distinct possibility for single journals). Of course, the cost can go up as the size of the journals operation increases. As more journals are added to the repertoire, the cost of office space, additional computers for employees (copy editors, production assistants, etc.) and other key costs must be factored in. However, as the size of the operation goes up, so too does the ability to leverage economies of scale. If, for example, a small university press or library handled 10 journals, the total infrastructure cost would be distributed over the 10 journals. If we assumed the basic infrastructure cost of $5700.00 and added the cost of a computer for the editor, copy editor, and production assistant but assumed the university provided office space for free, or at a reduced rate, the total yearly infrastructure cost would work in around $14,700. Distributed over the 10 journals this would bring the total cost per journal in around $1,500 dollars.

The International Consortium for Alternative Academic Publication (ICAAP) has made it its goal to demonstrate just how low infrastructure costs can be. ICAAP provides an extreme example but one that in instructive nevertheless. ICAAP provides basic journal infrastructure services (e.g., journal hosting, archival, site mirroring, link checking, site validation, a secure server for online credit card subscription, database services , and powerful and sophisticated document handling system) with an infrastructure cost that is ridiculously low. The actual cost of hardware and software for all these services has been less than $2,500. This extremely low cost is achieved by exploiting the full suite of open source software, and by sharing the Internet and network support available at Athabasca University. Admittedly this is an ideal and extreme case that would probably not be realised in any other location. Not only is ICAAP dependent on the largesse and foresight of the Athabasca University (which provides Internet connections, office space, and computer hardware), but it has also been dependent on this authors programming expertise and familiarity with a full range of available Internet

technologies. Still, the potential for reduced infrastructure costs is clearly present.

Infrastructure Costs – Labour

The other major component to electronic publication is labour. As with infrastructure costs, labour can be generally divided into two categories. On the one hand there are the one time costs associated with initial web site design and set-up. They may of course re-occur if the editor chooses to revamp the site on an annual or basis. However, for the sake of argument, these design costs can generally be written in as one time costs. The actual cost associated with this one time design can range anywhere from as little as $400 to have graduate students design the look, feel, and navigational structure, to as much as $4000.00 dollars to have professional design houses or professional designers develop the site. At ICAAP, a designer can create a professional looking web site for between $1500.00 and $2000.00. This includes design of the front page, navigational structure, and the provision of template pages for second and third level web pages. For most organisations, this initial cost would not be prohibitive.

Besides the initial one time set-up and design costs, there are ongoing labour requirements. Part of the ongoing cost is tied up with editorial labour and the labour of peer reviewers. However as noted in Chapter Two, these costs are often provided as a free service even to commercial publishing houses. There are of course circumstances where editors and associates might be paid honorariums. However by and large editorial labour is provided as part of the normal responsibilities of scholarship. Still, estimates of the total costs for producing online journals may or may not include the costs for providing editorial honorariums. For illustration, an example is provided below which includes the cost of providing these honorariums.

Besides editorial labour, the other major labour costs revolve around copy editing, production and administration. Copy editing labour is easy to quantify. At ICAAP, our copy editor is able to handle, on average, a thirty page document in approximately an hour and a half. Currently the editor is underpaid at twenty dollars per hour so the actual cost of creating a clean version of a thirty page article is approximately thirty dollars. However this initial estimate of thirty dollars per hour does not take into account possible efficiencies introduced into the copy editing process via an automated copy editing macros. These potential editorial efficiencies, including the automated application of the ICAAP house editorial style (e.g., color and not colour), will be discussed below.

In addition to labour associated with final editing of a document, there is administrative and production labour. In the world of print, production labour would include final proofing and typesetting of the article, preparation of issues for printing, transit to and from the printers, and final mailing of the journal to subscribers. In the world of electronic only journals, production involves document markup (including the addition of special codes for tables, graphics, etc.), preparation of tables of contents and other indices useful for adding navigational sophisticated to journals, the "mounting" of

articles on the web server and finally, final verification to ensure all links, graphics and other oddments that are part of the final article are functioning correctly.

It is difficult to provide an average estimate of the time it takes to handle an electronic document during the final phases of production since the approach taken and level of sophisticated achieved by each journal or production house will vary. However, if we start with the article after it has been copy edited, a reasonable estimation of the time required for final production might range from between four and fourteen hours. The former estimate would be appropriate for those articles that required no specialised markup (i.e., tables, graphics, few special entity codes, etc.). The latter estimate would apply to those articles that included graphics, tables and that, consequently, required extensive special treatment. Assuming that production labour was paid at the rate of twenty dollars per hour, the cost for handling an electronic article would range from between eighty to two hundred and eighty dollars. This estimate assumes, importantly, that the document is submitted electronically and requires no optical scanning or data entry before processing. Should documents require data input or scanning, then it is reasonable to suggest that document handling costs might double.

The above estimate of two hundred and eighty dollars might appear low to those familiar with the costs of paper production. To be sure it is probably about seventy five percent of the labour costs for handling documents in the print realm. However bear in mind that this example applies to electronic only production and all costs associated with paper, including typesetting, the creation of camera ready copy, printing and distribution, are eliminated when electronic only versions of documents are produced. As Harnad suggested it is not unreasonable to assume as much as an 80% reduction in the cost of handling scholarly articles when the bonds of paper are removed.

The final component on the labour side of the equation is administrative labour. Administrative labour can include a wide variety of activities including those activities normally associated with the job of the managing editor (e.g., managing subscription lists and contacts with subscription agents, handling advertising and in-kind arrangements of various sorts, producing published calls for papers and other journal announcements, etc.) and those activities associated with book keeping and accounting. Obviously, the addition of administrative costs can add significant over head to the cost of producing an electronic journal.

In order to provide an illustration of the costs associated with electronic publication, the following data, taken from a proposal submitted to the office of the Vice-President Academic at Athabasca University, is provided. [9] This data is presented in Table Five below.

Table Five – Electronic Journal Start-up and Maintenance Costs

Startup Costs

Initial design	$1,800.00
Editorial honorarium	$6,000.00
Associate editor honorarium	$2,000.00
Editorial assistance	$1,000.00
Public relations	$1,000.00
Contingency	$1,330.00
Total	$14,630.00

Continuing Costs (annualized)

Editorial Honorarium	$10,000
Associate editor honorarium	$4,000
Editorial assistance	$6000.00
Document production	$1,880.00
Contingency	$2000.00
Total	$23,880.00

As can be seen from the above data, the costs of starting and maintaining an electronic journal are significant. However a few words are in order. First of all, the single largest line item above is associated with the cost of providing an honorarium for the editor and associate editors. Together, the honorarium costs amount to fourteen thousand dollars per year. This is more than half the actual proposed cost of the journal! For many journals, the cost of editorial labour would not be this high. In fact, the editor would probably not receive any remuneration. Thus for the sake of this estimation of the costs of electronic journals, the ten thousand dollar editorial honorarium can be ignored. However, it is reasonable to retain the four thousand honorarium for the associate editor since in the above plan the associate editor would have assumed the responsibilities of a managing editor. It is fair, then, to include this as part of the administrative overhead of running an electronic journal.

Another major cost noted in table one is the cost associated with the editorial assistant. For this proposal, the editorial assistant would have been responsible for handling electronically submitted papers, managing the web site, mounting and verifying articles and other materials, and managing the interface of the journal web site with ICAAP robots. In short, the editorial assistant would handle all the day to day details of operating the journal. Some of these tasks would be administrative, and some production related (e.g., managing and updating the web site). However the one thing that the assistant would not have done would have been to actually produce the online articles. In the above plan, actual document production (including copy editing and final production) was to be turned over to ICAAP. Here a basic estimate of producing the articles (that assumes no special technology or knowledge) can be produced. If we assume an average cost of approximately one hundred and fifty dollars per article, and

thirty dollars for copyediting, and if we assume ten papers a year, the total cost for producing 2 issues would be one thousand, eight hundred and eighty dollars.

The final yearly labour cost, not including editorial honorarium but including all other line items, would thus be $13,880.00. This figures include a more than adequate $2000.00 contingency fund. The only line item missing are the infrastructure costs noted above. These can be added easily. If we were to add a basic infrastructure contribute of $1500.00 per year for use of Athabasca's Internet infrastructure, the full cost would be about $15,380. It is reasonable to round this figure up to $20,000 if the journal were to be responsible for providing its own computer hardware.

Obviously, twenty thousand dollars is not an insignificant figure. However a couple of points need to be mentioned. On the one hand, this cost per journal assumes a single journal produced by ICAAP and Athabasca. If Athabasca was to handle 2 or more journals, economies of scale could be introduced that would lower the overall cost of most line items above. On the other hand, the above estimate assumes no special production knowledge, only a basic journal interface, and only rudimentary HTML production. However if these assumptions are changed, that is if more than one journal is produced at the same location, and if significant technological expertise is brought to bear on the production process, then the overall estimate of costs can change significantly.

How would this reduction be accomplished? The reader will recall from the last chapter the discussion of the ICAAP extended markup language. Using the full power of SGML, it is possible to both enhance the handling and presentation of document online, and reduce the cost of that handling. It is also possible to turn all manner of automated indexing and search utilities loose on a carefully structured SGML document. How this potential is realised in a real world production environment is the topic of the final sections of this dissertation.

IXML – Document Automation, Database Functionality and Screen Widgets

As noted in the previous chapter, IXML, which is basically an extension to HTML, provides considerable potential for adding value to the production process. However IXML is not just another version of HTML designed to work with journals. It is much more. In the creation of the IXML document type definition, considerable care was taken to create a tightly controlled document structure that would lend itself to easy machine manipulation. The care that was taken in its design, and the outcome of that care, is vividly demonstrated in the powerful document handling capabilities of IXML.

ICAAP has already realised a number of applications demonstrating the potential if IXML and related technologies. For example, ICAAP has developed various document "filters" (really software programs) that allow instant conversion from IXML to any number of document formats. Because ICAAP focuses on online production, currently developed filters allow output to HTML and Dynamic HTML (DHTML). However

with a little bit of research and development, other output formats could be created including an interim Rich Text Format that would then be used to convert documents to Adobe's popular PDF format. Currently, the interim step is required because no available software can convert SGML directly to PDF. However, this interim step may not be required in the long term. A currently available software application called Jade, which uses the Document Style Semantics and Specification Language (DSSSL), can be used to transform IXML to a number of different formats [10] Currently, Jade supports RTF and some other obscure Unix based document formats. However there are plans to build in a PDF back end which would allow single step document conversion from IXML to PDF.

Jade can also be used as a transformation language to take IXML to HTML. However, the more impressive capabilities of ICAAP's handling of IXML require an IXML parser based on the Perl programming language and built by this author in house at ICAAP. This parser is a key technological component of the ICAAP production process as it allows for the easy creation of any number of text processing and IXML handling applications. As suggested above, this parser allows for very easy document transformation into any number of output formats. Usage of the parser inside Perl programs is simple. For example (and for the technically minded) if an editor or production team wanted to extract the authors, abstract, and copyright statement from an IXML document in order to output a separate abstract, they would simply have to use (with some minor preparation) the following computer code.

Figure Fifteen: The ICAAP XML Parser

```
@author     = parse ('RESOURCEGROUP', 'AUTHOR');
$webAddress = parse ('PUBLICATIONGROUP', 'DESCRIPTION' 'WEB');
$abstract   = parse ('ABSTRACT');
$copyright  = parse ('AVAILABILITY');
```

Once extracted in this fashion, this information can be used in any number of ways from web indexing through to document transformation. As noted above, this parser is already used in the ICAAP production process to transform IXML document to HTML and DHTML versions. In this transformation, selected bibliographic information is extracted and output into the HTML file in a predefined sequence (i.e., journal title, ISSN, article title, author, abstract, etc). [11] Creating the HTML in this fashion allows for very professional HTML coding. The coding is cleaner, easier to handle, and much easier to distribute with a consistent look and feel across multiple browsers and computer platforms. As those who have edited electronic journals for more than a few years will be aware, achieving a level of consistency in the application of HTML is extremely difficult. However, with the use of IXML and a well designed filter, consistency can be guaranteed with no additional labour cost.

IXML and the ICAAP parser fits into a value added, and automated, production process in other ways. For example, at the Electronic Journal of Sociology (http://www.sociology.org/), a simple indexing robot developed by this author parses

all IXML files at the web site and outputs, automatically and in less than a minute, by-author, by-date, and by-title indexes of the entire journal contents. With the IXML parser and a modicum of programming knowledge, developing the indexer was trivial and required very little development time. However the results are impressive. Basically, journals that utilise IXML can provide ongoing value-added navigational functions at basically *no additional cost* to the operation of the journal save the initial development and set up time. It goes without saying that the ability to add these indices adds significant pedagogical and research utility to an electronic journal and creates the type of interface that is simply not possible in paper. With this sort of functionality, electronic journals begin to look less like electronic copies of paper journals, and more like unique entities with unique capabilities of their own. Currently, this indexer handles only local documents. However eventually an online version will be provided that will be able to provide indices for all remotely held ICAAP journals.

Database Functionality

As noted in the last chapter, IXML also forms part of a indexing and search strategy initiated by ICAAP and the IALAB at the University of Evansville. There are numerous aspects to this strategy which are simply not possible with any other form of journal markup (and especially journal markup based only on HTML). For example, the IALAB is building structured document queries that will allow users to search ICAAP titles by IXML field. Thus, it will be possible to search for information inside author, subject, title, and Library of Congress keyword fields, to name a few. It will even be possible to search by journal title. In addition, the David search engine, introduced in the last chapter, will also provide full text indexing of ICAAP articles. As Anthony Beavers noted in the last chapter, all this can be added for very little additional cost if the potentials of structured information present in IXML are exploited to their fullest potential. It is probably worth pointing out that this search strategy represents a significant improvement over currently available search engines on the Internet. In addition, the fact that the engine will allow full text indexing means that this is even a significant advance over the search capabilities found in OPAC systems in libraries. Finally, it has the additional benefit of not costing a library tens of thousands of dollars as current indexes with similar capability, like Carl Uncover and ABI Inform, do. In fact, it is offered as a free service.

There are other database enhancements that are possible. For example, one of the IXML fields introduced in the last chapter was the IUICODE. There is was noted that this field will allow scholars and other uses of ICAAP journals the ability to track ICAAP articles on the web regardless of the current physical location of documents. This is an important feature. As Erwin Warkentin [12] notes the instability of electronic addressing (URLs) has been a factor impacting the credibility of electronic journals. Ejournals have a widely recognised tendency to move around and this is a clear impediment to developing prestigious electronic journals. Frequent address changes make scholars reluctant to assign then credibility and reluctant to publish key work in them because of the difficulty of accessing and verifying content over the long term.

The reasons for this transience are clearly understood and include both technical changes (e.g., hardware obsolescence) and regular changes of institutional ownership of journals (thus necessitating not only a change of machines, but a change of university networks). This instability has prompted a number of initiatives designed to solve the problem of transience. [13]

With IXML and data base functionality, ICAAP has solved this dilemma, or at least made it less of a concern, in an inexpensive manner. Via the informed use of IUICODES, ICAAP has the ability to provide sophisticated and global tracking of scholarly resources from a single location. The use of the code is illustrated in Figure Sixteen.

Figure Sixteen: The IUICODE

```
<INDEXINGGROUP>
      <KEYWORDS scheme="LCSH">
            <ITEM>Scholarly Journals</ITEM>
      </KEYWORDS>
        <IDNO type="iuicode">900.1999.2</IDNO>
        <STARTDATE><YEAR>1998-</YEAR></STARTDATE>
</INDEXINGGROUP>
```

What the incorporation of IUICODES means, essentially, is that any article that incorporates an IUICODE will be identifiable by that IUICODE. For example, an article written by this author for the Electronic Journal of Sociology describes developments surrounding IXML and how these relate to the look and feel of the EJS. This article, entitled, *The EJS and SGML Production: A New Era in Scholarly Communication* is available at the physical URL address of http://www.sociology.org/content/vol004.001/sosteric.html. However, as the reader will be well aware, this link will break if the EJS ever changes its domain name (to www.ejs.org for example) or if the EJS changes the way it organises documents on the web site (an event that has occurred at least twice in the last five years). Should either of these events occur, the URL will break. This well known, and seemingly intractable, limitation of web publication is effortlessly overcome by using URLs based on IUICODES. Thus, the article above can be referred to by its IUICODE which is 100.4.1.1. Simply enter this IUICODE into the ICAAP server and the users browser will be automatically taken to the current location of the article. The URL http://www.icaap.org/iuicode?100.4.1.1 provides a live example of this capability.

The ability to provide a URL referencing scheme independent of the physical location of journals is arguably a significant advance over current systems, both actual and experimental. Incidentally, this scheme should be easy to convert to DOI or URN specifications if these specification ever reach a point where they can be implemented in a reasonably cost effective manner. However, there is an added benefit to the ICAAP strategy in that, unlike other initiatives, the IUICODE need not be administered at a central location.[14] The only aspect of the system that would have to be co-ordinated

would be the assignment of the first field of the IUICODE. Thus, the IUICODE in the example above, 100.4.1.1 references the EJS. The "100" is the journal code for that particular journal. Likewise in the code "900.1999.2". the 900 represents the ICAAP journal, *The Craft*.

However everything else about the number can be fitted according to the requirements of the journal. Thus the EJS uses a scheme whereby the second, third and fourth fields represent the volume, issue, and article number of each article. The code 100.4.1.1 thus indicates volume four, issue one, article one. On the other hand, the journal The Craft does not follow a volume and issue numbering scheme. Rather, articles are collected into yearly repositories and numbered sequentially. This journal numbering scheme is represented in the format of the IUICODE which represents the year and the article number in the second and third fields. As can be seen, the IUICODE allows for considerable flexibility. This means that all that is required of ICAAP is that a journal number be assigned. After that, the journal editors themselves can develop a numbering scheme that, in addition to providing the ability to track articles via machine technology, can also be meaningful. This is a useful benefit of the IUICODE scheme since a locally meaningful numbering scheme allows for a more robust, less error prone, and easier to understand numbering system.

Finally, this approach obviates the need to administer each individual IUICODE at a central location. All that is required from journal editors is that they contact ICAAP for the initial assignment of the journal number portion of the IUICODE, and they agree to incorporate a minimum set of tags from the IXML header in the head of their regular HTML documents, so the ICAAP robot can index their document properly. After than, no further contact with ICAAP is required. The indexing robot simply reads a list of files provided at the journal site, and indexes each new file as it becomes available – or reindexes old files as they move. In this way, a process that is very easy to administer, and almost totally automated, can be introduced in a very cost effective manner. Indeed, the cost effectiveness of the solution is belied by the depth of value added to the process of publishing electronic journals.

It is probably important to consider this in more detail. Besides providing a solution to article transience, the incorporation of IUICODEs can also begin the process of building a globally interconnected web of scientific literature. As authors have noted, the creation of this framework is a desiderata now, but it will eventually become a basic requirement of online publication.[15] Hitherto this sort of complicated interlinking has only been possible within the production process of large multinational commercial presses. With ICAAP technology, it will now be possible to begin building a high value added production system that makes full use of complicated information technologies to provide interlinked resources, multimedia capability, and stable URN addressing, at very low cost to the scholarly world.

All that would be required is that authors be convinced of the utility of using IUICODEs in their citation to online articles. This is a sensible approach. Authors are already required to collect key bibliographic information into a citation so that articles can be located. For online articles, the pattern is generally to add the HTTP URL to the end of the citation. This fails in many cases, of course, because the URL of the article

may change. However, if articles are cited using the IUICODE instead of the URL, then it would be trivially easy to develop a simple filter that would add an HTML anchor to the IUICODE in order to reference the ICAAP router. The actual citation format being discussed here would look something like that represented in Figure Seventeen.

Figure Seventeen: Citation Formats

Sosteric, Mike. (1999). The EJS and SGML Production: A New Era in Scholarly Communication. *Electronic Journal of Sociology:* 4, 1. [iuicode: 100.4.1.1]

Indeed, using IXML software, it is even possible to automatically output, at the bottom of the article, the actual recommended citation format (or even multiple formats).[16] This citation can then simply be cut and paste on the users screen. In this context, it would be very easy to convince authors of the utility of the IUICODE not only because the citation is provided for them, but also because the IUICODE is a simpler and more robust way of referring to the online document than the equivalent URL scheme. Of course, steps would have to be taken to provide very fast and very stable servers to handle the IUICODE requests as the popularity of the system grew. Generally technology of this sort costs tens of thousands of dollars. But when considered against the alternative of hand coding the interlinks, or relying on the commercial presses to offer labour intensive solutions, the cost of purchasing high end, high availability servers is largely irrelevant.

As noted above, one of the benefits of the IUICODE scheme is that it is inexpensive and does not require significant central administration. This benefit is enhanced when we consider that not even the database and redirection needs to be centrally located. Other organisations could easily use the IUICODE in search schemes so that articles could be called up via their IUICODE even in engines like Excite or yahoo. This sort of distributed production environment where a number of organisations provide access to the base ICAAP technology is already being implemented. The David and Goliath search engine being developed co-operatively by ICAAP and the IALAB at the university of Evansville [17] will provide this functionality – and more. Significantly, the IUICODE plus all the other structured bibliographic information contained in the IXML head, will allow the IALAB to provide extremely sophisticated structured searching of online resources that potentially rivals the capabilities of most, if not all, commercially produced databases.

There is more. In addition to the full text structured queries and IUICODE functionality, ICAAP is also introducing a facility to search for ICAAP journals by Library of Congress Subject Heading. When implemented, this facility will allow users to search for all "sociology" or all "women's studies" journals affiliated with ICAAP. Like other enhancements, this is easily and effortlessly added to the ICAAP repertoire of services in a cost effective manner. All that is required is that journals place a version of the ICAAP header into the HEAD of their home page. An IXML web roaming robot

will then automatically search and index each individual ICAAP journal.

As noted above, adding these database enhancements for online journal production is easy and cost effective. Most of the cost is tied up in initial research, development and programming. However once that is paid for, then very little additional effort is required to realise the enhancements. Of course, it is reasonable to assume that an organisation like ICAAP would want to secure ongoing research funding in order to hire a full-time web and database programmer. This could add $60,000 a year to the cost of handling journals. However, it should be clearly understood that the technologies introduced above scale up and could easily handle, for example, all scholarly journals produced in Canada, North America, or even the world. In this context, even hiring two or three full time programmers to handle management and enhancement of the servers is trivial. In fact, an argument could be for full institutional support since these developments have potential to revolutionise scholarly publication on the Internet. Institutions might receive considerable international attention for supporting freely available database enhancements such as the ones made possible by IXML.

IXML Widgets

The cost effective enhancement of electronic publication with IXML extends further than the addition of globally distributed data base functionality. As noted in the last chapter, IXML has added SGML tags called "widgets." These widgets allow the easy incorporation of enhanced multimedia and onscreen navigational elements to electronic journals. Widgets, in IXML usage, are simply graphical boxes, graphic pop ups, and similar forms of interactive screen "real estate" used to enhance the look and feel of IXML documents. The IXML code used to add widgets is very simple. Figure Eighteen provides an illustrative example of the tags required to add popup graphic and popup endnote capability to web document.

Figure Eighteen: IXML Widgets - INLINE

```
INLINE
 |_((graphic,
 |___text)
 |___caption)
```

As is evident, the *inline* IXML element allows for the incorporation of inline graphics with textual anchors and captions. The actual realisation of the above code in a document is very simple and would look something like the code represented in Figure Nineteen.

Figure Nineteen: IXML Widgets - Example

```
<P>To attach the file go to the
<INLINE>
   <GRAPHIC type="graphical">attach01.jpg</GRAPHIC>
   <TEXT>tools/Templates and Add Ins</TEXT>
   <CAPTION>A graphical representation of an IXML
Widget</CAPTION>
</INLINE></P>
```

Here, the *inline* widget essentially specifies that the text contained in the *text* container is to be treated like an anchor. The graphic is to be treated as an *inline* popup graphic of type "graphical." The caption is used to run a caption along the top of the graphic as it is popped up in the user window. As can be seen, incorporating the elements in IXML is straightforward. Following this, no further manual handling of the "widgets" is required. In fact, from this initial specification in the IXML file, ICAAP conversion programs are able to parse the IXML document and create Dynamic HTML (DHTML) files with fancy screen note and graphical pop ups, instantly and with no additional effort on the part of the ICAAP production assistance. The conversion process also creates a more basic HTML file that adds graphics and endnotes at the end of the document for those without the advanced browser technologies required.

This is a significant achievement made possible only by combining IXML with ICAAP parser technology. An online and working example of IXML widgets is provided online at http://www.sociology.org/content/vol004.001/test.html (simply click the endnotes and links). Glancing at the source file of that document will reveal that actually implementing the IXML widgets requires extensive HTML (shown) and javascript (not shown) coding. Providing this functionality outside of the ICAAP production process would clearly require many hours of document handling. This would without a doubt greatly increase the cost of producing online journals. However, inside the IXML production process adding the widgets is easy and simple and takes only as much time as is required to enter in the *inline* tags that identify ICAAP widgets. The result is an impressive display of interactivity that creates, for the first time, an online journal presentation format that fully exploits the interactive potentials of information technology.

Wordprocessor Macros

Up until this point, the dissertation has examined in considerable detail the impressive value added features available in a cost-effective manner with the use of IXML and other ICAAP technologies. Interestingly enough, and putting aside research and development costs, none of what has been discussed so far adds to the cost of handling journal articles. Even now, the principle costs of electronic journal production remain the editing, markup and mounting of scholarly articles. The only difference is that

instead of marking article up in HTML, IXML is used. As should be clear, IXML is as simple as HTML and offers no additional labour requirements save training so that the users can properly apply widgets and the head elements, and so that users can properly exploit SGML markup and validating software. In terms of the actual cost, marking up an IXML document, either by hand or with SGML software, would require about the same time as marking up an HTML document by hand or with software. However the differences in potential between HTML and IXML are staggering.

All the other possibilities available to the user of IXML are added with very little addition labour cost. Running conversion filters takes a second as does adding links to local file lists which are used by the ICAAP robots to determine which files to index. At this point, what we have is a journal production process that provides numerous value added services at no additional cost. However we still basically are left with a tedious, time consuming, and error prone hand conversion process (as anyone who has ever marked up articles by hand will know). Not only do paragraphs have to be marked, but special formatting instructions that identify emphasised text (e.g., italics, bold underline), and special "entities" that identify special characters (e.g., "&" for the "&" character, or "&lsquo" for a left single quote " ` " must be inserted to ensure document portability from one system to the another. It is not unreasonable to suggest that a complex journal article with a significant amount of formatting and special characters would take several hours to translate into HTML (or IXML) if markup was conducted manually. Fortunately, information technology can be turned towards this task in order to enhance and ease the process of converting documents to IXML. This is done via the use of wordprocessor macros that can, in some case, totally automate the markup of a journal article. [18]

The macro automation being pointed to here is made possible by again exploiting one of the most useful features of journal articles – a well known and stable document structure. Like other documents, journals articles contain paragraphs, blockquotations, tables and graphics, citations, abstract, etc. This dissertation has already demonstrated how these journals structures can be mapped to IXML entities. However the same sort of mapping can be applied inside a wordprocessor so that style components of a document can be mapped to IXML entities. What this means, essentially, is that programs can be written that automatically and accurately identify textual structures based on styles applied during the copyediting process. At ICAAP, what this means in practice is that as an additional part of the copy editing process, ICAAP styles are added to documents. Thus, all paragraphs are identified with the "normal" style, quotations with "blockquote" or "quotation", lists with the "olist" or "ulist" style, and etc. Virtually all possible textual elements can be thus identified as a normal part of the copy editing process.

Once this initial tagging is done, which takes between 5 and 15 minutes depending on the complexity of the article and the number of "unusual" document elements (i.e., graphics and tables), the document can then be turned over the ICAAP production assistant. At that point, the assistant uses a suite of Microsoft Word macros (developed by this author) to mark the article in IXML. These macros perform a number of functions automatically including document cleaning, the conversion of quotations and

special characters to their SGML equivalents, the correct identification of underlined, italic and bold text and the conversion of this to their associated IXML mark styles (e.g., <I> for italic text), and the correct and automatic containment of all paragraphs, quotations, and graphics. The final result of this conversion process is a complete IXML document (sans header which is added by hand) with all special characters converted to their SGML equivalents, all block structures like paragraphs contained within the associated IXML tags (e.g., <P>...</P>), and all graphics and other special characteristics contained with the appropriate IXML widget entities.

The time it takes to apply this automated process, which is very robust, varies. Factors that influence the application of the process include the skill level of the production assistant, the complexity of the article, and the presence of any "unusual" document structures (authors can have extremely idiosyncratic ways of representing information in documents). Assuming a moderately skilled production assistant, and a reasonably clean and uncomplicated document (no tables, a few graphics), full conversion to IXML can take as little as five minutes or less. This short conversion time does not really depend on article length. A simple 40 page document can be converted almost as quickly as a simple 10 page document. Alternatively, a paper with many tables and graphics can take as long a four hours to convert to IXML.

Besides IXML markup, the macros can be turned to alleviating some of the tedium of editorial work. Currently, ICAAP is developing a house spelling and punctuation style. Many of the basic spelling corrections will be amenable to total automation thus saving perhaps ½ or more of editorial labour. Thus, it will be possible to Canadianize (Canadianise) words with the simple flick of a switch. Importantly, these textual replacements can be handled selectively so that text inside of blocked quotations can remain as originally intended, while text in normal paragraphs can be replaced. Obviously, only a fraction of the editorial labour can be fruitfully automated in this manner. However, that small fraction is the most tedious part of editorial labour. Automating this process could save money. However it is also reasonable to suggest that the time saved could be turned towards additional tasks and more substantive editorial corrections.

Implications for cost –labour costs revisited

So, after discussing in detail some of the technological potentials of IXML, the ICAAP parser, database handling of web documents, and automated markup, the question before us now, and finally, is what are the implications of these technologies for reducing the cost of electronic scholarly production. Before discussing this in more detail, let us recall the information on production provided for the Athabasca University journal proposal.

Table Six: Costs Revisited

Continuing Costs (annualized)

Associate editor honorarium	$4,000
Editorial assistance	$6,000.00
Document production	$1,880.00
Contingency	$2,000.00
Total	$13,880.00

As argued above, all of the value added indexing and database functions can be added with little additional cost to the journal. However the ground can be shifted. By fully exploiting IXML, significant savings in the labour for various components in the above distribution of costs can be realised. For example, part of the job of the editorial assistance revolves around site maintenance and the creation of links, indexes, and the like. With IXML and IXML robot technology, many of these functions can be automated and enhanced simultaneously. In addition, link checking technology, and other forms of automated site maintenance software, can further reduce the job requirement for editorial assistants. Many of these have already been discussed. However it is important to note that ICAAP has only scratched the surface potential. Still, a reasonable estimate of the potential cost savings would perhaps half the $6000.00 per year figure to $3000.00 for editorial assistance for a single journal.

The honorarium paid to the managing editor would remain largely unchanged. At least for now. However, significant savings could be realised in document production and handling. As demonstrated, IXML plus the intelligent application of document technologies can have a major impact on the cost of handling journal articles. Above it was noted that the average cost of handling journal articles without intelligent application of automation technologies would be one hundred and fifty dollars for article production, and thirty dollars for copyediting. With IXML, this estimate can be revised down dramatically. For a simple social science or humanities journal with no graphical or table requirements, and no math, the average cost of handling articles would be about thirty dollars. This would include an hour of copy editing, plus 10 minutes of production time, 10 minutes to mount the article, and another 10 to verify everything works properly. For more complicated articles, additional time would be required. However it is unlikely that any article would require more than five hours of processing time even with extensive tabular or mathematical data. This is considerably less the fourteen hour estimate given above. However, for the sake of argument, let us assume that the IXML production process allows us to trim one half of the current estimate of journal production costs. Putting all the various savings together, we are left with the cost estimate below.

Table Seven: Revised Costs

Continuing Costs (annualized)

Associate editor honorarium	$4,000.00
Editorial assistance	$3,000.00
Document production	$900.00
Contingency	$1,000.00
Total	$8,900.00

Obviously this figure is getting quite low. However it can be reduced even further. Imagine for a moment that the journal was offered online for free. This would immediately eliminate most of the tasks associated with the managing editor. No subscription lists, no contact databases for libraries or subscription agents, no need to perform mail out or advertising - in short, none of the administrative overhead associated with paper journals. Of course, the job of managing editor would not be totally eliminated. However the numbers of tasks would be significantly reduced. Perhaps it is reasonable to half the estimate for the associate editor's honorarium to two thousand dollars. This would leave a total production cost of $6,900 per electronic journal. Interestingly enough, this figure does not mean reducing the quality of online publication. In fact, as argued above, it represents an almost unimaginable enhancement over what is currently being offered to the scholarly world.

The production data provided above is based on the real world markup of ICAAP journals. However, the cost estimates themselves are just that – estimates. At the time of this writing, ICAAP has no hard data concerning the actual cost of running an electronic journal, including full administrative and production assistance, at full cost recovery. Now the question remains, is the above estimate realisable in a real world scenario? This is a good question. Although ICAAP has successfully implemented the infrastructure, ICAAP has yet to demonstrate that this infrastructure can realise a $7,000 per year scholarly journal production process. The question is, in short, can this infrastructure be turned to reducing the cost of the online scholarly journal?

The final verdict on this is not yet in. However there is an experiment currently in place that involves moving an established scholarly journal of environmental studies, *The Trumpeter*, from paper to online. In the process of moving this journal online, the editor of the journal has agreed to drop subscription requirements and turn all journal production over to ICAAP. The short-term intent of this move is to a) reduce the cost of the scholarly journal and b) recover 100 percent of the operating costs of the electronic version. ICAAP and the Trumpeter are operating from the assumption that the total yearly operational costs of the journal will be $10,000. This adds over $3000.00 to the base estimate provided above and gives some margin for error. If this is attainable within the confines of the ICAAP production process, it will be a significant vindication of the arguments laid out in the final two chapters of this dissertation.

Is this result attainable? This author believes so. If we assume the current subscription base of 700 individual and institutional subscribers, The Trumpeter and ICAAP expect to be able to provide a freely accessible journal of environmental science for $10.00 to individual subscribers, and $20.00 to institutional users. This fee would include access to all available ICAAP technologies. However it is important to note that this fee is not a subscription fee. Part of the ICAAP/Trumpeter experiment is to see whether the library and university community will freely support the electronic publication without requiring access restriction and the additional infrastructure this requires. This experiment with alternative funding is an important component of the experiment since if it is successful it will mean that it will be possible to provide some types of scholarly information free to the world while still attaining full cost recovery. It is an ambitious experiment that this author hopes will clearly and unequivocally demonstrate the true potentials of information technology.

Conclusion

> What we have learned from these experiments is that, in no uncertain terms, it is technologically possible *and* economically feasible to build a system of dissemination for academic resources that is completely administrated by the scholarly world without the intervention of economic interests. If the IALab has not yet demonstrated this fully in the concrete, this is only because we have been operating on a very small budget in an inexpensive lab that employs undergraduate Interns under the direction of a single faculty advisor. (This should underline the economic feasibility of enterprises like the ones discussed above.) It is not because standards must first be reached for meta-tags, nor is it because the problem is technologically difficult, though a considerable part of the paper paradigm must be rethought. We fully believe that the new Internet technology offers the academic community improvements to the existing system of dissemination as long as it does not wait for the corporate sector to solve these problems for it. [19]

As Beavers notes in the above quotation, considerable progress has been made towards demonstrating the feasibility of a system of scholarly communication controlled by scholars. The task of the last two chapters has been to examine in detail the full potential of information technologies. The ICAAP production system, along with IXML and various other database and web roaming software products demonstrates, in relatively unequivocal terms, that information technology can potentially revolutionise they way scholars pursue scholarly communication. To be sure, the system developed at ICAAP and discussed in this dissertation, is still in its preliminary stages of development. Yet even now it promises to be able to compete effectively with more expensive commercial alternatives.

The argument developed here is simple. With the help of organisations like the IALAB, and with the technological expertise developed at ICAAP, a scholar controlled system

of scholarly communication can be designed that makes effective and sophisticated use of information technology to provide all the basic features that one would expect from electronic scholarly journals (i.e., multimedia content, multiple formats, interactive displays, complex indexing and interlinking) without the high cost associated with for profit publication. This is a significantly revolutionary argument since it runs against the common sense knowledge of many stakeholders in the scholarly journals community. In 1995, Fytton Rowland [20] suggested that that because of academic workloads, the size of the task, the need for quality publications, and the need to filter information for quality purposes, scholars themselves would be unfit as purveyors of scholarly information. Rowland went so far as to suggest that *all* journals need to be run by information professionals and not, in his own words, by "*academic amateurs*." [21]

It would be difficult to argue against Rowland's statement that information professionals must be involved in the journals distribution system. A high quality, value added, and sophisticated journals production system should be striven towards. However it does not follow from Rowland's statement that scholars cannot perform the necessary research and development, or that scholars cannot perform the necessary groundwork for reforming the scholarly communication system in ways that benefit the scholarly community as a whole. Here Rowland is in error. Hopefully, the case of ICAAP and the IALAB (which is run by a philosopher) has demonstrated that current information technologies, when imaginatively applied, have the capacity to significantly alter the landscape of scholarly publication. As has been argued, the development of the IXML solution to document handling can provide the bedrock technology for a sophisticated publication system that is not only easy to use (consider the ease of adding IXML widgets), but that can incorporate most, if not all, of the current cutting edge thinking on electronic publication (DOI, URN, crosslinking, etc).

Conclusion

> I think it's safe to say that everyone in this room is aware that a communications revolution is under way that is as profound as the introduction of the printing press. This information revolution promises the creation of a worldwide resource with social and economic implications that have the capacity to alter dramatically the course of history and to change the way we live. [1]
>
> Transforming information into a salable good, available only to those with the ability to pay for it, changes the goal of information access from an egalitarian to a privileged condition. The consequences of this is that the essential underpinning of a democratic order is seriously, if not fatally, damaged. This is the ultimate outcome of commercializing information throughout the social sphere. [2]

When this dissertation was conceived some five years ago, the original intent had been to discuss the sociological aspects of publishing electronic journals. The motivation for pursuing this topic was simple. As founding editor of the *Electronic Journal of Sociology* (one of the world's first electronic journals, and the first electronic journal in sociology), it seemed like an apropos topic for a dissertation. I did not know at the time that choosing this particular topic, electronic journals, would lead in the directions it has – and pursuing this topic has led in some rather strange directions. At one time or another, and through 3 or 4 total revisions, this dissertation has been about citation analysis, scholarly journals, scholarly communication, the sociology of science, globalisation, inequality in class and gender, scientific communication, the sociology of scientific knowledge, postmodernism (just barely) and technology. It would an understatement to suggest that pursuing this task to completion has been a difficult and convoluted task.

Why the convoluted path to completion? Perhaps its because in the four or five years since I have been working with the electronic scholarly communication system, many, many things have changed. For a number of reasons, it has been difficult to keep up. When I first started the dissertation, HTML was a new technology, CERN was the premier web server, Linux was still an underdeveloped "hackers" operating system (meaning you needed an incredible amount of technological know how to install the operating system), and windows was still refereed to by a floating point number and not an integer (3.1 rather than 95). In less than five years, XML has emerged as the new technology of choice for storage and distribution of electronic communication, Apache has become the globally dominant web server, Bill Gates stands before the Supreme Court, and Linux is rapidly overtaking Windows as the premier Internet and desktop operating system.

Along with these technological shifts come shifts in technological potential that have required new levels of analysis and new types of technological expertise. Earlier

iterations of the dissertation grasped for meaning and potential among a set of immature information technologies. Glimmerings of a future potential were seen, dimly and sometimes in a twisted and convoluted fashion, but successfully arguing the potentials only dimly sensed was difficult. Perhaps working with the technology at a hands on level, i.e., doing all the programming, SGML and database development, setup and R&D for the EJS first, and later, ICAAP, has given me an insight into the future that others cannot have. Yet transforming that insight into reality, and convincing others of the existence of this potential, has been difficult. Rightly so, there has been deep scepticism and doubt about the true nature of the "crises" (some would prefer not to call it a crises) in the scholarly communication system, and deep scepticism about the transformative potentials of information technology.

Communicating the difficulties, and communicating the potential solutions, has been complicated by my own inexperience, to be sure, but also by the rapidly shifting technological ground. I have no doubt that in six months the ground will have shifted again. This rapidly shifting ground means two things. On the one hand it means it is very easy to get behind the technology, and very easy to have included obsolete technology and obsolete technological discussions in the dissertation. This is problematic in and of itself and obviously requires those involved in the dissertation to be aware of the rapidly shifting ground. Overcoming the problems associated with rapid technological shifts is compounded by the ease with which inertia can be allowed to carry forward obsolete solutions when new emerging solutions offer better alternatives. Unfortunately, in a choice between revising an obsolete dissertation (because technology has moved faster than the committee), and leaving old technology sit in the dissertation, good sense does not always win out.

This is especially so since it is often easier to discuss the latest developments in academic publications that deal with these issues – and let discussions in the dissertation slide. To illustrate, consider the fact that material presented in Chapters Five and Six of this dissertation will have been published and publicly accessible literally months before this dissertation reaches completion. Beyond this, ICAAP will have developed further technological enhancements not even conceivable as I write these words. It is a peculiar problem that draws into sharp relief the limitations of books and paper publications when compared with scholarly e-journals.

Besides the problems with a shifting technological ground, there has also been a deep tension in the work between the purely technological component of the project, and the sociological/theoretical component. It has not been easy to resolve this tension. At times the theoretical part of the project has burst the boundaries of reality ascending into lofty and unbounded ethereal realms. However, at other times the theoretical portion has been drowned amid a welter of empirical and technological details. But as experience has clearly demonstrated, the theoretical cannot be separated from the empirical, nor can the technological be separated from the theoretical. Doing so leaves an unbalanced project incapable of contributing in a significant way to the advancement of our understanding of the scholarly communication system, the difficulties it faces, or the possible ways forward. The reason for this should be clear. Leaving out a theoretical/sociological component leaves us unable to overcome social, political and

economic obstacles to reforming the system. On the other hand, leaving out the technological component leaves the dissertation unable to overcome the resistance and scepticism of most stakeholders. After much trial and error, the only way forward seems to be to balance the two by providing a sociologically informed discussion of information technology and a technological prototype of the potentials inherent in technology. Taken together, this "middle way" might provide a virtually unshakeable argument about the true potentials of information technology.

Of course, taking the middle way is not always as smooth as we might like. At the beginning, this dissertation spoke about technology and human activity and linked the two in discussions about the potentials of technology to alter human activity and human understanding of the natural and social world. However, after spending considerable time outlining how the current system of scholarly communication has failed, and what this failure means for individuals and social groupings in the academy and the wider society (e.g., structured inequality in the academy), the dissertation seemingly breaks with this sociologically informed analysis and moves off into a detailed and strictly technological discussion.

Still, the "break" is more apparent than real. As noted above, and again below, detailing the form and content of technological solutions was necessary in order to *establish* the true potentials of technology for those unfamiliar with the detailed working of advanced information handling systems. Yet this technological detour is as much a part of the social and political discussion as the more sociologically informed sections of the dissertation. In fact, the technological discussion is the necessary first statement in the development of an argument that suggests that technology can change the face of scholarly communication by *opening* access to the distribution system for scholars normally excluded from a full participation in the system. This argument is encapsulated in the discussion of an *open* journals communication system below. The argument is simple. New technologies, of the type outlined in the last two chapters, will allow us to lower the entrance barriers to participating in the scholarly communication system. This notion of Open Technology and an Open Communication system is the link between the purely technological component of the dissertation and the social/political. It is in this concept that we find the bridge that ties the two disparate sections of the dissertation together. However, before detailing this bridge it might be worthwhile to take broader stock of the dissertation.

Looking back over the gestation, growth and final maturity of this project, and given the strange and unusual directions the dissertation has been drawn in, the question needs to be asked, finally, what is it about the work that defines it? Has the work settled on a final topic, a thesis, that defines the nature and scope of this work. Besides the obvious answer which is that the work is about the scholarly communication system, what has been accomplished? What has been learned? Does this dissertation represent an unshakeable argument about the potentials of information technology? Let us go once more over the theoretical and technological components of this dissertation in order to answer these questions.

Theoretically, the project has settled on some minor expression of the utopian dreams of individuals like Bacon and Habermas who saw great transformative potentials in the

free and open communication of information. As noted in the introduction, and then again in Chapter One, there are powerful long term impacts of information distribution. High quality, low cost and open distribution of information lends itself to social and economic development. The reverse, closed, expensive, inaccessible information, arguably lends itself towards social and economic entropy. This was a fact understood by those who founded and edited the first scholarly journals, and of those who proselytised a utopian vision about the potentials of open information distribution whether of a scholarly or political form (it is even now the vision of countless gurus of a technological utopia). This was demonstrated in Chapter One where it was noted that, for the first scholarly journals at least, information was as much about industrial and social development as it was about the basic research of science. The new scientists, whether as part of enlightenment Europe or as part of the mythical imaginings of New Atlantis author Francis Bacon, knew no formal distinction between the communication of information, and societal development. It is this potential to enhance development that is captured in the visions of current technopundits, and also in the vision of the potentials of electronic communication offered in this dissertation.

It is probably worthwhile noting that the theoretical position taken vis a vis the potential of information to create the preconditions and opportunity for general social progress does not reflect a naïve understanding of the enlightenment project or the potentials of science. One thing that has been clearly learned in the course of exploring the sociology of science, and postmodern and gender aware criticisms of science, is that science and scholarly information is no guarantee of economic or social progress. This was the lesson in Chapter One and Chapter Two where it was pointed out that despite the advance that the primary journal was over the previously closed and cloistered letter and book system, it did not alleviate all associated problems. Just as before the emergence of the journal, after the primary journal some groups remained marginalised and excluded from the discourses of science and power. This is not to decry the advance that the primary journal represented. It is just to recall the fact that information and technology offer no mystical solutions to structured inequality. Open and public communication may be a desiderata, and they may contribute in a recognisable fashion to social and economic progress, but that is no guarantee that all will enjoy the benefits.

This theoretical position, that of the progressive potentials of information distribution, forms the underpinning of the fundamental question being asked in this dissertation. Can technology and new ways of organising and distributing information enhance the scholarly and social communication process? As was noted in Chapter Three, there is potential to carry forward the project first envisaged by Bacon. Even when focusing narrowly on individual electronic journals, the potential to lower cost, increase access, and speed the distribution of information is apparent. We only have to consider the explosion of electronic information distribution that has come with the development and maturation of the WWW and other Internet technologies to know that electronic scholarly communication is potentially a revolutionary force. There is nothing original in this observation, of course. Many others had been arguing about the potentials of information technology to enhance or transform scientific communication or society for decades prior.

Despite the fact that perception of the potentials of information technology has been widespread both physically and temporally, there has been variance in the faith people have placed in information technology. Some saw a moderate potential for reforming the system and bringing enhanced communication flow to society. Others saw a more revolutionary potential to explode the boundaries of information and also explode the limitations of scholarly discourse. The more utopian and visionary perspectives would have electronic scholarly communication feeding and nurturing a fundamentally new way of engaging scholarly discourse "at the speed of thought," as Harnad suggested.

Unfortunately, things did not work out as the early pioneers of electronic scholarly communication had hoped. Not only was our early enthusiasm not shared by others in the scholarly and commercial community, thereby hampering rapid deployment of electronic scholarly technologies, but active resistance on the part of some stakeholders impeded the free development of the technologies. In Chapter Four, the dissertation spent some time examining the blockages to significant reform of the system. As noted there, besides a defensive reaction on the part of traditional stakeholders and new publishing interests, commercial resistance and a global shift towards a market and monopoly orientation has further impeded rapid advance. The result, as pundits have noted, is a "failed revolution" in the scholarly communication system.

There are many unfortunate things about the last few years and the "failed" revolution – things that should now provide clear lessons of directions not to pursue. One of the more telling lessons derives from the examination of how the way early pioneers of alternative scholarly communication often painted the entire traditional scholarly communication system with the same brush they painted the commercial presses. Recognising that the system was in difficulty, and wanting to see a way through the current fiscal difficulties, early pioneers over generalised from the behaviours of a few commercial presses to the entire scholarly communication system. This led, predictably, to antagonism, defensiveness, and an inability to leverage the combined expertise of all stakeholders. Hopefully, that time is past and stakeholders can come together to find reasonable solutions that satisfy all interested parties.

Another of the lessons learned from the examination of blockages is that reform will not be easy. Even if stakeholders come together, as they are now more and more doing through initiatives like SPARC and ICAAP, there will still be significant resistance from the commercial presses. This is particularly true when we consider the technological advances required to reform (or revolutionise) the scholarly communication system. Despite the fact that many technological obstacles have been overcome, there are still huge gaps in our understanding of the potentials inherent in information technologies. It is not that knowledge is not already available. It is simply that much of it is holed away in technical communities and programmers communities distributed in the computing science departments and private laboratories of the world. Little of this expertise, it seems, penetrates up into the academy and the scholarly communication system. And even if it does, it is often isolated in unconnected centres where a more global impact is denied.

As noted above, this dissertation began as a result of my interest in electronic journals. It ends with the formation of ICAAP and an attempt to develop a workable prototype

infrastructure for electronic scholarly journals. As noted, political obstacles, social obstacles, and the immaturity of many approaches to electronic scholarly communication hamper the development of reasonable and cost effective solutions. ICAAP is an attempt to overcome these limitations by developing a workable electronic journals infrastructure. That is, the intent of ICAAP has been to engage in evolving currently available technologies to the point where the potentials of the technology are readily apparent and were the ability to redirect inquiry and initiative into unproductive avenues is reduced. In this way, ICAAP combined a technological strategy with a political and social one that seeks, ultimately, to block the ability of the commercial presses to define the system in ways that serve their interests. With a workable alternative infrastructure, such attempt to "define reality" will be perceived for exactly what they are.

The necessity of an organisation like ICAAP, devoted to R&D, and dedicated to exploiting the full potentials of information technology, became apparent as the discourse about the potentials of scholarly communication slowly shifted in conservative directions. As commercial presses and scholarly societies investigated the potentials of electronic scholarly communication, and as governments offered support or even their own solutions, the resulting visions seemed sadly out of sync with the dimly glimpsed potentials of information technology offered by the early pioneers. Could it be that the early revolutionaries like Harnad and Odylko were naïve about the potentials of information technology? Perhaps. As was demonstrated, one of the keys missing from the early picture was a sociologically and politically informed awareness of the political dynamics of the commercial system. This left early revolutionaries naively assuming that just because there was potential inherent in information technology, then it must, by virtue of some internal motive force, move us towards revolutionary change. As can be seen from the formation of initiatives like SPARC and ICAAP, this early naivete concerning the underlying politics of the system have been largely overcome.

However, other critical components of a reformed scholarly communication system have remained elusive. For example, early pundits spoke of the potential to reduce cost. However there was a certain naivete in these early discussion which led others to doubt the potential. The missing links were numerous but one critical missing component was simply that many seemed unaware of the potentials of open source software to provide professional quality, robust, and *free* infrastructure components for the scholarly communications infrastructure. This was an important lack since the difference in infrastructure cost between those using Open Source software and those not could be quite startling. For example, where others would pay upwards of $60,000 for basic text handling tools, Open Source alternatives that were at least a good, if not better in some cases, than their commercial alternatives were available at no charge. The implications for costing scholarly journals system seem obvious. When we rely on commercial solutions, the cost of providing basic infrastructure services rapidly escalates.

Other potentials seemed to be missed as well. For example, traditional publishers seemed unaware of the potentials of technology to automate and add value to the journals production process. These potentials seemed locked away in the very esoteric

and difficult to understand SGML system. As this author had been aware of for some time, a good SGML system could provide extensive opportunities to automate document handling and add value to production systems. The technical community knew this as well. A very popular implementation of SGML, known as DocBook, has been used for years to create multiple versions of documents for different computer and software platforms. Yet despite this powerful potential, most in the scholarly journals community worked with the highly successfully, but problematic, HTML as the principle language for journals production. This work has been extensive and attempts to use HTML for value added functions, like the provision of structured meta-data, have proliferated. However HTML was never intended to provide such highly structured information applications. As a *general purpose* text markup language it has been hugely successful. However as an application capable of meeting the more demanding needs of various communities, including the community of scholars interested in electronic scholarly communication, it has failed miserably.

However the potential is there as the SGML application IXML plainly demonstrates. Building on the strengths of HTML (i.e., widespread distribution and ease of use), IXML does away with the limitations of HTML and provides a concrete example of the embedded potential of information technology. With IXML, complicated bibliographic information can be stored in a sensible, easy to understand, and extensible SGML structure. In addition, specific elements designed to enhance the presentation of journal articles online (i.e., IXML widgets) can be added as needed. The result is a electronic representation of the journal article that lends itself to all manner of automation strategies. Multiple document formats can be output in a rapid and robust manner. In addition, automatic indices and various database enhancements (like the IUICODE) can be added with an ease and grace not possible with the "clunky" HTML. As noted towards the end of the last chapter, ICAAP has only started to tap the potentials for an enhanced journals infrastructure made possible via the full exploitation of currently available information technologies.

The outcome of the initial research at ICAAP is easy to encapsulate. Not only is there considerable untapped potential in information technology to enhance the scholarly communication system, but this potential comes at a low cost. Indeed, despite all the additional features that are possible, and despite the complexity of some software applications (web enabled databases applications are no fun to develop and program for), there is vast potential for reduction in cost. This is clear from a consideration of only Open Source, and the potentials of IXML. However leverage economies of scale by locating essential infrastructure services in house, and by accessing the technological expertise of centres of technological excellence, and fully exploit IXML and other information technologies, and the cost of producing scholarly information becomes almost trivial.

Admittedly, the ICAAP case is an extreme example that depends on the confluence of some unique factors (not the least of which is this author's ability to engage in all R&D and programming – an ability that has made it possible to understand the potentials of information technology at a deep level). Many factors would mitigate the full realisation of the ICAAP example in other organisations. However even if a middle road was

taken, i.e., partial use of open source, and partial use of commercial software, significant savings could still be realised. The actual balance will of course depend on the peculiar characteristics of an organisation (a subject of another study). However the potential is clearly there. In any case, the ultimate intent is not to create a bargain basement communication system. However, because of resistance to reform demonstrated by many stakeholders, because of the resistance from commercial interests, and because of the lack of vision identified by Peter Boyce, there has been a powerful need to demonstrate the radical potential of Information Technology. It is in this demonstration of the potential that the most powerful argument concerning the ability of information technology to revolutionise the scholarly communication system resides. Without initiatives like SPARC and ICAAP, all the prognostication in the world amounts to little more than utopian fantasy.

The contours of the ICAAP argument are worth repeating. By exploiting open source software, distributed centres of expertise, and the full potential of SGML and related technologies, it is possible to create low cost scholarly communications infrastructure that lends itself to fast publication, open and global access, and, perhaps most importantly, local control by scholars and their immediate representatives. It seems safe, at this point, to say at least this. However there is a future potential which, in closing, it is useful to consider.

As discussed above, one component of the ICAAP vision is to demonstrate that a high-quality, value added, scholarly owned, low cost and rapid system of communication is possible with current technologies. This has been the short term goal. However a more important longer term goal is to demonstrate that it is possible to fund a scholarly communications system in such a way that access to scholarly information is provided in an "open" manner. This means simply that unrestricted access to high quality scholarly information is provided. In other words, this requires that electronic journals are provided free, the way current journals are provided through library access. ICAAP attempts to institutionalise this requirement through a basic principle of operation or rule of "business." In exchange for free access to ICAAP infrastructure services, all journals must remain free or adopt shareware funding models. The net outcome is that all ICAAP journals are globally available.

Is such an open system of scholarly communication attainable? Unfortunately, at this time, there is no conclusive answer to that question. While the ICAAP infrastructure is in place, and while ICAAP can clearly demonstrate the ability to handle multiple electronic journals at a fraction of what the current system is capable of, the propagation of this vision is necessarily in the earliest stages and a final answer to this question awaits a reasonable lapse of time – and a reasonably extensive funding campaign. One thing should be made clear though. ICAAP does not expect to continue to develop without a funding base. The long term goal is to acquire government and institutional funding for ongoing R&D and growth of the ICAAP collection. In terms of institutional funding, the ICAAP model is simple - charge libraries a reasonable "subscription" fee collected on a voluntary basis. It is expected that if enough libraries voluntarily support ICAAP by paying a nominal fee for access to ICAAP titles (set at $300.00 for large institutional libraries) then ICAAP can continue to provide free

production and editorial support, and free access to the (eventually) 30 or so ICAAP journals, at a cost of about $10.00 per title. Should libraries provide funding for ICAAP without requiring the added incentive of restricted access (the commercial model requires payment before access), then the long term ICAAP experiment of demonstrating the viability of an alternative funding model will be successful.

Why would ICAAP choose to investigate the feasibility of this funding model? The answer is simple. The actualisation of this alternative funding model would revitalise a centuries old dream about the potential of high quality information to create the preconditions for economic and social advance. As was recognised when the first scholarly journals appeared on the scene more than four centuries ago, information is a basic building block. It is a fundamental component of the productive and social infrastructure of society. Like the road system or the hospital system, the smooth advancement of modern societies presumes a healthy scholarly communication system.

Open access to information, or scholarly information perceived as a basic infrastructure component, could help actuate some of the utopian potentials of information perceived by various individuals throughout history. Certainly providing scientific information to developing countries in a cost effective manner and timely manner can contribute in a tangible way to the development of these nations. The obstacles that are currently faced were noted in an earlier chapter. High cost, delay, and inaccessiblility create an inorganic interface to the scholarly research front. With a low cost, open, and globally accessible system of scholarly communication, concrete steps could be made to reduce or even eliminate the disadvantage that scholars in developing nations experience. The long term outcome, though a topic of another book length tome, could be remarkable.

It would be possible to argue for the lowering of barriers in other areas as well. A more open and accessible system of scholarly communication would go a long way towards weakening the informal system and bringing cutting edge science "into the open." While electronic journals would probably never eliminate informal networks altogether, they can make accessing the research in these networks in a timely fashion a bit easier. Shortening the publication day from months or years to weeks means reducing the need to rely exclusively on informal networks to know what is going on. It also means reducing the cost of accessing cutting edge research since constant travel to conferences is no longer necessary (to be sure other type of IT also make this possible, like mailing lists). As was noted earlier, this could mean the difference between a productive research program and an unproductive one. This could also help contribute to the reduction of structured inequality because it levels the playing field and allows more equitable access to cutting edge information. Of course, as with the original scholarly journal, inequality would no doubt still remain in attenuated form. Still, like the original scholarly journal, it would be a welcome advance over the current system.

There are deeper implications of creating an open scholarly communications system that go beyond the boundaries of the scholarly world. Creating an open and accessible system could also help revitalise a body politic isolated and reduced to superficial image politics in the western world. It could also help make social and political connections at a global level that would not be possible otherwise. This is of course the potential of open communication offered by Habermas. Information technology could help actuate

that vision of a sophisticated body politic participating in a global democratic society by providing open access to the critical information that would be required for informed participation. Presumably, the public could have access to the hard –nose scientific journals. However, when the discourse becomes too heavy, other outlets which require a more accessible language (but remain peer reviewed and quality controlled) could provide an invaluable public information source. The political and social potentials of an openly accessible journals system have been recognised by others. As Anthony Beavers notes about the IALAB/ICAAP search engine project:

> The hope of the IALab and the ICAAP is that Goliath will stimulate the proliferation of independent journals on the Internet that operate without economic interest. The price of this technology is inexpensive enough to create an Internet in which quality information is disseminated efficiently to the global community free of charge. In a matrix where authors have traditionally not been paid for their contributions to journals, we hope that authors will respond positively to these independent journals as well. Goliath means a wider readership, because access is free and efficient; and because it provides mechanisms for the validation of resources. Internet publication should start to "count" in promotion and tenure decisions. Furthermore, Goliath will work to bridge the gap between the general public and the university, allowing scholars the more traditional role of informing society rather than being subject to its economic whims.

This is of course not a new vision, or a new role, for academics. It is the reclamation of a right and an obligation stripped from us by global political and economic change and the rise of the entertainment/ideology industry (planet Hollywood). Of course, huge obstacles stand in the way of the realisation of this dream. The current sorry state of the body politic in the western world, and the creeping cultural hegemony of the United States, might make the actualisation of the deep potentials of information technology nothing more than a utopian dream. But, as we are all aware, utopian dreams have formed a part of critical scholarship for centuries. Though they may never be realised in their full glory, they may contribute in not insignificant ways to social and political advance.

But there is a choice involved. As this dissertation has attempted to argue, there is incredible potential locked away in information technology to recreate the scholarly communication system. But there is also potential for much damage. Information technology could contribute in significant ways towards social and political advance. Or it could create an Orwellian world of panoptic surveillance. As the late Jean Francois Lyotard who noted:

> We are finally in a position to understand how the computerization of society affects this problematic. It could become the "dream" instrument for controlling and regulating the market system, extended to include knowledge itself and governed exclusively by the performativity principle. In that case, it would inevitably involve the use of terror. But it could also aid groups discussing metaprescriptives by supplying them with information they usually lack for making knowledgeable decisions. The line to follow for computerization to take the second of these two paths is, in principle, quite simple. Give the public free access to the memory and data banks. [3]

Of course, it would be naïve to think that simply providing a socialised scholarly communication system, much like a socialised road network, would automatically lead to global transformation. The vision outlined and examined in this dissertation is only a small component of a solution to a very big problem. But it is an essential component. Still, there is an important lesson to be learned. Ultimately, we will never answer the really big questions about the transformative potential of information technology unless we actively develop progressive technological solutions that allow technology its full positive expression in an open system of [scholarly] communication. That there is significant transformative potential can no longer be reasonably debated. The question for the scholarly world at this point is, what will we do with this potential?

Future Research Directions

Much has been said in this dissertation about the potentials of IT. While the dissertation has covered considerable ground, there are still gaps in the analysis that require further research. Much more needs to be done to solidify the arguments presented and extend them beyond the closing focus on the purely technological side of scholarly production and into the social, political and economic realms. It is the task of this final section of the dissertation to point the reader in appropriate directions.

One area that deserves more sustained attention is that concerned with the cost of electronic publication. While this dissertation has argued that there are considerable benefits in terms of cost and accessibility when publishing electronically, and while a case study was provided that gave some indication of the potential of electronic publication to lower the cost of scholarly publication, no formal and rigorous attempt was made to study the potential cost savings. Partly this was the result of time and space constraints (the standard excuse I know), and partly the result of the extant immaturity of the ICAAP production process. No matter, it is important to remedy this failing in future research because there is still a widely held belief that SGML production methods do not offer significant improvements over older, more 'industrial' methods of publishing scholarly information.

It is easy to pinpoint the source of the above misconception regarding the potentials of the SGML production system. The misconception arises largely because traditional publishing houses attempt to import the full complexity of paper publication methods into electronic systems. The unnecessary complexity with which traditional publishing houses conceive of the electronic process is a result of their familiarity with the more varied and complex requirements of paper publication and their resulting inability to see "outside of the lines" when thinking about the electronic publication process. The significance of this was brought home with force at the 1999 Congress of the Social Science and Humanities where representatives from the University of Montreal Press (UMP/PUM) described what Jean-Claude Guedon called an "industrial" method of journal production. Their method of producing electronic texts required no less than 3 SGML DTDs and many complicated intermediate conversion processes. It is no wonder that representatives of PUM concluded that there is no cost savings for electronic publication.

Future research should take the ICAAP model of SGML production and tackle these misconceptions head on. A more rigorous demonstration of the potentials of IXML, and the strengths of its "light weight" alternative to industrial production methods, could go a long way towards shifting the terms of the debate on the cost of scholarly publication. In particular, it is important to demonstrate that a light weight but robust alternative to industrial production methods is available and viable and that moving towards this can have significant long term benefits for the scholarly communication system in terms of reduced cost. Given the early and demonstrable success of the ICAAP production process, undertaking this task should be relatively straight forward.

And additional, and perhaps more interesting, research task is a theoretical one. There is much in this dissertation and field of interest that speaks to certain central sociological debates. These themes and issues need to be drawn out and expanded in work that specifically addresses the implications of information technology and/or electronic scholarly publication to impact systems of stratification and power in society. For example, one potential area of much significance is the potential impact of information technologies on the surveillance capabilities of the academy. Recent shifts in the political balance towards neo-liberalism, and ongoing improvements in the technological ability of the state and those in positions of authority to surveille subordinate populations, have led some scholars to worry about the panoptic potentials of information technology.[4] This author to has had occasion to consider these negative potentials. Indeed, in earlier versions of this dissertation, an attempt was made to analyse the panoptic potentials of new information technologies.

In particular, earlier versions of this dissertation argued that advanced IT brought with it considerable potential for increasing control over the form and content of scholarly debate. The threat of information technology to provide mechanisms for exposing a scholar's work to the scrutiny of administrative eyes, and the potential for developing formal and informal (even hidden) sanctions against those scholars who strayed too far from established parameters, was discussed in the context of a theory of cybernetic control methods interfaced with electronic citation analysis. In earlier versions of this work, the goal had been to elaborate a theory that made clear that IT brought with it a powerful potential for exposing scholarly debate and individual scholars to the disciplining gaze of their superiors. The implications of this exposure were to be analysed by drawing from Foucault's work on the power of surveillance to subtly discipline target populations. Unfortunately, space and time constraints necessitated the removal of this analysis. However, an analysis of how panoptic IT might interfere with the freedom of scholarly discourse, an analysis that would complement the work of other scholars who have examined the implications of IT surveillance [5] is still needed.

Extending from an awareness that surveillance and panoptic technologies may have negative implications for scholarly freedom, there is also a need to develop an analysis of the "scholarly mode of production." Basically, a more detailed and traditional sociological analysis of the class, gender, and ethnic dimensions of the production and distribution of scholarly information is required. It should be clear from reading the body of this work that the academy is not a homogenous, smoothly operating, family affair. Stratification and inequality, differentials in power and position, and differentials

in status cut across the global population of the academy. This, of course, is not a new insight. However the technologies discussed in this dissertation do have potentials to impact on the production of scholarly information in one way or another. For example, the potential of ICAAP's lightweight production process to lower the entrance barriers to scholarly information distribution may have a significant impact on the balance of power in the academy. The ability for emerging scholars, scholars in southern nations, or others on the margins of scholarly debate, to access a robust and professional quality system of publication, at little cost, provides an interesting case study of the ability of technology to cut away barriers and provide space for the emergence of critical debate. The nature of this potential, and how best to realise it in full, are pressing research questions.

There are many more examples of needed research. However, to close let me simply draw out the opposition between the two suggested areas of research above. It is no coincidence that IT seems to have an ambivalent heritage and future. IT can be both bane and balm. As a component in panoptic systems of surveillance, IT can be used by those with power and authority to enforce social conventions and monitor compliance. A surveilled population thinks twice about moving beyond the parameters of acceptable social behaviour or acceptable debate. On the other hand, a properly deployed system of electronic publication can potentially smash current barriers to scholarly publication by lowering the entrance barriers and allowing the deployment, in a more democratic fashion, of the knowledge and expertise required to disseminate scholarly information.

And this brings us to the nub of the matter and places us squarely within the purview of those currently attempting to theorise the information society. [6] The main theoretical task from this point forward is to integrate the insights available in this dissertation on the potential of IT into wider sociological debates on the future of the information society. This integration will involve locating the potentials of IT identified in this work in current theoretical debates and also using the potentials identified here to add weight and evidence to current attempts to understand the implications of information technology.

Locating this dissertation and the potentials of IT is an easier task than may first appear. Much of the necessary groundwork has already been laid both in terms of *proving* the potential of technology and in terms of laying the theoretical groundwork. Indeed, Frank Webster in his book *Theories of the Information Society,* [7] provides an excellent overview of theories and theorists relevant to the task. Not surprisingly, early attempts to develop a theoretical understanding of the "information society" draw on the work of Habermas, Foucault, Marx, and other classic sociological theorists. The task now is to take the theoretical frame already being developed, and fit the insights of this dissertation into that frame. This will involve not only expanding the negative potentials of IT in the academy (i.e., the disciplining effects of the panoptic gaze), but also analysing the potentials of IT to expand the public sphere, open spaces for democratic scholarly discourse, or otherwise reconfigure the gender, class and ethnic boundaries of current scholarly discourse and current practice in the academy.

Endnotes

Notes Introduction

[1] See for example Denis Grogan (1976), or A. J. Meadows (1974: 1979). Mike Sosteric (1996), Rowland Lorimer (1997).

[2] William D. Garvey (1979). Donald W. King, Dennis McDonald, and Nancy Roderer (1976). William D. Garvey (1979). Derek J. de Sola Price (1963; 1965; 1966; 1970). Donald W. King, Dennis McDonald, and Nancy Roderer (1976; 1981). J. D. Bernal (1939). Derek J. de Sola Price (1963). J. C. R. Licklider (1965) C. J. Ballhausen, F. A. Cotton, A. Eshenmoser, E. Havinga, R. Hoffmann, R. Huisgen, H. G. Khorana, J. M. Lehn, L. Salem, G. Wilkinson (1974).

[3] Committee on Scientific and Technical Communication SATCOM (1969). Science Council of Canada (1969). Ralph H. Phelps and John P. Herlin (1969). United Nations Educational, Scientific and Cultural Organization (1979).

[4] It is useful to spend some time perusing the very long list of cancellations provided by the University of British Columbia library online at http://www.library.ubc.ca/home/serialcan/welcome.html in order to get a sense of the magnitude of the problem.

[5] David E. Shulenburger (1998). http://www.arl.org/arl/proceedings/133/shulenburger.html

[6] Herbert Schiller (1989).

[7] Pat Armstrong et. al (1997). Tony Clarke (1997). Stephen McBride and John Shields (1997). Janine Brodie (1995). Linda McQuaig (1995).

[8] Mike Sosteric, Gina Ratkovic, and Mike Gismondi (1998).

[9] (Sinclair, Ironside, and Seifert, 1996; Firestone, 1994; Ball, 1993)

[10] Mike Sosteric, Gina Ratkovic, and Mike Gismondi (1998).

[11] Andrew Odylzko (1996)

[12] Steve Harnad (1997).

[13] Reed-Elsevier. Possible Divestment of IPC Magazines. October 27, 1997b. Press release available at http://www.reed-elsevier.com/Reed-Elsevier/newsreleases/nr32.asp

[14] Reed-Elsevier (1997a).

[15] Mark J. McCabe (1988: 5).

Notes Chapter One

1 Sherman B. Barnes (1934).

2 M. J. Mulkay (1979).

3 While it would certainly be possible to extend the history of scholarly communication back to the Ancient Chinese, South Asian, Greek, Roman and Byzantine civilisations (Goonatilake, 1984; Alioto, 1987; Eamon, 1994), such a detailed treatment is a) beyond the scope of this work and b) not really necessary since arguably the system as we now know it began its development in the 17th century with the birth of the scholarly journal and the subsequent evolution of the formal scholarly communication system. Accounts of the communication system, then, can reasonably leave of the prehistory of scholarship and scholarly communication without sacrificing necessary substantive depth or breadth of coverage.

4 Margaret C. Jacob (1988).

5 Founded just three years earlier in 1662 (Margaret C. Jacob, 1988).

6 See David A. Kronick (1976), J.R. Porter (1964), Houghton (1975), McKie (1979), and Barnes (1934).

7 Bernard Houghton (1975).

8 Douglas McKie (1979).

9 Derek de Sola Price (1963).

10 Figures are from Ulrich's 1995 periodical directory.

11 Jean Gimpel (1977).

12 M. T. Clanchy (1979).

13 David C. Lindberg (1992).

14 Francis Bacon (1929).

15 Oldenburg (1671) writes in "A preface to this Seventh Years of these Transactions." *Philosophical Transactions*, 6 (March 25): 2088:

> And here I earnestly implore ... to bring into publick Light the Treasures of Libraries, before they be sacrificed to works and putrefaction; and to examine Herodotus and Pliny, Theophrastus and Dioscorides...both with candour and equal integrity; to remark what is manifestly false, or with great reason to be suspected; to confirm what may be by Parallels be confirmed, & what may be thence discarded and what...may be adopted.

16 Henry Oldenburg (1666), "A Preface to the Third Year of these Tracts."

Philosophical Transactions, 2 (March 11): 412.

17 J. R. Porter (1964).

18 David A. Kronick (1976).

19 David A. Kronick (1976).

20 David A. Kronick (1976).

21 Margaret C. Jacob (1988: 156)

22 All from the *Transactions*, March 6, 1665. Volume 1.

23 Henry Oldenburg (1647). "An Advertisement." *Philosophical Transactions*, 8 (February 9): 7002

24 Francis Bacon (1929). Quoted from the web page at http://www.cix.co.uk/~craftings/atlantisb.htm

25 Francis Bacon (1929). http://www.cix.co.uk/~craftings/atlantisc.htm

26 Karl Popper (1963: 28).

27 Craig Calhoun (1992: 1).

28 Craig Calhoun (1992); 15).

29 Craig Calhoun (1992: 13).

30 Craig Calhoun (1992: 12-13).

31 Craig Calhoun (1992: 23).

32 Craig Calhoun (1992).

33 Craig Calhoun (1992).

34 Susan Bordo (1987).

35 Douglas McKie (1979: 9).

36 Nancy Leys Stepan and Sander L. Gilman (1993: 174-175).

37 Bruce M. Manzer (1977).

38 Bruce M. Manzer (1977).

39 William D. Garvey (1979).

40 Saul Herner (1969). William D. Garvey and Belver C. Griffith (1979). Denis Grogan (1979).

41 As the scientific and technical literature has exploded, abstracting and indexing services have grown in importance not only for individuals who utilise them for retrospective and current awareness searching of the voluminous and scattered literature, but also, and perhaps more importantly, for libraries who can no

longer maintain comprehensive collections. The services provided by the various secondary publications makes it easier for libraries and users to access material not currently held by their local libraries via interlibrary loan and document delivery services.

42 Abstracting journal function just as their name implies. They supply abstracts of journals, conferences, meetings, and even the output of entire countries as with the *Abstracts of Bulgarian Scientific Literature.* The abstracts themselves contain summaries of the contents of a document and citation pointers to the location of the full text, the author, and possible institutional affiliation. They can either be *indicative, informative* or *slanted* (Houghton, 1975). The *indicative* abstract, otherwise knows as the *descriptive* abstract is used to indicate the "scope and content" of the original document. It generally contains only descriptive statements about the original article. The *informative abstract* summarizes the main data and arguments only, contextualised the article, and provides a basic level of analysis. It treats the article in more detail and can often function as a replacement for the original. The *slanted abstract* goes a step further than the informative abstract by emphasizing information relevant to a particular speciality or discipline. Journals that provide slanted abstracts are most common in the industrial and technical literature.

43 Review journals offer a quick but substantive glance at the scholarly literature by providing a critical summary and evaluation of the material found in primary journals (Lambert, 1985). There are hundreds of review journals. Review journals can be distinguished from abstracting journals that supply informative or slanted abstracts by their emphasis on substantive evaluation of the literature by acknowledged experts in the field of interest.

44 Computers were first used in abstracting services in 1961 by the *Chemical Abstracts Service* which introduced a system called KWIC (Keyword-in-Context). This initial foray into the computer world was highly successful and spawned a host of similar machine readable indexing services like the extremely popular and still influential MEDLARS (Medical Literature Analysis and Retrieval System) in 1964. By the end of the decade, almost all abstracting services had shifted to computer based format (Houghton, 1975) and were being used for current awareness and retrospective searching. Other electronic value added services were also experimented with. There was, for example, an SDI service (Selective Dissemination of Information) which distributed information to users based on a user profile that consisted of keywords that were matched each week against new publications. The first SDI service was the Chemical-Biological Activities (CBAC) serviced introduce din 1966 by Nottingham University.

With recent technological advances (i.e., developments in computer (the PC) and storage technology (the CDROM)) these services have become quite

popular and are now fixtures at most research libraries. Accessible online, these services include indexes to scientific (Cambridge Scientific Abstracts), social science (PsychINFO, ERIC, Current Contents), medical (Medline, Cancerlit), biomedical and pharmaceutical (Excerpta Medica (EMBASE)), and business (ABI Inform) literature. All services provide author, subject and keyword searches. Some however only provide index and tables of contents (OCLC is one such service) and others go a step beyond by providing full text in CDROM libraries (ABI Inform) or through various forms of electronic delivery of documents (normally fax).

The breadth of coverage of these services can be quite impressive. The Colorado Alliance of Research Libraries (CARL), for example, provides access to 14,000 multidisciplinary journals and various other commercial databases. CARL has a user profile search and document delivery system which has recently migrated to the WWW at http://uncweb.carl.org/ and which contains citations and abstract information from 17,000 journals representing some 7,000,000 articles. Canada has a similar service which provides access to databases like MEDLARS, user profile services, and document delivery, and automated ILL services. An overview of the services can be found at http://www.nrc.ca/cisti/cisti.html.

45 Denis Grogan (1979).

46 The entire process of scholarly communication, from the time a scholar gets her first idea to the time the work is disseminated and integrated, is extremely lengthy. Garvey (1979) has estimated that for psychology the average time span is about 13 years. Garvey suggests that this lengthy delay is essential in order for the system as a whole to be able to weed out questionable and irrelevant material. The average time from initiation of a research project to its final publication is shorter than the 13 year distillation period (see Chapter Two).

47 William D. Garvey (1979)

48 William D. Garvey (1979: 28)

49 William D. Garvey (1979: 69)

50 Robert K. Merton (1973a).

51 Robert K. Merton (1973a: 323).

52 Harriet Zuckerman and Robert K. Merton (1971).

53 William D. Garvey, Nan Lin, Carnot E. Nelson (1970) and William D. Garvey, Nan Lin, Carnot E. Nelson, and Kazuo Tomita (1979).

54 Derek de Sola Price (1970).

55 Lowell L. Hargens (1988: 149)

[56] A. J. Nederhof, R. A. Zwaan, R.E. De Bruin, and P. J. Decker (1989). Anton J. Nederhof (1989). Maurice B. Line (1979). David J. Hanson (1990; 1975).

[57] Anton J. Nederhof (1989).

[58] Maurice B. Line (1979).

[59] William D. Garvey, Nan Lin, and Carnot E. Nelson (1970).

[60] William D. Garvey, Nan Lin and Kazuo Tomita (1979).

[61] Derek de Sola Price (1970: 13-15. Italics added).

[62] Harriet Zuckerman and Robert K. Merton (1971: 474).

[63] Stephen Cole, Jonathan R. Cole and Gary Simon (1988).

[64] Stephen Cole, Jonathan R. Cole and Gary Simon (1988).

[65] Stephen Cole, Jonathan R. Cole and Gary Simon (1988: 153).

[66] Stephen Cole, Jonathan R. Cole and Gary Simon (1988: 153).

[67] Stephen Cole, Jonathan R. Cole and Gary Simon (1988).

[68] Stephen Cole, Jonathan R. Cole and Gary Simon (1988: 153-4).

[69] William D. Garvey, Nan Lin and Kazuo Tomita (1979).

[70] William D. Garvey, Nan Lin, Carnot E. Nelson, and Kazuo Tomita (1979).

[71] William D. Garvey (1979).

[72] William D. Garvey (1979).

[73] William D. Garvey (1979: 58).

[74] William D. Garvey (1979: 23).

[75] William D. Garvey and Belver C. Griffith (1979).

[76] William D. Garvey, Nan Lin, and Carnot E. Nelson (1979).

[77] Herbert Menzel (1966: 1001).

[78] Derek J. de Solla Price and Donald Beaver (1966).

[79] F. Reif (1961)

Notes Chapter Two

[1] J. C. R. Licklider (1965: 1046).

[2] J. D. Bernal (1939).

[3] Daniel Bell (1973), Alvin Toffler (1980), Marshal McLuhan (1989), Robert Reich (1991).

[4] Margot Montgomery (1997).

[5] Committee on Scientific and Technical Information (1969).

[6] Over the years, the U.S. government has had an ongoing concern with the state of their scholarly journals systems as evinced by the almost continuous flow of funds into research designed to investigate and enhance the system. See for example the National Academy of Sciences (1969), Ackoff et al, (1976), King, McDonald, Roderer, and Wood (1976), Garvey, (1979), King, McDonald, and Roderer (1981). By

[7] The JACUDI plan was formalised and outlined in

[8] Ralph H. Phelps and John P. Herlin (1969). United Nations Educational, Scientific and Cultural Organization (UNESCO) (1979).

[9] Science Council of Canada (1969).

[10] Jocelyn Ghent Mallett (1993). As an aside, Canada is strongly encouraging the partnership" of education, industry, and government in the development of an information infrastructure. Canada's information highway is called CaNARIE (Canadian Network for the Advancement of Research, Industry and Education). Although ostensibly a co-operative network, it would appear that the priorities are primarily commercial as Mallet (1993: 5) notes: "Although CaNARIE undoubtedly will benefit all Canadians by offering improved access to education, its primary purpose is to serve industry by providing an effective means for research and development (R&D) and information sharing. Therefore, only industry could accurately define the requirement for CaNARIE and then fulfil it."

[11] CISTI is at http://www.nrc.ca/cisti/

[12] David Beattie and David McCallum (1997: 153).

[13] Roberta Lamb (1997).

[14] Herbert I. Schiller (1989: 68).

[15] Manuel Castells (1996).

[16] Rowland Lorimer (1997: 13).

[17] Rowland Lorimer (1997).

[18] See http://www.library.ubc.ca/home/serialcan/welcome.html.

[19] Walter Ludwig (1997).

[20] William D. Garvey, Nan Lin and Kazuo Tomita (1979).

[21] William D. Garvey, Nan Lin and Kazuo Tomita (1979).

[22] Paul F. Jacobs and Chris Holland (1997).

[23] William D. Garvey, Nan Lin and Carnot E. Nelson (1979).

[24] For a more detailed description of the differences between the social and natural sciences see William D. Garvey, Nan Lin, and Carnot E. Nelson (1979). However do not expect much in the way of a satisfactory explanation from the authors. They can do no better than offer up the credulous notion that the scientific communication process in the social sciences is less evolved, more eclectic, more haphazard, more diffuse and less predictable than that of the natural sciences.

[25] William D. Garvey, Nan Lin and Carnot E. Nelson (1979).

[26] A. J. Meadows (1979: 105).

[27] The delay associated with the refereeing process has caused concern and prompted various attempts to reform the process. Meadows points to the efforts of the American Institute for Physics to take three months of the reviewing process. Similarly, a social science journal attempted to elicit comments from its reviewers within two weeks. Following their efforts, however, the range of delays remained between less than a week for 8% of contributions, to more than six weeks for 19%. This prompted the author of an article in *American Sociology* to conclude that procrastinating referees are a major bottleneck in the editorial process (Rodman, 1970: cited in Meadows, 1979).

[28] Jill Lambert (1985).

[29] One Canadian journal receives only about 100 manuscripts a year. Yet the editor (in an informal conversation with the author) noted that they had publication backlogs.

[30] J. Carson and H.V. Wyatt (1983).

[31] Paul Nijhoff Asser (1979). A number of reasons were given for missing journals including problems with postal service, misdirection in departments of large users, inadequate addressing, address change, theft, and inadequate wrapping. The primary factors identified in their multiple response questionnaire were faults in the postal system (90%) and misdirection (76).

[32] J. M. Ziman (1969: 319-20) argued, for example, that when considered in the context of the entire process from initiation to final publication, the "4 months between the receipt of a typescript and its publication in a reputable journal is not a significant portion of the time required to 'make a discovery.'"

[33] Thomas P. Stossel (1985) argued that "There is little evidence that the rate of publication today has a limiting effect on scientific and medical progress...." Stossel points to an over concern with establishing priority as a major reason for what he thinks is an overly anxious desire to get results published in journals

quickly.

[34] Eugene A. Confrey (1966). In the early sixties the National Institute of Health experimented with a centralised and computerised system of information exchange known as an Information Exchange Group. The IEG was designed to overcome long publication delays. According to Confrey the experiment was highly successful and quickly grew beyond the NIH's ability to handle. Yet the experiment was terminated and decades have gone without similar experimentation.

[35] William D. Garvey (1979: 73).

[36] Derek J. De Solla Price (1963: 90-1; emphasis added).

[37] Don R. Swanson (1966).

[38] Steve Harnad (1991).

[39] Steve Harnad (1991: 44).

[40] Derek J. de Solla Price and Donald Beaver (1966).

[41] Ziman (1977: 111-2).

[42] Robert K. Merton (1977).

[43] Robert K. Merton (1977: 89)

[44] Margaret W. Rossiter (1993).

[45] Margaret W. Rossiter (1993: 29).

[46] Gender Working Group (1995: 8).

[47] Margaret W. Rossiter (1993: 33-7).

[48] Susantha Goonatilake (1984).

[49] Susantha Goonatilake (1993).

[50] J. Carson and Wyatt (1983) note, for example, that a paper published in the *Israel Journal of Medical Sciences* reached the U.S. two years after publication.

[51] Susantha Goonatilake (1984).

[52] Susantha Goonatilake (1984: 102)

[53] Susantha Goonatilake (1984: 102)

[54] Susantha Goonatilake (1984).

[55] Ralph Korteling quoted in Norma Vale (1996: 8).

[56] Harold Wooster.

[57] Derek de Sola Price (1963) notes that because of the exponential growth of the

academy and scholarly literature, at any given time, the majority of all scientists who ever lived are alive an publishing. This gives the "impression" that information is running away from us when in fact it is not.

Donald W. King, Dennis McDonald, and Nancy Roderer (1981: 61) in their analysis of the U. S. scholarly communication system provide some empirical evidence that at first glance might cause us to side with Price. They noted that the proportion of publications to number of authors did not change in the period of their survey. "For the nine fields of science combined, the average number of articles per scientists or engineer changed very little between 1965 and 1977." This is fine as far as it goes. But in this case, a proportion hides the magnitude of journal proliferation behind a relativized figure. A simply count of the 25,000 + scholarly journals now in existence should be enough to indicate the that proportions are not the best indicator to use in this circumstance.

[58] Astle (1989).

[59] J. C. R. Licklider (1966).

[60] Donald W. King, Dennis McDonald and Nancy Roderer (1981).

[61] Robert K. Merton (1973a).

[62] See for example Mary Frank Fox (1994), Stephen Lock (1994), T.P. Stossel (1985) and William J. Broad (1982).

[63] F. Reif (1961).

[64] According to Broad (1982), the average length of life science papers is about 7 pages!

[65] W. J. Broad (1981).

[66] Deana L. Astle (1989: 152). William J. Broad (1981: 645-6) gives the following example of abuse of the system.

A different and much more serious type of coauthor abuse is seen in the large lab where a senior scientist provides little work or inspiration but manages, nonetheless, to walk away with a large measure of the credit for the efforts of his underlings. Today it is not uncommon for the name of a prominent biomedical lab chief to appear on 500 or 600 papers produced in large measure by his juniors. An example comes from the case of immunologist Robert A. Good, who worked at the Sloan-Kettering Institute for Cancer Research and who, in a 5-year period, coauthored almost 700 scientific reports, a feat achieved in part by establishing a large empire of research workers under his personal banner.

[67] Rowland Lorimer (1997).

[68] Deana L. Astle (1989).

[69] Paul Metz and Paul M. Gherman (1991: 317).

[70] C.J. Ballhausen, F.A. Cotton, A. Eschenmoser, E. Havinga, R. Hoffman, R. Huisgen, H.G. Khorana, J.M. Lehn, L. Salem and G. Wilkinson (1974).

[71] Robert Maxwell, Pergamon Journals Commercial Publishing House. Quoted in William Kay, in the journal Global Business, Spring 1988: 42).

[72] Anon in Dougherty and Barr (1988: 5).

[73] Paul L. K. Gross and E. M. Gross (1927).

[74] Richard de Gennaro (1977). Herbert S. White and Bernard M. Fry (1979).

[75] Scott Bennett (1992).

[76] Herbert S. White and Bernard M. Fry (1979: 54),

[77] Richard de Gennaro (1977).

[78] Paul McCarthy (1994).

[79] Robert Hauptman (1995).

[80] Asser's (1979) data is based on the results of two survey's conducted by the Journals Committee of the International Group of Scientific, Technical and Medical Publishers. The samples are quite small comprising only 43 responses from an initial sample set of 158 questionnaires sent to interested publishing houses. All together, about 1,417 journals in the life, physical,, medical, and engineering sciences from various countries were represented in their sample.

[81] Richard De Gennaro (1997).

[82] The Association of Research Libraries is an organization of 58 of the largest North American research university libraries (Okerson, 1995). The ARL home page is located at http://arl.cni.org. For a description of the purpose of ARL and a list of member libraries see http://www.lib.washington.edu/~tdowling/arl.html.

[83] Data provided for 1986 to 1996 by ARL in the graph, *Monograph and Serial Costs.* It is available at: http://www.lib.virginia.edu/socsci/arl/1996/arl962.gif

[84] Complete data on Periodicals is available in Alexander and Hammell (1995). Also see Chaffin (1995) for an analysis of serial publications.

[85] Association of Research Libraries (1991).

[86] For example, Herbert S. White (1976: 361) discounts concern over a journal crisis by arguing that "during the years 1969-1973, the growth of publication of new American scholarly and research journals was not as rapid as many librarians supposed."

[87] Richard M. Dougherty and Nancy E. Barr (1994).

[88] Paul McCarthy (1994).

[89] Canadian Institute for Scientific and Technical Information (1994).

[90] Alan R. Taylor (1978).

[91] Ibid (1978: 48).

[92] Ibid (1978: 48).

[93] Paul Metz and Paul M. Gherman (1991: 24).

[94] Eugene Vance (1994).

[95] Mary Case (1998:1).

[96] See http://www.lib.virginia.edu/socsci/arl/1996/arl962.gif

[97] Herbert S. While (1975: 372).

[98] Herbert S. While (1975: 372).

[99] Brian L. Hawkins (1994).

[100] Richard M. Dougherty and Nancy E. Barr (1988).

[101] Steven Bosch, Doug Jones, and Nancy Simons (1994).

[102] Association of Research Libraries (1997).

[103] Task Force on the Economics of Scholarly Publication (1979).

[104] Task Force on the Economics of Scholarly Publication (1979: 25).

[105] King, McDonald & Roderer (1981).

[106] James C. Thompson (1988).

[107] Patrick Joyce and Thomas Merz (1985).

[108] Ibid (1985: 274-5).

[109] Joseph J. Esposito. Document available at gopher://arl.cni.org:70/00/scomm/newsltr/esposito

[110] Quoted in Thompson (1988: 481).

[111] James C. Thompson (1988: 482).

[112] Michael E. Koenig (1984).

[113] Herbert S. White (1976). White pegged the annual rate of profit for commercial publishers in 1973 at 14.1%. However besides this figure being based on the self-reporting of commercial publishers, it is also *highly* suspect because it is based on a response rate of only 14% of the commercial publishers! This is obviously not an adequate response rate since it is highly likely that there is serious response bias in the sample (i.e., those with high profit margins chose

not to respond to the survey!). Because of this, it is impossible to draw meaningful conclusions from this data. Also as White notes, the figures are only relevant for the years 1969 to 1973 which are the years just before massive inflation and budgetary cutbacks began to seriously threaten the journal enterprises.

To further complicate this matter, White notes that the figures for the rate in price increases provided by the commercial publishers and the libraries which participated in the study do not coincide. Commercial publishers noted they had price increases of 9.89 percent per year while libraries (drawing on their accounting deparmnents) reported an annual price increase of 11.2% for academic libraries and 12.4% for special libraries. White attributes the differences to the role of subscription agents who inject various service charges into the equation though there could be other reasons for the differential.

[114] David W. Lewis (1989: 674).

[115] Robert Hauptman (1995).

[116] Richard M. Dougherty and Nancy E. Barr (1988).

[117] Economic Consulting Services Inc., quoted in Metz and Gherman (1991: 317).

[118] Kenneth E. Marx, Steven P. Nielson, H. Craig Peterson, and Peter E. Wagner (1991: 136).

[119] Sandra Moline (1989).

[120] Ribbe (1988: 460) notes that "In order to meaningfully compare the prices of journals, it is necessary to somehow normalize the database. To consider price per page would be misleading, because formats vary widely. For example, word density in *Mineralogy and Petrology* is ~ 500 per page, but in *Contributions to Mineralogy and Petrology*, it is > 1000." An oversimplified analysis based on price per page was what led White (1976) to his mislead support of commercial publishing houses.

Various analysts have approached this problem in different ways. Ribbe (1988) for example uses the cost per source item (article) and Moline uses cost per character.

[121] These price differentials are duplicated in the most recent data from the U.S. Periodical Price Index (Alexander and Carpenter, 1995).

[122] Bernard Fry and Herbert White (1976).

[123] Paul Ribbe (1988).

[124] Rowland Lorimer (1997: 13).

[125] Rowland Lorimer (1997).

Notes Chapter Three

1 J. M. Ziman (1969: 318).

2 John Senders (1977) spoke about electronic journals and their **inevitability**. His account is interesting not so much for its prognostication but for the fact that the current situation was predicted even before the PC hit the stage in the early eighties.

3 Jeanne Guillaume (1980) reports on an early experiment investigating the feasibility and operational characteristics of electronic journals. This experiment, funded by the U.S. NSF, failed to find much support for an electronic journal. Guillaume accounts for the failure by pointing to group dynamics. However the failure of the project probably has as much to do with the primitive and unappealing user interfaces available in the early 1980s (Guillaume, 1980: 27). For example, see Cliff McKnight (1993) for an overview and examination of some of the limitations of some of the early experiments with electronic journals. See also Murray Turoff and Starr R. Hiltz (1982).

4 Ann L. Okerson (1993) notes the Ejournal became a more serious possibility with the initiation by Willard McCarty in 1987 of the Humanist discussion list. Following this, in the same year, graduate students at Syracuse University started *New Horizons in Adult Education.*

5 Anne B. Piternick (1989) provides a good overview of earlier experiments with Synopsis Journals, Selective Dissemination (SDI) services, and Miniprint and microfiche experiments. As Piternick notes, by and large these alternatives, some of which make use of information technology, have failed in their bid to replace the traditional primary journal. Her diagnosis is that the early projects failed not only because of technical difficulties and reluctance of authors to submit articles to unappealing distribution formats, but also because they were not aimed at finding true alternatives to primary journal publication. Rather they were attempts to find "additional ways of disseminating articles" (Piternick, 1989: 265).

6 Cliff McKnight (1993).

7 The ARL list of electronic publications is located at http://www.arl.org:591/.

8 See the introduction to the 1998 ARL list at http://www.arl.org/scomm/edir/pr97.html

9 See the introduction to the 1998 ARL list at http://www.arl.org/scomm/edir/pr97.html

10 Andrew Odlyzko (1994: 14)

[11] Andrew Odlyzko (1994: 2-3)

[12] Andrew Odlyzko (1994)

[13] Susan R. Harris and Elise Gerich (1996). The U.S. NSFNet upgraded its older and slower T1 communications technology to the faster 45Mps 1 Technology in April of 1995.

[14] Merit Network (1992).

[15] Cliff McKnight (1993).

[16] Ann Okerson (1994:11).

[17] David Pullinger (1994).

[18] Martha J. Lindeman, Charles Crabb, John R. Bonneau, and Vera Fosnot Wehrli (1992).

[19] Steven Silvern (1987:5).

[20] Andrew Dillon (1991).

[21] Yu Novikov (1979) notes that the structure of a document can either facilitate or retard the reading process. When faced with the decision of whether or not to read a specific journal article, readers invariably utilizs a browsing strategy which includes scanning the table of contents and abstract, examining the heading and sectioning of the journal, and reading the introduction and conclusion. It is thus wise to include these elements in an easy to navigate structure to encourage readers to browse journals and articles.

[22] J. Price-Wilkin (1994).

[23] See the original HTML specification by Tim Berners-Lee and Danial Connolly (1993). It is available at http://www.w3.org/pub/WWW/MarkUp.archive/html-spec.txt. For reference, Tim Beners-Lee is the inventor of the WWW.

[24] Philip Greenspun (1996).

[25] See the document *Life on the Bleeding Edge* at http://www.stratcom.com/edge.html.

[26] Information about stylesheets can be found at http://www.w3.org/pub/WWW/Style/. The currently accepted specification is for Cascading Style Sheets. It is available at http://www.w3.org/pub/WWW/TR/WD-css1.html.

[27] Bill Readings (1994).

[28] Rowland Lorimer (no date specified) from the article *Going Electric: A Few Items for Journal Editors* at http://www.ccsp.sfu.ca/calj/going.electric.html

[29] Gregory Crane (1988).

[30] Gregory Crane (1988).

[31] A Merit Network press release of dated December 1992 had this to say about the connectivity of U.S. institutions.

> Today every major research, graduate, and four-year university is tied together through NSFNET, along with private and federal research institutions and industries. Over 700 colleges and universities are connected representing 80 percent of the nation's student population and 90 percent of the nation's federally sponsored research. Further, NSFNET provides access to hundreds of high schools, libraries, community colleges, and smaller educational institutions. With over 1,000 public and private research and education institutions, NSFNET links an estimated 10 million users. As the commercial Internet has grown, links are expanding between education and business communities which are promoted through expanding connectivity.

[32] The most recent statistics available on the number of wired countries are from May 1995. At that time, 93 countries had purchased the equipment and infrastructure to connect to the Internet. The countries which have most recently come online are Algeria, Armenia, Belarus, Burkina Faso, China, Columbia, Dominican Republic, French Polynesia, Jamaica, Lebanon, Lithuania, Macau, Morocco, Mozambique, New Caledonia, Nicaragua, Niger, Panama, Philippines, Senegal, Swaziland, Uruguay, Uzbekistan, and Vietnam. The most recent estimates (i.e., April 1997) of the total number of people wired to the net puts the figure at over 20 million worldwide.

> These statistics are available from the Merit Network FTP server at ftp://nic.merit.edu/nsfnet/statistics/history.hosts and ftp://nic.merit.edu/nsfnet/statistics/nets.by.country

[33] Andrew Odlylzko (1994: 18).

[34] Paul Fontaine (1995).

[35] See the short text by Mike Paciello at http://www.webable.com/mp-blnax.html.

[36] Terry Winograd (1995). See http://www-pcd.stanford.edu/pcd-archives/pcd-seminar/1994-1995/0034.html

[37] Computer in general increase accessibility. Just one example of current developments that are aiding the impaired is provided by T.V. Raman's page on the EMACS general purpose UNIX tool at http://www.research.digital.com/CRL/personal/raman/emacspeak/emacspeak.html. His EMACS implementation provides a complete voice enabled interface to the UNIX operating system allowing the visually impaired total access and control over the computers functions.

[38] While the WWW offers vastly increased potential for those with disabilities,

there are difficulties. In particular web designers have to pay careful attention to design conformance (Venderheiden, 1995). Developing nonstandard documents is a concern because there are a two companies in particular which are playing a game to increase their market share by introducing enhancements to standard HTML without first going through the standards body responsible for the WWW. We will have more to say about this difficulty in the next chapter.

[39] Stevan Harnad (1990; 1991).

[40] Paul F. Jacobs and Chris Holland (1997).

[41] Paul F. Jacobs and Chris Holland (1997).

[42] Paul F. Jacobs and Chris Holland (1997).

[43] Paul F. Jacobs and Chris Holland (1997).

[44] Pope, Shealagh and Miller, Lee (1998).

[45] Stephen P. Harter (1997).

[46] Stephen P. Harter (1997).

[47] Steve Harnad (1992).

[48] Ann S. Okerson and O'Donnell, James. J. (1995). Ellen Finnie Duranceau (1995). See also Lorrin Garson, Paul Ginsparg and Steve Harnad (1994).

[49] Malcolm Getz (1992) provides a useful overview of the cost savings in editing, production, and distribution wrought by a shift to electronic systems of journal production.

[50] Aldyth Holmes (1997).

[51] Aldyth Holmes (1997: 110-111).

[52] Aldyth Holmes (1997).

[53] Timothy Mcgettigan (1998, October 21). Email correspondence.

[54] Shealagh Pope and Lee Miller (1998).

[55] Paul Ginsparg (1994).

[56] The significant reduction in the cost of storage has one ancillary benefit. It eliminates concern over page length. Traditionally, paper based journals have placed strict limits on the length of articles they would publish. This of course has everything to do with the cost per page of publication and nothing to do with the requirements of scholarly communication. This restriction may have had an inordinate influence on the style of cutting edge scholarly discourse which, because of the need to pack as much information into 10,000 words as possible, is often thick and difficult to wade through, obtuse, and even occasionally poorly written. This has resulted in some cases in a discourse that,

though not intentionally so, is fundamentally exclusionary. With the advent of electronic publication this straight jacket is removed since it costs fractions of a penny more to publish a 60 page document than a 30 page document. Of course, whether or not this will have a significant impact on scholarly discourse is an empirical question.

[57] Andrew Odlyzko (1994).

[58] Steven B. Silvern (1987).

[59] Estelle Irizarry (1993). Irizarry also notes some additional benefits of the move to an electronic editorial office. Probably the most interesting is the increased international representation of the editorial board since submissions are reviewed electronically and transmitting electronic documents internationally is much easier with email than snailmail. She also noted a decreased document turnaround time citing a lower limit of three months from submission to publication. Supplying the manuscript on disk also reduced the introduction of errors at this stage of the process since rekeying by the typesetter was made unnecessary. Finally, the digitizing of the journal database has made it easier to track journal functioning.

Irizarry also noted some difficulties. Because the journal is a foreign language outlet, they experienced difficulties with the inability of ASCII to handle diacritics. This has necessitated the use of a marking system that uses semicolons to indicate accents and tildes.

[60] Jane Lago (1993). Lago also notes that style and copy editing is much easier when utilizing the cut and paste and spell check functions of wordprocessors. "Surprisingly enough, I have found that I can read a manuscript much more closely on the screen than on paper, and that I miss far fewer details." (p. 108).

[61] Andrew W. Appel (1996) provides such a how-to manual on the use of email to referee manuscripts.

[62] Aldyth Holmes (1997).

[63] Peter B. Boyce, Evan Owens and Chris Biemesderfer (1996).

[64] Peter B. Boyce (1998, October 21). Email correspondence.

[65] Peter B. Boyce (1998, October 21). Email correspondence.

Notes Chapter Four

[1] Sonia Jarvis (1993).

[2] Mike Sosteric, Gina Ratkovic, and Mike Gismondi (1998).

[3] Andrew Odlyzko (1994). Bill Readings (1994).

[4] Steve Harnad (1991: 1995). Bernard Naylor and Steve Harnad (1994).

[5] Steve Harnad (1994).

[6] Astle (1989). J. C. R. Licklider (1966). Donald W. King, Dennis McDonald and Nancy Roderer (1981).

[7] Richard de Gennaro (1977). Metz and Gherman (1991).

[8] William D. Garvey (1979).

[9] Richard M. Dougherty and Nancy E. Barr (1988). Sandra Moline (1989). Kenneth E. Marx, Steven P. Nielson, H. Craig Peterson, and Peter E. Wagner (1991).

[10] Richard M. Dougherty and Brenda L. Johnson (1988). Andrew Odlyzko (1994). Ann L. Okerson (1993).

[11] Ann L. Okerson (1993: 1.2).

[12] Deana L. Astle (1989:155).

[13] James C. Thompson (1988: 482).

[14] Charles A. Schwartz (1994).

[15] See for example Lisa Guernsey (1998).

[16] The server is located at http://xxx.lanl.gov/.

[17] Bernard Hibbitts (1996; emphasis added).

[18] Janet H. Fisher (1995: 90).

[19] Janet H. Fisher (1995: 90).

[20] Lisa Guernsey (1998a).

[21] Available at http://www.sociology.net/socinfo/journalminder.html.

[22] A similar service called *ContentsDirect* has recently been announced by Elsevier Publishers and is, according to the publishers, "the fastest and most direct alerting service for Elsevier Science Journals." The service is operated via traditional Bitnet Listserver and provides table of contents pages 2 or 3 weeks prior to the official release of the publication thereby obviating the need for other current awareness services. More information on the service can be found at http://www.elsevier.com/homepage/about/caware/condir/

[23] James S. Gardner (1993).

[24] Walter Ludwig (1997: 121).

[25] Nancy Duxbury (1994). Gary Taubes (1996) describes the wave of publication starts as a *tidal wave.*

Two WWW pages give a good overview of what is now available from traditional publishers. One is provided by a service called E-doc and is available at http://www.edoc.com/ejournal/publishers.html. The other is provided by the British library and is available at http://www.comlab.ox.ac.uk/archive/publishers.html. Nancy Duxbury (1994) also provides a list of university presses now on line.

An exhaustive compilation of UUAP presses is available at http://gopher.pupress.princeton.edu. Another list of traditional journal publishers, is provided by *Project Muse* at http://muse.jhu.edu. For examples of electronic texts on the Internet see *The Catalog of Electronic Texts on the Internet* [http://www.lib.ncsu.edu/stacks/alex-index.html] or *The Online Books Page* [http://www.cs.cmu.edu/Web/books.html].

[26] David J. Pullinger (1994). The Superjournal home page is at http://www.dlib.org/dlib/january96/briefings/01super.html

[27] Ellen Messmer (1994). Also Gary Taubes (1996).

[28] RedSage Home Page [http://www.cnri.reston.va.us/home/dlib/august95/lucier/08lucier.html]

[29] Gary Taubes (1996).

[30] Hans-Christoph Hobohm (1997).

[31] John Lubans Jr (1987: 181).

[32] Steve Harnad (1994).

[33] ICOLC (1988). http://www.library.yale.edu/consortia/statement.html.

[34] Jack Meadows, David Pullinger and Peter Such (1995).

[35] Mark J. McCabe (1988: 5).

[36] Dennis P. Carrigan (1995).

[37] Dennis P. Carrigan (1995: 100).

[38] Dennis P. Carrigan (1995).

[39] Malcolm Getz (1992: 29).

[40] Reed-Elsevier (1997b).

[41] Herbert I. Schiller (1989: 81)

[42] Herbert I. Schiller (1989: 71).

[43] Herbert Schiller (1989)

[44] See a special issue of the EJS, http://www.sociology.org/vol003.003/

[45] D. Bruce Johnstone, Alka Arora and William Experton (1998).

[46] World Bank Report on Higher Education (1998: 23-4: Online document).

[47] Herbert Schiller (1989: 80).

[48] Gary Taubes (1996).

[49] ICOLC (1988). http://www.library.yale.edu/consortia/statement.html.

[50] Gerard M. van Trier (1992)

[51] Dennis P. Carrigan (1994).

[52] Marvin A. Sirbu (1995).

[53] Gary Taubes (1996).

[54] Duane E. Webster and Mary E. Jackson (1994: 262).

[55] Although not directly related to scholarly publication, we can see that type of balkanisation predicted for the scholarly communication system is already occurring in the public library sector as libraries focus on the popular academic pursuits at the expense of other areas. John Buschman (1994: 222-3) describes the loss of access at the New York Public Library caused by an emphasis on the development of Science, Industry and Business collection.

The New York Public Library only recently has found the funds to restore staff and extend hours cut from branch libraries around the city (of primary benefit to local neighborhoods and schoolchildren). In the meantime, NYPL was able to proceed with a Science, Industry, and Business Library with an integrated technology system at a cost of $18.5 million to the public.

[56] Alvin Finkle (1998). http://hoshi.cic.sfu.ca/calj/newsletter/mar97.html#9

Notes Chapter Five

[1] Clifford A. Lynch (1994: 27).

[2] Some authors (i.e., Carrigan, 1995) draw on managerial discourse and refer to a move from a *just-in-case* to a *just-in-time* model or resource delivery. In the former model, libraries own as much material as they can afford just in case someone needs it. In the latter model, libraries arrange to provide access so that the material is available if it is needed.

[3] See for example Bart Harloe and John M. Budd (1994). Also Paul M. Gherman (1991).

[4] Duane E. Webster and Mary E. Jackson (1994).

[5] Beth Brin and Elissa Cochran's (1994) report on the initiatives of the University of Arizona library makes clear that libraries can pursue, and probably should pursue, a number of different approaches to providing document access.

[6] Calls for cooperative collection development are at least forty years old (Downs, 1945). More recent statements are provided by Richard M. Dougherty and Nancy Barr (1988) and Tine E. Chrzastowski and Karen A. Schmidt (1993).

[7] Charles A. Schwartz (1994).

[8] The ARL in the U.S. and CARL (Canadian ARL) in Western Canada have developed cooperative strategies amongst their member organizations. Libraries in the consortium hold shared subscriptions to journals. When the new issue of a periodical arrives, the table of contents of that issue is faxed to other members of the consortium (Piternick, 1989). A similar strategy was implemented in 1984 by the Network of Alabama Libraries (NAAL) (Medina, 1992: 7).

[9] Dennis P. Carrigan (1995).

[10] Dennis P. Carrigan (1995).

[11] Dennis P. Carrigan (1995: 178).

[12] Michael Lesk (1992). Back in 1992 there was some debate about the Economic Models that would be most viable and useful to libraries, publishers, and end users in the electronic marketplace (Czeslaw Jan Grycz, 1992). Now however publishers seem to be pursuing the cite license model in temp guisto so the debate has been rendered academic.

[13] Gail McMillan (1992).

[14] Joseph Branin (1991).

[15] Frank Quinn and Gail McMillan (1995).

[16] The University of Virginia's Electronic Text Centre: An Interview with David Seaman. [http://etext.lib.virginia.edu/articles/VirgLib/virglib.html]

[17] Chronicle of Higher Education (1998: July 10). http://chronicle.com/

[18] Athabasca University mission is to "remove barriers that traditionally restrict access to and success in university... and to increase equality of educational opportunity." Supporting the development of a high quality, low cost, scholarly communication system supports the long terms goals of Athabasca University. More information is available at http://www.athabascau.ca/ and at http://www.athabascau.ca/openu.htm.

[19] See http://www.linux.org and http://www.freebsd.org

[20] See http://www.perl.com/pace/pub for more information.

[21] Eric S. Raymond (1998).

[22] See the Introduction to Open Source at http://www.opensource.org/intro.html

[23] See http://www.opensource.org/halloween.html for details on the Microsoft memos.

[24] John Naughton (1998). For Microsoft's response to the Halloween documents see http://www.microsoft.com/ntserver/highlights/editorletter.asp

[25] H-net is located at http://www.h-net.msu.edu/

[26] The University of Evansville is located at http://www.evansville.edu/.

[27] See http://www.icaap.org/standards.html for more information.

[28] See http://hippias.evansville.edu/ and http://noesis.evansville.edu/ for more information on these projects

[29] Anthony F. Beavers (1998).

[30] Anthony F. Beavers (1998).

[31] Anthony F. Beavers (1998).

[32] Richard Light (1997).

[33] Peter Flynn from the XML Faq at http://www.ucc.ie/xml/.

[34] For production examples of IXML, see http://www.icaap.org/TheCraft/ and examine the *contents* page and the associated articles.

Notes Chapter Six

[1] Paul Ginsparg (1994).

[2] Andrew Odlyzko (1994).

[3] A company by the name of Omnimark (http://www.omnimark.com/summary/konst-info.html) offers SGML/XML aware software at the cost of $60,000 per unit. It goes without saying that the purchase of software such as this would add significantly to the infrastructure costs of electronic publication.

[4] For more information see the Apache home page at http://www.apache.org/. Also see their awards page at http://www.apache.org/in_the_news.html. Significantly, both software giants Netscape and Microsoft have been unable to complete against the free Apache despite intense efforts to reduce the market share of this program. See http://www.apache.org/awards.html

[5] See http://www.engelschall.com/sw/mod_ssl/

[6] The DB drives mysql is one freely available db engine which is used at ICAAP to provide URN functionality for our journals. See http://www.mysql.org/

[7] See http://www.perl.com/pace/pub

[8] See the GNU pages at http://www.gnu.org/software/emacs/emacs.html for more information on the EMACS text editor.

[9] Ian Mugridge (1998).

[10] For more information on DSSSL see http://www.mulberrytech.com/dsssl/dsssldoc/cookbook/. For information on Jade see http://www.jclark.com/jade/

[11] See http://www.icaap.org/TheCraft/1999/sosteric/article.html.

[12] Erwin Warkentin (1997).

[13] Andy Powell (1998).

[14] Andy Powell (1998).

[15] Steve Hitchcock, Les Carr, Wendy Hall and Steve Harris, Steve Probets, David Evans, and David Brailsford (1998).

[16] see http://www.sociology.org/content/vol004.001/sosteric.html for an example.

[17] Anthony Beavers (1998).

[18] Mike Sosteric (1998).

[19] Anthony F. Beavers (1998).

[20] Fytton Rowland (1995).

[21] Fytton Rowland (1995: 85; italics added).

Conclusion

[1] Susan Nutter (1993: 3).

[2] Herbert Schiller (1989: 75).

[3] Jean-Francois Lyotard (1994: 37-8). Steven Seidman

[4] Oscar H. Gandy (1993), David Lyon (1994).

[5] Oscar H. Gandy (1993), David Lyon (1994).

[6] Frank Webster (1995).

[7] Frank Webster (1995).

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APPENDIX ONE: TECHNICAL GLOSSARY

EMACS

EMACS is a multifunctional text editor that handles mail, news, contact databases, SGML parsing and validation, and numerous other basic computer text and programming functions.

Document Transformation

Document transformation occurs when a computer file in one format (e.g. Microsoft Word) is *transformed* to another format (e.g., HTML). Document transformation is the basic task of electronic publication. One of the reasons for the development of SGML was in order to facilitate document transformation.

DTD Document Type Definition.

A DTD is a list of statements that specifies the syntax of an SGML system. This syntax definition includes a list of all allowable *elements*. It also includes rules to specify how the elements can combine. For example, in the HTML DTD, paragraph elements (<P>) cannot nest.

DTDs are read and processed by SGML software during the document validation phase to ensure a document complies with the definitions in the DTD. Validating SGML documents allows designers to tightly control the document structure. This in turns makes it much easier to machine process (transform) the document.

ELEMENT

Elements are the basic SGML tags that are used to identify the function of text in an electronic document. For example, the <P> element identifies the following block of text as a paragraph.

HTML

The Hypertext Markup Language (HTML) is the standard for marking up and presenting textual information the World Wide Web. HTML is an implementation of SGML.

HTTP

The Hypertext Transport Protocol is the computer language that client browsers like Netscape use to communicate with an HTTPD and request documents and other resources from remote computers.

HTTPD

The Hypertext Transport Protocol Daemon is the software used to *serve* documents over the world wide web. The HTTPD understands the HTTP.

IXML

IXML stands for ICAAP eXtended Markup Language. Like HTML, IXML is an SGML implementation.

LASE

A LASE is a Limited Area Search Engine. LASE search engines index and catalogue only selected resources on the World Wide Web. For example, the Noesis (http://noesis.evansville.edu/) search engine catalogues only full text, philosophical resources that have been cleared by an editorial team. LASE search engines are to be distinguished from promiscuous search engines like Excite or Hotbot that index and catalogue all available Internet resources.

LINUX

Linux is a *flavour* of the UNIX operating system that runs on Intel processors (the PC on your desktop) and that is provided free for commercial and non-commercial use.

Listserv

Listserv is a software program that handles large volume mailing lists. It is equivalent to the address book most of us keep when managing our collection of email addresses. However, it adds additional functionality for managing multiple address books and thousands of addresses.

Majordomo

Majordomo is a software program equivalent in functionality to Listserv.

PDF

The Portable Document Format is Adobe's propriety document format. It is an alternative used by some information providers for WWW document delivery.

SGML

The Standard Generalised Markup Language is the *meta language* used to **define** markup language implementation. SGML is basically a set of rules and procedures that tell individuals how to implement markup systems. HTML is an implementation of SGML.

SGML languages like HTML are used to *represent* text in electronic format. They are designed to facilitate machine handling of textual information. A tight SGML system (like IXML) allows very easy document archival, storage and transformation.

UNIX

UNIX is the defacto standard operating system for all mission critical computer applications. There are numerous *flavours* of UNIX developed by individuals

and organisations (even Microsoft has XENIX which is a flavour of UNIX that runs on the Intel processor). In recent years, various free versions of UNIX (Linux, FreeBSD) have been developed and are rapidly gaining acceptance.

XML

XML is SGML. XML is basically a stripped down version of SGML that does away with certain complex and seldom used rules for markup. XML was developed in order to popularise SGML and in order to overcome the limitations of HTML. It is much easier to write DTDs with XML and it is also much easier to write software that parses XML documents.