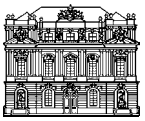
Michael Nentwich

cyberscience

Research in the Age of the Internet

Chapter 7

CYBERSCIENCE AND PUBLISHING



Austrian Academy of Sciences Press
Vienna 2003

Submitted to the Austrian Academy of Sciences on 10 April 2003
by Gunther Tichy, member of the Academy

British Library Cataloguing in Publication data.
A Catalogue record of this book is available from the British Library.

ISBN 3-7001-3188-7

Austrian Academy of Sciences Press
Tel. +43-1-5129050-3405, Fax +43-1-51581-3400,
Postgasse 7, A-1010 Vienna
Email: verlag@oeaw.ac.at
http://hw.oeaw.ac.at/cyberscience

Layout, cover & type-setting: Manuela Kaitna, A-1080 Vienna
Printed and bound in Austria by Manz Crossmedia GmbH & Co KG, A-1051 Vienna

DETAILED LIST OF CONTENTS

> "It is often thought that changes will be incremental, with perhaps a few electronic journals appearing and further use of email, ftp, etc. My guess is that change will be far more drastic. Traditional scholarly journals will likely disappear within 10 to 20 years."
> (Odlyzko 1994, 4)

7 CYBERSCIENCE AND PUBLISHING

One of the most visible impacts of the evolution of cyberscience relates to the scholarly publication system. It is, in fact, one facet of the wider field of "knowledge representation" (as discussed in the previous chapter) but needs special emphasis. The massive advent of electronic (E-)publications in various forms, in particular E-journals, has already shattered the long-standing relationships between libraries, publishers and scholars. Not only are E-journals relatively cheap to produce if compared to printed journals and can thus be run relatively easily, but they also provide for various innovative features unheard of in the paper world. The guiding question of this chapter will be: In what direction will the scholarly publication system evolve?

The previous chapter 6 explored not only the basics of the new publishing environment (such as digitisation), but also addressed a number of far-reaching scenarios with regard to a profound change of what academics will produce in the future. The present chapter, by contrast, is a little bit more conservative and describes the current evolution from traditional publishing on paper to digital publishing. I start with an overview of the status quo of academic publishing, which is no longer purely paper-based (7.1). I shall then look at the innovative features of E-publishing as compared to print (P-)publishing (7.2), and at the special aspect of archiving (7.4) of digital publications. The main body of this chapter is devoted to the question whether we have to expect the end of scholarly publications on paper (7.3). The answer will be differentiated according to the various types of scholarly publications (7.3.1) and will be discussed in terms of our trilogy of intervening factors (technical/actor-related/institutional; 7.3.2). The final section is devoted to an overall assessment of the transformation of academic publishing and sketches a scenario of the mid-term future (7.5).[660]

7.1 The status quo: P-publishing, E-publishing and hybrid forms

Today's academic publishing system is characterised by the synchronous existence of both paper and electronic publications. While print on paper is still predominant as regards books of all types, electronic forms of delivery as regards journals and working papers increasingly parallel it. The current development is stamped by two developments to be explored in the following: a significant overall increase of academic publications (7.1.1) and a forceful trend towards E-publishing of all types (7.1.2).

[660] Note that I look at new forms of knowledge representation in chapter 6, quality control in chapter 8 and at legal aspects as well as the economical side of E-publishing in chapter 9.

7.1.1 The increase of academic publishing, its reasons and its consequences

This is not the place to trace in detail the enormous increase of the number of academic publications over the last decades, a few hints should suffice. The development had already been documented in the 1960s by Price (1986 (1963)). Recently, the amount of publications have doubled every 10 to 16 years depending on the discipline (Grötschel/Lügger 1996, 2). Already in 1993, the doubling time for the body of scientific information (that is the time span in which the number of pages published in academic books or journals doubles) was only about 12 years (CSTB 1993, 5). Reviewing this exponential growth with a focus on mathematics, Odlyzko predicts that "(e)ven if the rate of publication were to stay at 50,000 papers per year, the size of the mathematical literature would double in another 20 years" (1994). As regards science as a whole, according to one author, around 10,000 scientific articles are published every day (Twigg/Oblinger 1996). By contrast, both the number of articles and of scientific scholarly journals per scientist have decreased from 1975 to 1995. However, at the same time, the size of journals has increased (in both the number of articles per journal and the length of individual articles). Consequently, there has been a marked increase in the number of pages published per researcher (Tenopir/King 1998).

Why is this so? Three main reasons for this increase can be named: first, the steady growth in the number of researchers – 90 % of all scientists throughout history are alive today (Pfeffer 1999; CSTB 1993, 5); second, the profitability of journal publication due to the advent of electronic type-setting; and third, the growing specialisation of scientific research, relentless pressure exerted on all academics to demonstrate their research output in terms of publications. The increasing competition in science, both in terms of content among competing researchers and for funding reasons, leads in turn to "upward pressure on the communication and information system" (Kircz/Roosendaal 1996; similar Bourguignon/European Mathematical Society 1999, 111; Olivieri 1997, 82).

What are the consequences of this development? First, the reading market for technical scholarly papers is all but large: estimates say that on average, only 20 people will read a paper intensively, not least due to increasing specialisation. Although the numbers of researchers is growing, they tend to work in narrower specialities with the effect that the audience for the results stays practically constant (Odlyzko 1994). Furthermore, there seems to be a general feeling that this accumulated growth has lead to an increasingly unmanageable pile of information. This growth of information seems to lead "to less effective and efficient communication, threatening in turn the effectiveness and the efficiency of the science process itself" (Kircz/Roosendaal 1996, 2).

As E-publishing started only in the 1990s, it cannot be at the root of this increase of scholarly publications. Furthermore, as we shall see in the next section, most of E-publications today are so-called parallel publications, in other words: they do not exist independently of the paper version of journals. What we may observe, however, is that the online medium is contributing to more informal or preliminary publishing in the form of working paper series and self-published papers on individual homepages.[661] Does the Internet really reinforce the trend just described as it is offering the tools to circumvent the previous restrictions of the printing-press-based system of publication? Yes and no. Yes because it is undeniable that it has become much easier to "run" a journal and to pub-

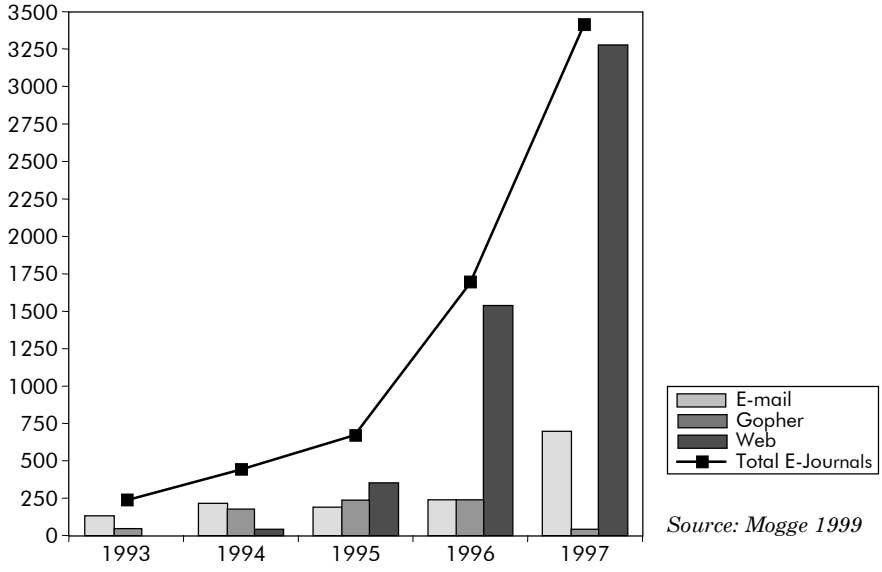
[661] I shall come back to the question whether this may lead to less quality in the next chapter (cf. 8.3.1).

lish. No because, at the same time, cyberscience also provides for the tools to handle the tide. Powerful search tools, filtering, knowbots etc. (cf. 2.2.2) will most probably be able in the future (and are already to some extent able) to make it easier both to find the right pieces for a very targeted question and to get an overview on the status quo of research as a whole. I addressed this issue already in the last chapter (cf. 6.4.3.1) and shall come back to it when I discuss the properties of E-publications (7.2.2).

7.1.2 E-publishing today

> "(D)elivering the old technology via the new is only a transitory phase and (...) it must not be viewed as an end in itself. Before we embark on the large-scale compilation of electronic information, we must consider how future scholars might use this information and what are the best ways of ensuring that the information will last beyond the current technology."
> (Hockey 1997b, 2)

As we have seen in 2.4.4.1, E-publishing comes in various forms. In roughly chronological order, the technologies adopted for *E-journals*[662] were E-lists, anonymous file transfer protocol (FTP) and Gopher (cf. 2.1.2). Today, E-journals are mainly delivered online via the Web (cf. Figure 7-1). Many new technologies tended to be used in addition to older technologies, rather than supplanting them. So far, this is also true for online journal publishing so that "it is not unusual to find journals that were initially distributed by listserv, and which then added aftoy, and later perhaps gopher or access via the Web" (Treloar 1996, 136).



Source: Mogge 1999

Figure 7-1: Access to E-journals 1993-1997

[662] For a definition, see 2.4.4.1.

The first E-journals appeared in the late 1980s. According to some sources, the very first E-Journal was "New Horizons in Adult Education", published by the Syracuse University Kellogg Project from autumn 1987 onwards.[663] The increase of E-journals during the 1990s was impressive (cf. Table 7-1).

Table 7-1: Increase of peer-reviewed E-journals 1991-2000

	1991	1992	1993	1994	1995	1996	1997	2000
E-Journals/Zines[664]	27	36	45	181	306	1093	2459	5436
Peer-Review	7	15	29	73	139	417	1049	–

Source: Mogge 1997 and DSEJ 2000[665]

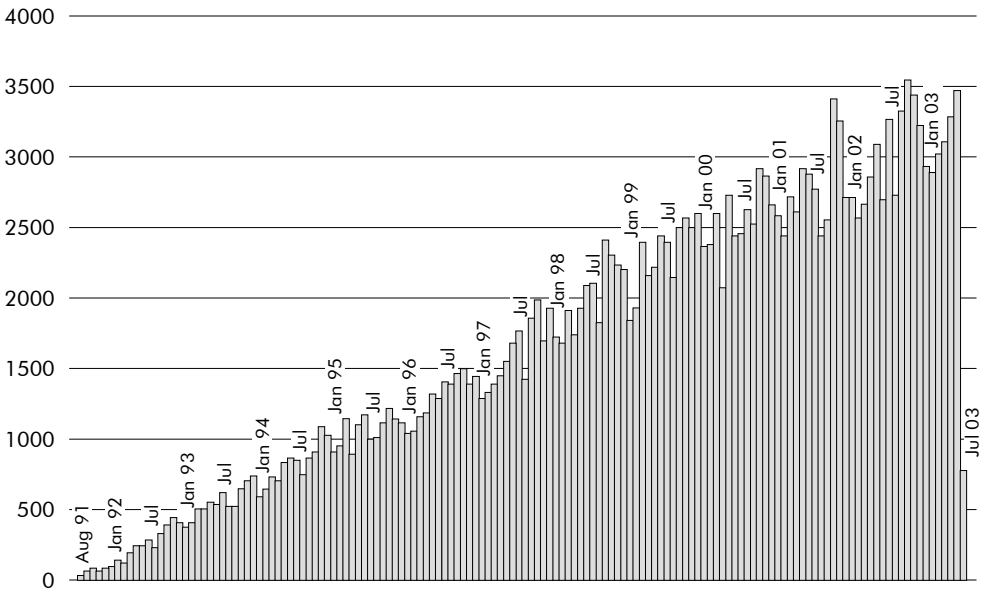
Based on NewJour[666], an E-list monitoring new E-journals around the world, Okerson (1997b) notes in 1996 an average of about six new E-journal titles every working day for well over a year. Back in October 1990, the E-journals covered several disciplines, largely humanistic and social sciences whereas the sciences were not well represented among E-journal start-ups, "perhaps because technical capabilities for easily dealing with non-text [we]re not fully ready" (Okerson 1991a, 4). This has changed since (cf. Figure 3-1 and Figure 3-2 in 3.3.2).

The newer figures in Table 7-1 include not only E-only journals, but to an ever larger extent parallel P+E-journals. The latter are journals, which are published primarily in print as traditional journals, but which have a proper homepage with the electronic full text available for download by the subscribers (a "companion" E-journal). The present development of "uploading the flotilla" (Harnad 1998b, 127) of previously existing print journals will soon have tapped the full potential. This is the main reason for the sharp increase of E-journals. They are, however, separated by a "financial fire wall" (ibid.). While in the majority of the cases the digital version of the printed article is identical in layout and content, some journals offer additional graphics and pictures for download which are not included in the print version. In general, by far most academic E-journals available today are no independent products, but they offer, in essence, an additional delivery channel for individual articles to individual researchers. Often, digital and print come in a package and it is not even possible for a library to order the E-journal version alone.

While these P+E-journals are published in the same rhythm and with the same number of contributions, some of the E-only journals, in particular those run by scholarly associations independently from a commercial publisher are unstable ventures. A comprehensive overview of the state of E-publishing affairs in the UK in 1997 finds that, at that time, the E-journals under scrutiny "have so far barely attracted enough papers between them to fill a single issue of a conventional journal" (Hitchcock et al. 1997a, 14; cf. also 1996). This is, however, no general rule and there are quite many E-only journals today which are well-established publishing channels in their field.

663 <Cyberlink=785>; another very early one is EJournal, published since 1991 (<Cyberlink=729>).
664 "E-zines" is an often used abbreviation for "electronic magazines" that is online magazine-like publications.
665 <Cyberlink=180>.
666 <Cyberlink=793>.

Working papers have seen a parallel development. They were first distributed among peers via E-mail, later via FTP and are now on the Web. The first E-pre-print archive (cf. 2.3.4.1) in high energy particle theory started in August 1991[667], soon followed by various further archives from February 1992 onwards – both in the areas of physics, mathematics, chemistry and later in other fields like cognitive sciences etc. Its founder, Paul Ginsparg (1994) tells the interesting story of this history-making development which started with a PC under his office desk. The submission rates have been constantly growing, reaching the impressive level of over 3,000 new papers each month with, by now, well over 200,000 papers in the database (cf. Figure 7-2). Between 180,000, on peak weekdays, and 60,000 connections to the server on weekend days are counted.



Source: ArXiv.org statistics page

Figure 7-2: Monthly submission rate statistics for arXiv (as of 7 July 2003)

As mentioned in 2.3.4.1, in some fields the pre-print archives are not central depositories but merely central search-engines for meta-data while the papers reside at many sites around the world. One of the largest of such search-engines is in economics, which comprises the meta-information of over 118,000 working papers plus 79,000 journal articles.[668] The overall effects of such decentral archives are similar to the ones of the arXiv type: much of the pre-print literature of a field is easily available worldwide and in full text.

E-books, by contrast, are still rather rare in academia – for examples, see already 2.4.4.1: There are isolated examples of large texts written as E-books here and there. Increasingly, dissertations are not printed any more, but uploaded to a university server only.

667 ArXiv <Cyberlink=216>.
668 At the time of updating (July 2003); RePEc is to be found at <Cyberlink=214>.

In sum, the academic publishing scene is evolving fast. We are in a transitory phase between the traditional system with printed publications in the physical world and an increasingly "virtual" model with digital publications in a networked environment. The present state of affairs is a *hybrid model* (Owen 2000, 5): we still have printed matter while already using digital resources, and search for those publications still in the physical world of libraries while, at the same time, already using the electronic network. The hybrid model may stay with us for long, possibly re-arranging the proportion of its components. However, the transitory phase could as well finally give way to a basically digital or "virtual" model. I shall come back to this in 7.3 after an analysis of the features of E-publishing in the next section.

7.2 What is new about E-publishing?

> "What must not be lost in these sober comparisons is that the conversion from print to pixels is not merely a change of clothes: it is an enormous expansion of capability."
> (Regier 1997, 4)

There are two different types of E-publications. The majority is but paper publications stored in a different medium. Most of them even try to mimic the exact layout of their paper parent and only rarely or hesitantly implement innovative features. Kling/Covi's statement of 1995 still holds true today to a large degree:

> "One of the remarkable features of today's e-journals is that few of them use special features of the electronic media to scholarly intellectual advantage. Most of the e-journals publish papers that could appear in p-journals. (...) (T)he articles that appear in e-journals (...) do not make special use of their electronic formats, except for distribution." (1995; similar Hitchcock et al. 1996, 5f.)

One of the reasons given is that even then (and much more so today), most E-journals are 'parallel' online journals (see above). A publication based on the paper journal model cannot have real interactivity with online speeds and multimedia content "without diverging from the paper production process and content" (Hitchcock et al. 1996, 6) However, there are also truly innovative E-publications implementing novel features, not possible and conceivable in the printed world. While the most advanced are discussed in chapter 6, I shall look here at the present and nearer future.

It is helpful to distinguish three types of changes on the path from P-publishing to E-publishing, namely improving (doing better), enhancing (doing more) and transforming (doing differently) what P-journals have already achieved (Treloar 1999). Using this distinction and expanding on Treloar's examples, I come up with the following overview of novel properties of E-publications – which also serves as an itinerary to the more detailed discussions in the rest of this study:

E-PUBLISHING ...	
1. ... improves:	
○ Navigation in articles	(above 6.2.3)
○ Speed of publishing and dissemination	(below 7.2.1)
2. ... enhances:	
○ Layout and enables new content (multimedia)	(above 6.2.2)
○ Browsing between articles and sources (links)	(above 6.2.3.2)
○ Capacity of publication media (length)	(above 6.4.1.2)
○ Search function	(below 7.2.2)
○ Reach and enables new distribution models	(below 7.2.3)
3. ... transforms:	
○ Text into genuine hypertext	(above 6.3)
○ Text stability (fixity)	(above 6.4.1.3)
○ By adding interactivity	(above 6.4.4.1)
○ Into new types of publications	(below 7.2.4)
○ By enabling new ways of refereeing	(below 8.2)

Overview 7-1: Comparing P- and E-publishing

7.2.1 Speeding up publishing and dissemination

ICT impacts on the speed of the performance of a variety of scholarly activities. In particular, finding a citation with the help of online bibliographic databases is greatly accelerated. This will be even further improved as soon as cross-linking between all academic publications is fully implemented (cf. 2.3.4.3). Furthermore, as discussed in 4.3.2.2 on the productivity of the academic system, ICT use may lead to time reduction for certain scientific tasks, including the overall time to finalise projects carried out by researchers spread over different time zones. Here I shall focus on yet another important area in which ICT helps reducing time constraints, namely the publication and dissemination process.

A widely perceived disadvantage is the slowness of the paper journal. For instance, in mathematics, it is not seldom that an article appears in a journal only two to three years after completion; often it takes another year before the article is neatly shelved and archived and, thus, accessible (Grötschel/Lügger 1996, 3). Similar time lags can be observed in many other fields. Similarly, book production is also often despairingly slow (often more than a year). The disadvantage of this long time lag between submission and availability influences what Neal calls the "currency" (1997, 6), that is the timeliness of publications: it may well be that a publication is hopelessly outdated when it finally reaches its audience.

ICT in general and E-publishing in particular provide the tools to make publications available much earlier than is possible for print versions. We may distinguish the following sources for gains in speed:

- The *editorial work* is accelerated due to E-mail. The communication with both the authors, the referees, the members of the editorial board and the staff of the publisher

are increasingly done via this instantaneous and fast channel. The previously long delays due to the need to mail manuscripts and reports in paper around the world are history by now. Furthermore, it is facilitated and partly automated due to the advent of new software (often handmade for particular innovative E-journals, cf. 2.4.4.2).[669]

- The *rhythm of publication* of traditional journals in issues with a limited number of pages and hence articles, bounded in yearly volumes, can be easily altered in the E-world: new articles can be published, that is "put online", as soon as they are ready (reviewed, edited, formatted etc.). This is called "continuous publishing". Hence, those delays caused solely by backlogs at publishers (in contrast to those due to content-related reasons) can be eliminated with E-publishing.[670]
- *Printing and shipping time* is reduced to zero. Note that layout or "typesetting" nevertheless has to be done, but the time of physical printing as well as of distribution to the readers can be deducted from the overall production cycle. Today, printing and delivery is literally replaced by copying a PDF file to the document server instead of sending the same[671] PDF file to the printing press computer.[672]

A comparison of a number of scenarios with different communication media ("snail" mail vs. E-mail) and different final products (P-journal, E-journal, E-pre-print, see Kling/McKim 1997) reveals that cycle times range from over 300 days down to 3 days only (cf. Table 7-2). The differences between upper and lower day numbers are due to a number of different reasons, including mail problems, late referees and differing standards for layout and control. In addition, the type of publication plays a role as the OECD report rightly notes (1998, 213).

Table 7-2: Cycle time in academic journal production

Scenario	Days
Conventional scenario	128-308
Courier scenario	107-287
E-mail attachment scenario	104-284
E-journal with issue packaging	100-280
Pure E-journal with individual articles	54-84
E-pre-print system, article sent at time of acceptance	50-80
E-pre-print system, article sent at time of submission	3

Legend: Days ... days from submission to publication

Source: Based on Kling/McKim 1997

669 For an informative description of one such system, see Pope (1998). See also 8.2.4.1.

670 Tomlins (1998, 141) reports that the non-issues format is less popular among authors. Probably this is a matter of his limited empirical evidence (both in terms of discipline and time). Anecdotal evidence from my interviewees and this author's own experience in editing a continuously publishing journal show that the time-related advantages are highly appreciated among authors.

671 It is actually not exactly the same PDF file as one sets certain parameters differently and perhaps includes more font and other layout information in detail if the PDF file goes to the printing machine as opposed to on-screen viewing or printing on laser printers around the world (not least because in the latter case file size is an issue).

672 Note that E-publication on CD-ROM or diskette has, in this respect, slightly different properties. For instance, production and shipping of CD-ROMs may take as long as for traditional print media.

Analysing these figures, it is helpful to distinguish between two phases of the publication process: (1) from original submission to final acceptance of the revised and edited manuscript and (2) from final acceptance to final appearance of the published article (Raney 1998, 6). In contrast to the second phase, electronic media offer no intrinsic speed advantages over conventional journals in the first phase since electronic communication can be used in both "worlds". That is, while my first bullet point regarding editorial work certainly belongs to the development towards cyberscience, it is only my second and third points that distinguish P- from E-publishing. Quality requires thorough review and revision – which takes time (Raney 1998, 6; similar Odlyzko 1994, 45). The time spans reported by Kling/McKim above show this perfectly: while a non-refereed E-pre-print system only takes a few days (perhaps even only hours), the refereed version needs, at average, one and a half months longer. The biggest net gains (about half of the total time) are, however, to be made by altering the rhythm of publication, whereas changing the communication medium only accounts for a couple of days difference (if we take the minimum numbers of days, this accounts for around three weeks only).

In sum, ICT contribute to a considerable decrease of cycle times in academic journal production. There are, however, limits in time reductions given by the need to control the quality. In this latter respect only relatively small gains can be made due to faster communication media. However, apart from formal E-publishing, also informal dissemination of research results via E-lists and E-pre-print servers is considerably accelerated when compared to sharing working papers by postal mail.[673]

7.2.2 Advantages for searching

E-publications are stored in digital format. This qualifies them for advanced searching technologies. Even if a text-based electronic document is printed out in the end for reading, the value added in comparison to a paper-only document is still considerable. If it was part of a large collection of electronic documents it could be retrieved electronically, downloaded swiftly and looked at on screen (Brüggemann-Klein 1995, 172). We may distinguish two ways of searching:

On the one hand, as soon as text is available electronically, *full text search* is possible. No particular treatment is necessary if you do not expect extremely precise results, but rough indications. Take the well-known web search-engine GOOGLE[674], compare it to the hypothetical idea of browsing through hundreds of books and you will recognise the power of full-text search. In particular, the opportunity of combined searches (that is, with several keywords, which should all be present in the target document) is very attractive if a researcher is looking for an explanation, an example, a definition or simply for something s/he remembers vaguely to have read once, but which cannot be found directly. Present search-engines are certainly only the beginning. As soon as search-engines become more sophisticated and integrated, E-publications may be searched universally and via tools for analysing text, perhaps based on artificial intelligence. In the longer run, even "knowledge discovery" techniques such as web mining and bibliomining (cf. 2.2.2.3) could serve the research community.

[673] One effect of this could be that, today, scholars are in a better position to "market" (not in a commercial sense) their products.

[674] <Cyberlink=760>; on web search-engines in general, see 2.3.5.

On the other hand, in an electronic environment documents can also be retrieved much more targeted in case they have been tagged, that is marked in a special way (*meta-data searches*). Meta-tags make documents not only machine-readable, but also machine-understandable. The various meta-tagging initiatives (DC – Dublin Core, RDF – Resource Description Format etc.) and the overall aim of a Semantic Web are described in 2.2.2.1. Clever 'knowbots'[675] could be designed "to go out instead of us and look for papers fitting our profile of interests, leaving us even more time to actually read what we want and to do our research, rather than running after the literature" (Harnad 1995, 3). The shift to E-media would not mean an increase in information overload but, in contrast, a means to cope with it: "the agents will earn to select [the articles a reader typically chooses], sifting out articles of no interest to that reader" (LaPorte et al. 1995).

Summing up, E-publications have an important advantage vis-à-vis P-publications as regards their searchability. Information contained in digital format is more easily accessible, not only as regards distant delivery (cf. 4.3.4.2), but also as regards content. It is, however, important to stress that – despite all obvious advantages of the current technology – the full potential of these enhanced search capabilities will only pay off after intensive investment in the data. As a database needs to be serviced and cultivated, E-publications in the worldwide web of academia will, too. This is no easy or small task. The possible futures are diverse. In the previous chapter, I have already discussed the scenarios of field-wide hyperbases and consolidated knowledge bases (cf. 6.3). Alternatively, cybrarians may analyse and describe each document stored in their "cybrary", probably on the basis of input by the authors (cf. 5.3). A final route may be provided by the publishers or agencies, commercial or not, who may invest in the meta-description of their publications with a view to gain a competitive advantage (cf. 9.1.3.4).

7.2.3 New modes of distribution and enhanced reach

> "One of the biggest changes – and potential benefits – of electronic publishing is its wide dissemination."
> (Rohe 1998, 1)

There is only one delivery mode for P-publications, namely bringing the physical printed copy of the whole book or journal to the reader. It may be a personal copy sent by mail or a commonly owned one that is only accessible by going to the respective shelf in the library. In the latter, by far more common case, it is, in addition, necessary to get to know the contents list with a view to making the decision whether it makes sense to go and get a copy. There have always been slow and cumulative abstracting services, which you had to subscribe to. In large research institutes, an internal service is often provided with plain copies of the contents lists of all newly arrived journal issues. The other route to be up-to-date on new publications, still on offer today, is browsing through bibliographies of new articles and talking to fellow researchers.

All this changed in the beginning age of cyberscience. What Neal (1997, 6) calls "accessibility" of academic publications has been greatly enhanced. First, it is now possible to stay informed about the latest publications through *alerting services*. Dedicated journal E-lists or newsgroups are widespread and inform the subscribers of new additions to

[675] Automatic search programmes, cf. 2.2.2.2.

either one or a group of journals. Alternatively, there are also websites offering this information. The disadvantage is that you have to visit these pages regularly to stay up-to-date. The advantage is that such a webpage may cover related journals and provide for special filtering services. Second, E-publications are accessible online, meaning that you can instantaneously *download the full* text to your office desktop computer. In addition, E-publications are more fine-grained. I am not talking here about modularisation in the hypertext meaning (cf. 6.2.3.1), but of *partial delivery of articles* instead of whole books or journal issues. One can speak of "tailored reading" (Bates 1994) meaning that an E-journal allows the reader to read (and print or save) only the articles of interest to him/her.

Universal access to publication is a precondition for academic communication. In 1989, Stichweh was still wondering whether this might be fulfilled in an online environment (1989, 56ff.). It has been argued that network communication can be "clunky, cranky, and inconsistent" and hence rather than to open up the universe, "they may appear temporarily to limit it, because only text is easily keyed and transmitted" (as reported by Okerson 1991b, 7). The above-described novel services in the E-publishing world, however, are likely to secure universal access in the future, at least in principle.[676] Diffusion of research results is "done effectively through electronic means" (Guedon 1994, 4). Reach is increased. Hence, the early fears that E-journals would only serve those who are already information and computer rich and highly skilled are outdated since computer literacy, at least in the academic world, is now widespread.

7.2.4 New forms of academic publishing

As we have seen in 2.4.4, the traditional formats of publication (journal, book etc.) all have gone online at least to some degree. The digitisation also opens up new ways of representing data, text and knowledge. One could even argue that "journals are not where the interesting action is" and that the "vigorous growth in novel forms of scientific communication that take full advantage of the online medium" (Odlyzko 2000, 3) is even more important. As we shall see in this section, I cannot fully agree with this opinion as there are very interesting and innovative journal formats. However, those innovative formats, which can hardly be compared with present academic publishing, will be of special interest. While hypertext and multimedia is the subject of the previous chapter (6), I present these innovative publishing formats which are closer to present publishing in the following sub-sections.

7.2.4.1 Innovative journal formats

As already mentioned above, most E-journals and in particular most P+E-journals are rather conservative in their use of the opportunities of the new medium. What even those journals increasingly do is to insert electronic links instead of the traditional hyper-elements[677]. There are, however, a few examples of journals, which go well beyond this and experiment with multimedia, interactivity, virtuality or fluidity.

[676] The financial aspects of the question of access, however, are the other side of the coin: access to journals is generally not for free; on the issue of peripheral research and digital unity, see 4.3.4.3.
[677] Such as footnotes and indices, cf. 6.1.

Virtual journals

The networked structure of the new E-publishing environment allows for journal models that are not centralised in the traditional sense, but decentral. What appears as a journal is in fact "virtual": The articles are distributed throughout the Internet, the "journal" homepage provides for their access. Two sub-forms are known:

(1) In the first version, the papers are not published elsewhere. They remain stored by the authors "at point of origin" or by arrangement with colleagues or with Internet databases. The authors submit them to the refereeing process of the virtual journal. The central journal database consists of abstracts, comments and relevant manuscript information including pointers to the Internet address of the original article. One example is Interjournal[678], which is in fact a group of three such virtual journals. They describe themselves as "distributed self-organizing refereed journals on selected topics in science and engineering". These journals have been labelled "multiple virtual journal" (Hitchcock et al. 1996, 11) to depict that they consist of "a number of interlocking journals on different subjects to which papers can be submitted simultaneously. The interrelated subject areas (...) are all part of the same global hierarchy and all manuscript information is stored in a common database" (ibid.).

(2) The alternative is a virtual journal that presents an online collection of relevant papers from a broad range of "source" journals in a field. From the user's perspective, the virtual journal looks and feels like a "real" journal providing useful features such as: tables of contents, abstracts, links to source journal home pages, full-text articles access, search-engine and E-mail alerting. The US physicists' community has a whole series of such virtual journals, the Virtual Journals in Science and Technology (VJS)[679].

Living reviews

The fluidity of the new medium may be framed as a problem (cf. 6.4.1.3), but it may also be used creatively by considering the possibility of updating an article not as a vice, but a virtue. In particular, when it comes to reviewing articles, that is articles describing the state-of-the-art in a research field, timeliness is an asset. While in the paper world you can only publish a new version of the review at a later date (which will again be outdated very soon)[680], it is conceivable to make "living" articles in the electronic world. They may be updated as soon as it becomes necessary, that is, on a current basis.

In 1994, Odlyzko (1994, 47) rhetorically asked whether review publications are likely to disappear since computerised searches can take over many of the functions of review journals. On the contrary, he predicted that they will flourish and become "gateways to published science" since "they provide valuable services that might not be easily derivable from the information supplied by authors in their papers." He was right: today, there are even new review E-journals popping up in the WWW. The potential inherent dynamics of E-publications make it particularly attractive to use E-journals for reviews since they may be updated on a regular basis. It is quite likely that "there will always be corners of the electronic universe that will require human attention". While "(f)ree auto-

[678] <Cyberlink=415>; another example is SSRN (<Cyberlink=460>), although this database is somewhat a hybrid between a multiple virtual journal and an E-print server: all submitted papers go into the archives, but are screened by area editors of "journals".

[679] <Cyberlink=748>.

[680] Note also that the reader who finds a printed review article has no immediate means of knowing whether a newer version has already been published.

mated search systems might provide 80 % of what scholars need, review journals might well justify their prices by providing the extra 20 %" (ibid. 48).

One good example is the journal "Living Reviews of Relativity",[681] published by the Albert Einstein Institute of the Max Planck Society. The editorial rules of this particular living review allow for two different types of updating. Errata or small, important additions will be published within the original article with a popup window indicating where the change has been made, without waiting for the next major article update (every two years on average). All changes are documented in a history file attached to each article. In fact, many of the articles published since 1998 have already seen a second (updated, revised, expanded) version (which has been put to refereeing again). The older versions are still available online. Furthermore, the way the references in the articles are processed is real value added for the reader: one can search in all references of all articles (reference archive) and, with one click, go to the exact context in which the quote was given in a specific review article.

Another type of E-review-journal is The Medieval Review (TMR)[682], based on an E-mail announcement list and its archive which publishes reviews of books in the field of medieval research (Hamilton/Shory 1997). In this case, the living, dynamic character consists in the constant update of the archive by new additions of reviews. It would be conceivable to even allow for comments or contrary reviews by different authors to be linked to the original review. A very useful additional service provided by TMR, is the so-called "bookbag". It allows the reader of reviews in case s/he is interested in a particular book to select the item from the TMR database as s/he searches or browses collections and hold them for the duration of the search session. Item records in the bookbag can be saved to the reader's desktop as a text file or mailed to his/her E-mail address.

Interactive multimedia journals

There is a new type of journal arising, combining multimedia and novel forms of reviewing, labelled the "interactive multimedia electronic journals"[683]. Small video sequences, audio tracks and animated graphics are included in the text. In addition, open-peer review, commenting, rating etc. are implemented. The IMEj[684] is the prototype journal in the field of computer-enhanced learning. Its goal it is to serve as a model and test bed for an electronic journal with a high level of multimedia and interactivity and to advance the acceptance of electronic publication as a legitimate and valuable form of academic discourse. Another example is JIME[685]. Both journals actively encourage their potential authors to "bring alive their contributions". An extract of the (online) editorial guidelines of JIME reads as follows:

> "If the description of new interactive media forms a substantive part of the submission, the article must be integrated with illustrative extracts of the media which convey to readers its interactivity. (...)
> Theoretical articles or literature reviews can now illustrate their analyses with particular examples of interactive media (which should become increasingly available over the Net). (...)

[681] <Cyberlink=237>.
[682] <Cyberlink=404>; a related venture is the Bryn Mawr Classical Review (<Cyberlink=405>).
[683] Sometimes abbreviated "imej", pronounced as "image" according to Burg (2000, 2).
[684] The Interactive Multimedia Electronic Journal in Computer-Enhanced Learning (<Cyberlink=242>).
[685] The Journal of Interactive Media in Education (<Cyberlink=236>).

> Authors can provide readers with better access to qualitative data, such as dialogue exchanges between students, extracts of video observation data, etc. With careful indexing and linkage to the article, this will provide the opportunity for greater rigour in the presentation of results."

So far, there are not many multimedia journals, yet. An informal search of existing electronic journals (Burg et al. 2000) shows that "although the word multimedia is used generously to describe online publications, there is still relatively little real multimedia development, particularly of the interactive sort. (...) (I)t is difficult to find examples of the type of journal predicted since the early 1990's." For a discussion of possible reasons, see 7.3.2.1.

7.2.4.2 Special web publishing formats

While I presented further developments of the traditional journal format in the previous sub-section, I shall look here at novel publishing formats with practically no counter-part in the paper world.

Link collections and area webpages

As the WWW is not well structured, many researchers and other players in academia (like cybrarians – see 5.3) are engaged in collecting and ordering WWW addresses in their particular field of specialisation. As structuring the knowledge available in a field is one of the tasks of scientists, publishing link collections can be seen as an academic publication. Under particular circumstances, link collections may be apt for quotation, too (cf. 0.3.2). Such link collections come – similar to other webpages (see 2.4.3) – in two distinct forms: either they are static webpages or they are databases, which enable the user to search for keywords and other meta-data. An example of the former is the homepage of the worldwide virtual library[686], and for the latter the "history.toolbox"[687].

Link collections may be the beginning of a more in-depth activity of structuring the web-space of a particular field. One option would be "area webpages" (Ullman 1996) organised by "area editors", perhaps appointed by the learned societies who evaluate the online documents related to a particular subject for validity. Such area webpages could be organised hierarchically. This vision is somehow a low-tech version of what I have discussed in scenario 5 on "consolidated knowledge bases" (cf. 6.3.5). The area editors may also be the cybrarians as discussed in 5.3.

Frequently asked questions (FAQs)

Originally an offspring of E-mail lists or newsgroups, FAQs are now very widespread and often totally unrelated to any lists. While the earlier FAQs were all in E-mail, i.e. text format, most of them are today on the web with hyperlinks to jump from the question to the answer. They include the answers to typical (mostly basic) questions asked in a particular area. Often these are technical questions related to software and the like.[688] Originally, FAQs have been collaborative projects. Many people contribute, at least by sending questions, a few write it up by answering, many read it. In the academic realm, FAQs may play the role of introductions to a particular field.[689] Here, there may be even single-

[686] <Cyberlink=603>.
[687] <Cyberlink=709>.
[688] For an example see <Cyberlink=385>.
[689] For an example in astronomy, see: <Cyberlink=730>.

authored FAQs. The format of FAQ provide the opportunity to publish new content which, previously, would not have been published at all, but which is now available in the Internet archives (Odlyzko 1994, 24).

Online self-(pre-)publishing

As it is relatively easy to produce webpages and to convert text files into a format which allows them to be shared over the Internet (see 2.4.4.3), researchers are increasingly using their homepages as a platform for self-publication. They offer their recent papers for download by fellow researchers. By this token, a paper can be made available long before it is actually (formally) published even in a working paper series or on a conference webpage.

7.2.4.3 Databases and archives

Although most databases and archives are on the Web, too – and could therefore be listed in the previous sub-section – it nevertheless makes sense to group them together because of their distinctive features.

Shared databases

Databases have become another new way of publishing academic knowledge (see 2.3.4). Data sets could be published alongside the research paper (Odlyzko 1994 36) or separately. In many cases, the databases are run by academics[690], others are provided by governmental bodies[691]. Databases can be commercialised so that one can access only for a fee, or available for free. In particular the latter seems to be a growing activity in academia.[692] For further examples in the sub-disciplines included in this study, see 3.3.7.

Access to shared and community resources via online databases is important in many fields, as it can be the solution to two problems. The first is *ageing*. Databases like those of the geneticists in biology[693] reflect the need to exchange data in an electronic format since a printed text would be immediately obsolete. The second problem addressed is *size*. Shared and collaborative databases enable the individual researcher to do more and on a different level than s/he could do with his/her much more limited own data. An important challenge is to describe data precisely enough to prevent misinterpretation if distributed to others via online data repositories (OECD 1998, 205).

Software sharing

Transfer and use of software via the Internet have become quite essential to researchers in a number of fields, such as mathematics, economics, physics or computer sciences. As the software becomes increasingly sophisticated and requires considerable investment to develop, "the incentive to share software is increasing" (OECD 1998, 204). By this token, software which was originally developed for a particular project or in-house project gets

[690] To name just one out of hundreds: the Heidelberg Registry in papyrology (<Cyberlink=554>).
[691] Examples are legal texts (e.g. CELEX <Cyberlink=757>) and statistical material (e.g. Eurostat <Cyberlink=750>).
[692] For instance, in the legal field, there is a big enough market of practitioners outside academia to sustain commercial databases, e.g. Lexis Nexis (<Cyberlink=442>) or RDB (<Cyberlink=676>). Another big provider of databases for a variety of disciplines is SilverPlatter (<Cyberlink=667>).
[693] For instance HUGO <Cyberlink=408>; see also Walsh/Roselle (1999, 60) and Thagard (1997b).

"published" by making it available to others via the Internet. In general, the originator of the software only asks for due acknowledgement and gives it for free. One typical example is the library for mathematical software Netlib[694].

Archives of primary sources and study protocols

In some fields where archives of primary source material play a role, the Internet provides the opportunity to collaboratively develop and manage such archives. For instance, historic documents may be made accessible again or for the first time through E-publishing (scanning etc.), either in full text databases or as part of a paper devoted to its discussion (cf. Glatthaar 1996, 32; see also St. Laurent 1992). Prominent examples are to be found in North-American history, namely the "Valley of Shadow"[695] site, or in archaeology and history of arts, namely the Prometheus[696] archive. Brandtner (1998) describes manuscript and autograph archives in the field of literature.

Also to be mentioned here is BioMedCentral's[697] effort to publish study protocols. These are crucial parts of any study providing a detailed account of the hypothesis, rationale and methodology, and is a plan for all the investigators to follow (Godlee 2001). But they are rarely available to people outside the study and once a study is completed, the protocol may be filed and forgotten, if not lost. As journals have severe space constraints, most reports of studies contain only a shortened summary of the methods. The online environment of BioMedCentral is ideally suited to overcome these deficits.

7.2.4.4 Scholarly "skywriting"

Certain contributions to academic newsgroups and discussion lists may be counted as a new type of publication, too. This may be the case if two conditions are met: first, if the posting is more than an announcement or question, e.g. an elaborate answer or comment; and second, if the postings are archived. Stevan Harnad coined the label "scholarly skywriting" (1990) for this, meaning

> "all the [E-mail] interactions at the 'pilot' stage of inquiry – from informal brainstorming to participating in research symposia to circulating preprints for peer criticism before formally submitting them to an archival journal for peer review".

There are many practical examples of this already. For instance, some active researchers participating in the newsgroup communication on cold fusion admittedly intended to do "E-mail science", i.e. shaping and forming thoughts in an open discourse and eventually publish this as "co-authored by the newsgroup" (Lewenstein 1995, 136ff.). According to Lewenstein, contributors to the net discussion observed by him have indicated "that they consider their use of CMC not just as an adjunct to traditional scientific communication but as a first step to recasting the entire structure of science". Lewenstein interprets this as "an intellectual commitment to changing the process by which information is exchanged and validated as knowledge" (ibid.).

Skywriting may eventually lead to a traditional publication. One example of this is the book edited by Okerson/O'Donnell (1995): most of the text was written in the course

[694] <Cyberlink=379>.
[695] <Cyberlink=295>.
[696] <Cyberlink=567>.
[697] <Cyberlink=226>.

of an extended (nine months long) discussion in an E-list. The book exists as both a free E-book and a printed version under the auspices of ARL.[698]

7.2.4.5 "Crossover publications"

There is a widespread hypothesis in the literature that with "the move toward greater availability of full-text electronic resources, the dividing line between journals and monographs is likely to become increasingly blurred" (Armstrong/Lonsdale 1998, 7). At the end of the day, we might "end up not with an electronic monograph but with something that's in between a journal article and a book" (ibid., 17). If we compare the properties of the book and the journal article and their functions in the scholarly communication process, we may conclude that in a "fully networked environment, formal scholarly publication can no longer be characterized by the dichotomy of monographs and periodical articles" (Atkinson 1993, 207f.; similarly, Okerson/O'Donnell 1995, Conclusion).

This hypothesis can be sustained by my own observations. As length of academic publications is no longer a principled problem in the E-publishing world (cf. 6.4.1.2) and as modularisation (cf. 6.4.1.4) would enable layered publications with multiple access and varying depth according to reader or reading purpose (cf. 6.3.1), the boundaries between the various formats of publications may become permeable. What we may call "crossover publications" may become possible. The crossovers would fall in neither traditional category, they might be read as a short journal article and simultaneously as a richly documented research report, as a research abstract and as a book-long argument.

Two other types of emerging crossovers are described in 7.3.1.3. The first are a mix between "special issues of E-journals" and "edited E-volumes". A first example is the E-publication TRANS[699] which is neither a journal (as it does not accept submissions) nor an edited volume (as it publishes individual articles). The second are "E-readers" which would be something in between a "distributed book" and a "review article".[700]

The following Overview 7-2 summarises the innovative E-publishing formats discussed in the previous sub-sections.

[698] Skywriting is further discussed in various other sections of this study, in particular with a view to quality control (cf. 8.2.1.3) and as regards credentials for new forms of cyber-scholarliness (cf. 8.4.2).

[699] <Cyberlink=788>, documented in Arlt (1999, 87).

[700] Something like it, although not exactly what is expected above in the text, is Perspectives in Electronic Publishing (PeP) by Hitchcock (2002), see <Cyberlink=494>. The selection of (pre-published online) texts included in PeP databases together with the editorial keywording and presentation come close to an editorial comment and framework as known in traditional readers.

INNOVATIVE E-PUBLISHING FORMATS

- New journal formats
  - Virtual journals
  - Living reviews
  - Interactive multimedia journals
- Special web publishing formats
  - Link collections and area webpages
  - Frequently asked questions (FAQs)
  - Online self-(pre-)publishing
- Databases and archives
  - Shared databases
  - Software sharing
  - Archives
- Skywriting
- "Crossover publications"

Overview 7-2: Innovative E-publishing formats

7.2.5 Quoting E-publications

From a practical point of view, quoting E-publications is an issue with some problems and differing solutions. That "the citation styles of online references are frequently inconsistent, incomplete, and/or are inaccessible – that is, they do not lead to the wanted online resource, in contrast to the citation styles of print references" (Harter/Kim 1996, 9) is still valid in 2002. We can distinguish two related issues under this heading:

(1) *Quoting standards*: There are no uniform rules yet, but some standards are crystallising. A number of style guides are known: earlier attempts are those of the historian Page who issued a "brief citation guide for Internet sources in history and the humanities" which received much quoting (Page 1996)[701] and the citation proposal drafted by the Coalition of Online Law Journals (1998)[702]. Meanwhile, most quasi official citation styles (Chicago etc.) deal with citing online sources, as documented for instance by the publisher Bedford/St. Martin's.[703] The main issues concern how to give Internet addresses (in which type of brackets, if at all, for instance), the need to give the date of last update, the date of downloading and/or last access, the version number etc. Certainly, there are different solutions for the different online sources, such as web sites, E-mail messages, web discussion forum postings, listserv postings, newsgroup messages, real-time communication (chat contributions) and other sites, such as telnet, FTP and Gopher. Giving the access date, date of last change and version number will be particularly important with regard to intrinsically dynamic E-publications, like databases and hypertexts because their content is bound to change over time (see already 6.4.1.2, last point).

Note that, in general, pagination does not exist in E-only publications (Armstrong/Lonsdale 1998, 19). Instead, reference to headings or paragraphs (with numbers) or, in a hypertext environment, reference to specific modules may be used. Alternatively, pages can be given according to the personal printout of an online document. However, one has to be aware that the page numbers can and do differ according to the printer (and printer

[701] <Cyberlink=142>.
[702] <Cyberlink=564>.
[703] <Cyberlink=792>.

driver) used for printing.[704] Most early and some present E-only journals[705] insert specific page-breaks. Therefore, even if the printouts differ in pagination, there are nevertheless "virtual pages" which can be used for precise quoting. Most of the present P+E-journals offer the digital version not in HTML (which cannot control for pagination), but in PDF or a similar format (cf. 2.4.4.1). In this case, pagination is exactly as in the print version.

(2) *Fluidity*: As already discussed in 2.1.2 and 6.4.1.3, the WWW is highly dynamic: a document which was found at one particular Internet address may have been moved somewhere else the following week; half a year later a considerable part of all quoted documents has certainly moved. Therefore quoting in an electronic environment is difficult, if we want to preserve the very purpose of quoting, namely to make research transparent and retraceable. How can we cope with this? The interim solution found by the various style guides (see above 1), is to make it obligatory to give the date of last access. Some publishers even require that a local copy has to be held by the author and made available on request. Another solution (developed by the author of this study) is to refer in a publication not directly to an URL, but to an entry in a link collection. While this does not solve the problem of changing URLs at its root, it nevertheless alleviates the problem, as the link collection can be kept up-to-date for a while at least. This, however, moves the burden of regularly checking and correcting the URLs to the author.

Therefore, this solution can only be an interim one and has to be replaced by a standardised system of fixed Internet addresses in combination with a solution of the long-term responsibility of archiving. A number of technical and organisational solutions have been put forward in this respect which are discussed in 2.1.2 and 6.4.1.3 under the label of persistent Internet addressing schemes. The idea is to have, in the long run, a system of E-publications with a unified system of addresses and meta-data (cf. 2.2.2.1).

7.3 The end of scholarly publications on paper?

> "The essential question at this point is not *whether* the scientific research literature will migrate to fully electronic dissemination, but rather *how quickly* this transition will take place now that all of the requisite tools are on-line."
> (Ginsparg 1996, 2)

The promise of the advent of the paperless office was never kept. Today, more paper is being used than ever, despite all the computer equipment present in offices – or perhaps even because of it, as printers become cheaper and better and as on-screen reading is still no delight. This is not different in the offices of scholars. Take the example of E-mails which are delivered in the paperless "state of aggregation", but soon change their state as they are often printed out for archival purposes. Another source of increase of paper on the desks of academics is, ironically, the improvement of word processing software. It allows for sophisticated layout which, however, also seems to have raised the

[704] Because many of the online documents quoted in this study have neither (virtual) pagination nor paragraph numbers, I chose this alternative in some cases. The reference to particular pages is not very precise, for sure, but better than no page reference at all. See also the introductory note to the reference list in the annex.

[705] E.g. EJournal (<Cyberlink=729>) and EIoP (<Cyberlink=699>).

standards and expectations – with the result that reasonably well laid out printouts are not considered appropriate enough and get discarded. Hence, the paperless academic work place seems not to be coming soon. In the short run, cyberspace will rather "diffuse the source of paper consumption, as each person prints out materials downloaded from the Web" (Fuller 1998, 137). Nonetheless, there are good arguments pointing in the direction of decreasing paper use in the long run: first, on-screen reading is likely to become much more convenient with next-generation screens and reading devices (cf. 2.3.1). Second, personal online annotation might be a way to "personalise" one's E-documents, which would be either carried around in small memory chips or available through the network (cf. 2.3.2). Third, in case the publishing system evolves into the direction described in chapter 6 (hypermedia), printing out would be a loss rather than a gain (cf. 6.4.3). Finally, data security measures and archiving might become trustworthy so that researchers would entrust their personal files and downloaded documents to a purely digital system outside their control (cf. 2.5 and 7.3.3). In any case, the path to the paperless research office would be a long one and would involve changes of obviously deep-seated habits and necessities. This is, however, only a secondary topic of this section.

The main focus here, by contrast, is the following: Will there still be print media alongside E-publications? This is not about whether or not a researcher makes a personal copy of a publication which was delivered to him/her in digital form, but it is about whether or not it would still be delivered as a printed matter at all. To put it in even more concrete terms: Will the publishers of, for instance, P+E-journals cease to make print copies and turn their journals in E-only publications, that is only delivered through the network?

Many scholars have been predicting the end of scholarly publications on paper for a long time already (since the advent of E-publishing at the end of the 1980s). To mention just a few authors: in the early 1990s, Odlyzko predicted that "traditional scholarly journals will likely disappear within 10 to 20 years" (1994, 4). Also Atkinson (2000, 59) assesses the " 'subversive' position (...) that most scholarly communication will shift to electronic form in the relatively near future (...) [to be] a very reasonable expectation". Grötschel/Lügger argue that in order to cope with the problems of information overload due to the increase in scholarly output and information lack due to difficulties in access, "there is only one way out. The scholarly publication system has to be established electronically." (1996, 5, transl. MN). Also Owen predicts that within a few years P-publications "will play only a very minor role, at least in a number of scholarly domains" (Owen 2000, 4-5). "(P)rinted information will become more or less invisible because most users will regard the network as their one and only source of information" (ibid.).

Note that, in this section, I talk primarily of the future of *print*, not of the future of *publications*. Publishing and printing should not be confounded, printing being but one form of publishing (Zeigler 1997, 36). This is particularly important if we talk about the various forms of publications: the essence of "the book" or "the journal" may be independent from its external form, e.g. print. So, there may be "books" in the future without print.[706]

As the specific characteristics of the publication formats vary considerably, I shall proceed in this section by a separate discussion of the possible future of these various formats, from the monograph and the journal to primary source material (7.3.1). In the concluding sections, a number of factors impacting on the possible disappearance of the academic paper publication will be analysed (7.3.2) and a scenario will be drafted (7.3.3).

[706] See, however, the option of "crossover publications" as discussed in 7.2.4.5 and my far-reaching scenarios in 6.3.

7.3.1 The future of print publications and their digital alternatives

In this section, the appropriateness of the different formats (analogue and digital) for the various types of academic publications are at stake. There are no systematic and encompassing analyses of this topic yet. What comes closest is the economically inspired "appropriateness matrix" (Jensen 1998) which collects general arguments, distinguishing between digital formats (page image, raw HTML, enriched HTML, XML content encoding), publishing purposes, content demands, personnel demands, publisher options, print formats and context choices. Jensen does not, however, discuss concrete cases, such as the destiny of, say, the academic textbook. As a background for the following discussion, however, Jensen's categories will be inspiring.

As a first step, I shall set the scene by looking at the technological alternatives to print (7.3.1.1) and by establishing that academic publications are not directly comparable to publications for the general reader (7.3.1.2). In the subsequent sub-sections (7.3.1.3 to 7.3.1.5), the various traditional academic publication formats are reviewed, one at a time.

7.3.1.1 The alternative technologies to paper

There are the following alternatives to traditional offset print, which will serve as the reference points for the following analysis:

- *Pure E-publishing (E-only)*: In this scenario, no printed version of the text is published. Printouts are only made individually and decentrally on personal or institutional printers. See 2.4.4 for the different formats (from page image to XML encoding). In particular, I shall discuss E-books and E-only journals.
- *Print-on-demand (PoD)*: This is not E-publishing, but a new form of P-publishing. A professional paper (bound) copy of a digital print file is made only on request centrally with the one publisher-printer or decentrally in specialised printing stores and then delivered to the reader. PoD may solve the problem of high prices of books.[707] *Just-in-time micro-runs* are an alternative similar to PoD, but in this case printing is only done centrally and not only for single copies, but for smaller editions (Jensen 1998).
- *Mixed systems*: In this scenario, both E- and P-publishing are present. This can be either a continuation of the present "hybrid model" with, for instance, both an (archival) print and an (enhanced) digital version of an E-journal article (above 7.1.2) or a new combination of the technologies, for instance including PoD.

7.3.1.2 Academic publications are different

In the rest of this section, my focus are solely academic publications, not the books and journals for the general reader.[708] The assessment for the general book market may be quite different and is widely discussed by those arguing against and in favour of E-books. For instance, some actors in the E-publishing sector predict that the field of activity of publishing houses will change dramatically within the next five to ten years (quoted by Böhler 2001). The future expectations as regards material read in electronic format vary

[707] See Mueller (2000b, 3) and also Day (1998, 4) for a critique of PoD; see 2.4.4.4 for the technical details.

[708] Among the many contributions on the future of the book in general, see in particular the most interesting contributions to Nunberg (1996b).

considerably (e.g. Interquest 1997, 8, Figure 1). While non-fiction books, novels, magazines and the like are expected to be read in paper for quite some time, those categories which are more relevant in the context of scholarship are deemed to be read in electronic format up to almost 100 per cent: professional letters, professional reports, professional journals, memos, legal documents and reference materials. The Interquest study concludes "books will continue to be produced and read in prodigious numbers, as far into the future as one can imagine. However, they will not command the center of the cultural stage." (ibid., 11)

The difference could be explained by the fact that the academic reader uses books and journals very differently than the general reader. Academic publications are working tools and belong to a highly specialised communication system. Scholars read them rarely under circumstances inappropriate for more "technical" forms of reading. As academic publications are usually worked with rather target-oriented and as they contain content in a technical language, any form of psychological attachment to a particular item or external properties like a leather cover or a golden spine do normally not play any role. Consider that most researchers work most of their time with black and white xerox copies of books and articles whose physical originals they have to share with their colleagues. We should therefore not set the bar too high, as

> "the less-than-optimality of today's most advanced screen-reading technology for bath-, bed- and beach-based reading is hardly relevant to the desk-based searching, skimming, spot-checking, citation-tracing, and active cut-pasting and quote/ commenting that is the mainstay of learned enquiry." (Harnad 1998b, 127)

This distinction between general and academic publications should be kept in mind with a view to avoiding the possible argumentative trap consisting of a mixing of two very different worlds of publishing.

7.3.1.3 Academic books

> "Books of a scholarly nature (but not necessarily monographs), as opposed to trade and regional books of university presses, are the likely choice for electronic publishing projects." (Siler 2000, 12)

> "Books, I conclude, are not a hide bound alternative to the freedoms of the multiply linked items of hypertext, but an important social, political, and historical solution to problems raised by the particularity of such linked items." (Duguid 1996, 66)

The printed scholarly book has a number of problems, which suggest, together with the new opportunity to publish electronically, thinking about alternative futures. The main shortcomings and their possible E-solutions are:

- They are both *expensive to produce* and *expensive to buy* so that many books are never produced because there might be too small a market and even if they are printed, their reach is increasingly smaller (on the economic crisis of academic publishing, see 9.1.3.2). In principle, E-publishing is cheaper than P-publishing (cf. 9.1.1) and the widespread distribution of E-publications is easier (cf. 7.2.3).
- Their *production is time-consuming* so that often they are long outdated the day they appear on the market. E-publishing is faster (cf. 7.2.1).

- They do have *representational limits* as regards length, content and the inclusion of multimedia. E-publishing has a potential here (cf. 6.1 and 6.4.1.2) and offers the opportunity for new publishing models (cf. 7.2.4).

Many believe with Darnton (1999, 10) that the world of learning "will remain within the Gutenberg galaxy – though the galaxy will expand, thanks to a new source of energy, the electronic book, which will act as a supplement to, not a substitute for, Gutenberg's great machine." In this section, however, I shall argue that whether Darnton's prediction comes true cannot be answered on a general level since there are several types of academic books (see Overview 7-3). We can distinguish eight different types, which may be grouped in three categories: monographs, article collections and others. How good the digital alternative would fit, can only be discussed for each of these types separately.

TYPES OF BOOK-LONG ACADEMIC TEXTS		
Monographs	Monographic book	Learned treatises on particular subjects; single- or co-authored; self-contained
	Thesis	Single-authored monograph, accepted for academic graduation (master, doctoral, habilitation levels); typically only available in self-made layout and very few copies, published as monographs in revised version
Article collections	Edited volume	Collection of separate contributions of several authors, put together under a common heading; editor(s) often write an introduction and a conclusion, summarising the contributions
	Reader[709] or anthology	Collection of article-length manuscripts already published elsewhere (in books or journals); either selected according to author or subject; an anthology is mainly to be found in the literary sciences and compiles poems, stories etc. or other literary passages
	Reference work or encyclopaedia	Collection of data, definitions or short articles on selected topics; in general as an edited book with many authors
	Proceedings	Collection of papers presented at one particular conference
Others	Textbook or student book	Text with educational purpose, presenting the state-of-the-art in a (sub-)field; often including little quizzes, further reading sections etc.; single- or co-authored or edited book
	Edition	Collection of primary source material, with commentary; either transcriptions or photographs/scans of originals or both

Overview 7-3: Typology of academic books

[709] Note that the terminology is not univocal as regards the notion of "reader". By some, it is used synonymously with "edited volume" and often also "conference reader" is used. For reasons of clarity, I propose to use "reader" only for the category above.

Monographic book

The economic problems with traditional monographs are important (cf. 9.1.3.2). In addition, the issue of time lags between finishing the manuscript and publication date is crucial. There are, however, differences according to discipline with probably the humanities with the lowest incentive to publish fast, whereas the social science books often include empirical data and topical issues that should not age before publication.

Notwithstanding these problems, large-scale publications obviously have a place in academia. Notwithstanding "the humanist's religious attachment to the book" (Mueller 2000a, 5), there are many topics of inquiry for which the medium of the book is suitable. In particular, "wherever a story is told or a case is made with a strong narrative or logical direction", it is often argued that an electronic representation is worse than a traditional book. Often cited are the following reasons which may lead to a long life of the scholarly monograph: first, of tradition as it serves as credentials for tenure and promotion and, second, of the appropriateness of the form to its use (Givler 2000). So far, they serve a vital purpose in the transmission of scholarly knowledge.

Based on these considerations, it is probably not a question of doing without the monograph altogether, but of looking at the alternative medial format, namely the E-book:

> "But if we define an e-book as a document whose circulation in a system of knowledge depends crucially on information technology, then we must concede that the digitization of the book and of the library has gone for a generation, that the process is virtually complete, and that the printed book of the future is just a particular display option for a digital object." (Mueller 2000b, 2)

We may distinguish between three novel "display options" (cf. 7.3.1.1): (1) the E-book, (2) hybrid models and (3) PoD and just-in-time models. Bennett discusses at length the economic models to be imagined with regard to the future of what he calls the "infrequently read scholarly monograph", i.e. a scholarly monograph that is "used between five and fifty times over a 50-year period" (1998). His conclusion is that "traditional libraries might disappear, giving way to something like an ubiquitous, virtual bookstore for gaining access to information". Just-in-time delivery models, based on digital (not analogous, i.e. in paper) storage may give way to just-in-time delivery models, i.e. where the books are only printed if actually needed. His economic models suggest that the digital format, as e.g. tried out at Yale University with the Open Book[710] project, is cheaper than storage in paper for just-in-time delivery. There is also a hybrid alternative, namely the combination of books and websites (Mueller 2000a, 6): the latter being the enhancement and resource depositories of the printed books. This is already known from the encyclopaedia as well as from the textbook sectors (see below). But it might also turn out to be a valuable model for the humanities' monographs.

It seems that the best case to be made for E-books concerns scholarly publishing "in large stretches of the humanities and social sciences where conventional monographs (...) have become prohibitively expensive to produce" (Darnton 1999, 2). And indeed, there are already examples for genuine E-book endeavours in academia. As a first example, the project HistoryEbook[711] aims at digitising about 500 published monographs and at producing around 80 new E-monographs. But there are also genuine academic E-books on the web, such as the study Right-Hand-Left-Hand by Chris McManus[712].

[710] In this project, the feasibility and costs of large-scale conversion of preserved material from microfilm to digital imagery have been assessed (<Cyberlink=390>).
[711] <Cyberlink=246>
[712] <Cyberlink=794>

A second example and a special case are academic *theses*. Although they are in general not considered very important and central academic literature (unless published as a monograph), they are, in some respect, an ideal field for experiments with electronic publishing (Hapke 1999, 248; similarly Darnton 1999, 8). In contrast to the general scholarly monograph, the cost issue does not play a role as theses are not professionally published items, but rather "hand-made" in often less than a dozen copies by the authors themselves. In particular, their wider distribution (beyond the local university and those directly involved in the procedure) is a concern. Therefore, dissertations online are already widespread: Ph.D. and master theses can, and in some cases have to be submitted (also) in electronic format (Sietmann 1999, 218; for Germany, see Berkemeyer/Weiß 1999).[713]

We should be aware that "the Web allows for a restructuring of existing documents to suite the medium or a totally new approach to monograph writing" (Armstrong/Lonsdale 1998, 18). It seems rather unlikely that the E-book would be just a digital version of a text, which could be equally published as a printed book, chapter after chapter. More realistic is an incremental change of writing and presentation styles, as discussed in 6.4.1. Note as well that instead of simplifying the process of converting a raw text into a book, E-publishing is more likely to "add further complications, but the result could be a great increase in value" (Darnton 1999, 8).

Article collections

The second group of book-long academic texts includes four different forms of collections of contributions. While all arguments discussed in the context of scholarly monographs are pertinent with regard to article collections, too, a number of additional arguments can be named. The most important difference of collections vis-à-vis monographs is that the formers consist of smaller units that could, in principle, be published separately. The unique selling point of the collection is how the articles have been selected and arranged.

(1) *Edited volumes* may lose ground since there are two strong alternatives (both in the analogue and) in the digital world: the special issue of a journal and the proceedings. Frequently, edited volumes are but collections of slightly revised versions of papers given at workshops or in the course of lecture series. Depending on the publishing house, the quality of the papers is either equal to articles in refereed journals or, perhaps more frequently, lesser. In addition, due to the often long time lags between the initial event and the actual appearance on the market, articles are "recycled", that is they are often no longer original contributions any more, in other words: they have been published elsewhere in the meantime (e.g. in a journal).

E-journal-like "crossover publications" (cf. 7.2.4.5; with or without refereeing to accommodate the different needs) might be the better alternative than slow books. In particular, E-journals have an important advantage as to the timing of publication. Articles may be put online, that is added to the special issue page, as soon as they are sent by the author in the revised version. Hence, there is no need to wait until the last author delivers before the whole set of contributions could be published. For instance, the E-journal TRANS[714] does this on a regular basis and is more like a collection of dynamic edited E-books than a genuine E-journal as there is no article submission. All issues are devoted to a particular topic, which is often (but not always) rooted in an initial conference or work-

[713] See e.g. the project Networked Digital Library of Theses and Dissertations (NDLTD <Cyberlink=286>).

[714] <Cyberlink=788>.

shop. Each issue starts as soon as a minimum number of contributions are ready for publication, late-comers are added constantly, often years after the initial event. Some argue that continuous publishing has the side effect of leading to less coherence between articles, and praise the particular role of an edited form of scholarly discourse (Tomlins 1998, 141f.). In particular, individual issues instead of continuous publication of papers[715] are favoured by some. While this argument is certainly not pertinent given the very weak, if not non-existent, editing done in standard journals (often, the articles in one issue have not got much to do with each other), it may be true as regards special issues of journals. However, as the example of TRANS shows, even in this case continuous publishing may have its place. The editors certainly have the duty to produce continuity and coherence between the articles, even if an article is added only later on.

As for pure conference proceedings books, that is only very slightly edited books, conference websites seem more appropriate than books (see below).

Although the format of special issues has already existed for a long time, even in some E-journals, there are still many edited volumes in print. As in most cases, the advent of E-publications did not change anything immediately. Given the importance of editorships (of both books and special journal issues) in academia which, in some disciplines, are ranked on an equal footing with original research in refereed journal articles, it would obviously take a long time to change these practices. However, if there are more E-journals offering the option of special issues and if the financial problems in printing edited volumes become increasingly important, E-publishing may become ever more attractive. Whether we should then speak of "edited E-volumes" or of "special issues of E-journals" is of secondary importance as the two converge (even in the printed world) and we may soon have a genuine "crossover publication" (cf. 7.2.4.5).

(2) *Proceedings*: This sub-category of edited volumes is probably the one with the most examples of digital versions. In some fields, e.g. computer sciences, conference proceedings have not been printed on paper any more for a couple of years already, but rather published as a CD-ROM. In other fields, conference papers are published only at the conference or a related homepage. Many of these special homepages are intended to be available forever, others disappear after a while, with or without notice. An example of the former is PROceedings[716], the conference papers database of the American Political Science Association (APSA): all papers are submitted electronically to this server before the annual conference and stay there for about a year until the electronic submission of the following annual conference begins. The advantage of the WWW model of proceedings is that it can easily be combined (as in the case of PROceedings) with the electronic submission of papers. In addition, both the WWW and the CD-ROM versions are chosen with a view to having more space available for both more and longer contributions.

(3) *Readers (anthologies)*: In a fully E-publishing world, re-publication would lose its justification except for those (with the time increasingly) rare cases where the material which should go into the reader is not yet available online.[717] The editorial work which

[715] Continuous publication means that manuscripts are published as soon as they are ready for publication, one after the other. This is the alternative to publishing issues where manuscripts often wait for quite some time before there is space available in an issue.

[716] <Cyberlink=728>.

[717] Anthologies in literature studies may be different in this respect, as it is not to be expected that poems, stories etc. will be soon published *also* in digital form, at least not generally. Recently, however, some writers have started to publish E-*only* poems. It may be that this is indeed a field for E-anthologies or PoD anthologies as the market may be too small for a standard printed anthology.

goes into readers, namely the selection, arranging, summarising and commenting of the articles could be done in a separate (E-)publication in article form on a dedicated website or in the form of a journal (review) article. The article would link to the selected papers, which remain at their original locations. Again, a "crossover" (cf. 7.2.4.5) between (distributed) E-book and E-review journal article might be the new format for "E-readers".

(4) *Reference Books – encyclopaedias*: Although not always a scholarly product in itself, it is the book of the non-academic world which comes closest to it and plays, in any case, an important role in academia, too. Many argue that the reference work or encyclopaedia is perfectly suited to E-publishing (e.g. Miller 1998; Siler 2000, 12) and predict that the number of paper reference books will decline (Rohe 1998, 1; similarly Johnston 1998, 18).

It is the "need for rapid access and searching and online access that would increase the usability of the work" (Siler 2000, 13) which is at the heart of any considerations to make reference books and the like online only. In addition, the possibility to constantly update and amend the data included in the publication is highly attractive in the case of reference works. Even those encyclopaedias for the mass market which are now available (partly only) on CD-ROM have active links to update websites. In the academic realm, both advantages (usability and timeliness) are of even more importance given the necessity for "sound science" to build on reliable and up-to-date information.

It has been argued that the traditional reference books – as opposed to databases – will not disappear because it would be unlikely that the digitisation of all old paper books, journals etc. will be financially possible (Fröhlich 1997, 8). The contrary might, however, be the case. Logically, we need to distinguish between the old paper books and journals, on the one hand, and the reference books, indices etc., on the other. While retro-digitisation of all old books and journals is definitely unlikely – except for some limited initiatives[718] – it is not to be excluded that the old reference works, if still useful, should be digitised and incorporated in the other retrieval systems. One telling example is papyrology where there are (still) no digital publications, but nevertheless all old paper indices are online now (cf. 3.2.1.4).

Textbooks

Three main reasons may lead to completely replacing student textbooks by multimedia courseware. First, interactive multimedia seems to be a promising route for educational purposes. Online quizzes, interactive graphics, additional documents and sources can easily be incorporated and may turn the sober textbook into a more effective learning tool. For an example of a successful publisher of digital textbooks, see METATEXT[719].

Second, a disadvantage of traditional textbooks is the need for students to buy the whole volume, even if they only need a small selection of chapters. By contrast, network versions could enable purchasing the relevant sections only (Armstrong/Lonsdale 1998, 8). As an alternative to online E-books, textbooks may possibly be the prime market for print-on-demand publishing: instructors will choose from a publisher's catalogue what sections are to go into the students' textbook. The students will get individualised textbooks printed out locally (Odlyzko 1994, 37).[720]

[718] E.g. the journals project JSTOR (<Cyberlink=322>) and the HistoryEbook project (<Cyberlink=246>).

[719] <Cyberlink=756>.

[720] There are already a number of such schemes, both for printed textbooks (e.g. <Cyberlink=861>) and E-textbooks (<Cyberlink=862>).

Third, it could, in the long run, be more cost-effective to lease or buy portable display devices for all students and to provide them with curriculum materials on CD-ROMs or through the Internet than to continue buying printed textbooks (Christie 1998). One example of this is the US publisher W.W. Norton.[721]

Others are more sceptical. Pointing at the specific character of this sub-segment of the academic publishing market, they predict that the replacement of P- by E-publications would start with journals, then move on to monographs, and only much later would it reach college textbooks (e.g. Odlyzko 1994, 37). Their argument is that this change would be affected by their different economic situations since with regard to textbooks the authors do expect to earn substantial financial remuneration. However, it remains unclear why the multimedia textbook should not be as financially interesting as the traditional one. Except for my second argument above (that students may want to purchase only parts of a book instead of the whole), there is no reason why this market segment should be less attractive.

Editions

In some disciplines, scholars are engaged in collecting and editing primary source material, namely literary works, historical documents, manuscripts, papyri, inscriptions, coins, transcriptions of spoken texts and dictionaries (Hockey 1997a). Most examples come from the humanities, but editions can also play a role in the sciences, for instance photographs of specimens in biology, videos of experiments in physics, observations in ethology, photographs of stars in astronomy. All this could be transferred to the digital world for worldwide access and in a format that allows for additional functionalities such as full text and meta-data search even in pictures and graphical representations. Unlike in the printed world, these "E-editions" would probably be in the form of databases to enhance the access routes to the stored material. So far, "(a)utomatic concept-based searching, which is what most scholars really want to do, is still a long way off" (Hockey 1997a, 2), probably due to the still limited use of meta-data. In the future, this could be based on SGML[722] and the text encoding initiative (TEI)[723].

The project Model Editions Partnership[724] is an example of an SGML-based approach to create historical editions in the digital age. It explores ways of creating editions of historical documents, which meet the standards scholars traditionally, use in preparing printed editions. Equally important is their goal of making these materials more widely available via the Web. Mueller envisages that such sophisticated E-edition databases could allow comparisons of different versions of the same original text in a humanities paper (Mueller 1997, 9). Many electronic archives or primary sources are already to be found, mainly in the historical and literature studies.[725]

[721] They call it "online tutor" (example in American politics: <Cyberlink=755>).
[722] Cf. 2.4.4.1.
[723] <Cyberlink=341>; for an introduction to the TEI mark-up language, see <Cyberlink=339>.
[724] <Cyberlink=370>.
[725] Cf. 3.2.1.3 and 3.2.1.1 for examples.

7.3.1.4 Journals

The journal is, in most disciplines, the key publishing medium. A survey among over 13,000 scientists about their usage of scholarly journals in general "found abundant evidence that scholarly journals are not only widely read, but are extremely useful and important to scientists' work, whether it be teaching, research, administration, or other activities" (Tenopir/King 1998, 2).

In contrast to the scholarly book which, as a rule, tries to make a full argument, tells a story as a whole and provides in-depth documentation, journal articles are much shorter, less comprehensive and focus on one or two particular aspects. Journal articles are but a piece in a puzzle, whereas books, in particular monographs, may be the whole puzzle picture. The pieces of the puzzle change even while being put into the picture, that is journal articles are in some respect preliminary and short-lived, whereas the content of books should be longer lasting. Taken together, these characteristics make the journal the fast, whereas the book is the slow medium of scholarly communication. This may translate into the preferences of the various disciplines for either communication channel. For instance, monographs are rather rare in fields where research is fast evolving. By contrast, where the whole picture is more at the centre, where longer narratives are necessary to convey the message, where speed of publication is not important, the journal article is less prominent (cf. 3.4.4.4). Nonetheless, journals exist in all disciplines, but their characteristics differ according to the overall disciplinary necessities of length and speed. There are journals with short contributions of two pages as a maximum and others with articles of 50 and more print pages. Furthermore, journals can be of different types (for instance, novel research or reviews or debates) or can have different sections. Hence, it is unlikely that we shall be able to give an overall answer as to whether the P-journal will give way to the E-journal. This stated, we can now have a look at the current transformation process.[726]

There can be no doubt that the journal sector is in a profound process of transformation worldwide. As shown in 7.1.2, E-publishing in the form of E-journals, in particular of parallel P+E-journals is advancing fast. It is not unlikely that in the not so distant future, i.e. in only a couple of years, all journals will be available in electronic form, too. As discussed, the advantages of enhanced speed (cf. 7.2.1), for searching (cf. 7.2.2) and new modes of distribution (cf. 7.2.3) are obviously economically so attractive that most journal publishers have decided to use the new delivery channel. At the same time, many new journals have seen the light of the virtual day in E-only format with no printed counterpart. The first question we have to ask therefore is *whether the P-only journals will survive?*

Some are radical: On the one hand, it has been declared that E-journals will not (Raney 1998, 8) or not as rapidly (Kling/Covi 1995) displace P-journals. On the other hand, many argue that the scientific publishers will have to put their hopes on E-only publications (e.g. Brüggemann-Klein 1995, 174). But so far, it seems that commercial publishers see online versions of their journals not as a gradual replacement, but as an additional source of income (see the pricing policies which often do not even allow for a separate, and cheaper, online subscription). However, while there are still P-journals today, there are, at the same time, literally thousands of E-journals. Others favour a slow evolution

[726] Similar to hear, Kling/Callahan (2002) recently reviewed thoroughly the pros and cons of E-only, P+E- and P-journals.

model. This implies that there will be P-journals but there will be less. Furthermore, those surviving will look different (e.g. Graetzel von Graetz 2000) and "their capacity to perform their key disseminating and authorizing functions efficiently and usefully will be significantly impaired" (Tomlins 1998, 136).

I summarise the present situation by saying that probably very soon all academic journals will be available online, because those that refuse to go online will have difficulties reaching their audience. The reason for this is a simple bandwagon effect: the more journals are available online, the more attractive are journal portals and databases giving access to them instead of the old-fashioned way (going to the library, browsing the latest issues and copying the articles sought out). There might be a day when researchers simply forget about the few journals not included in their online journal database. This is the strongest incentive to go online.

The second question then is *whether the paper issues of present P+E-journals will disappear completely?* In a simplistic model, one could argue that we are in a transitory phase: the former phase was characterised by P-journals, now we have some E-only and increasingly P+E-journals, in the next phase there will only be E-journals left. In this model it would only be a matter of time before the present phase gives way to the E-only phase. Things are, however, not that simple. At least three intertwined factors play a role here: paper prestige, archiving and character of E-version:

The E-versions are, so far, either a simple duplication of the P-versions or an enhancement (providing for additional documentation, a related discussion forum etc.). Hence, it may be useful to distinguish between the two variants. In the first case, the customers may soon ask for one product instead of a twin package, because they do not need both at the same time. If the users of a library can access the journals from their offices instead of going to the library, the library may soon question whether it makes sense to buy and store the paper copies. Note that it is, in economic terms, practically the same whether the user copies from the paper journal or whether s/he prints from the digital file: in both cases, you need the paper and the same amount of toner (there are already hybrids of printers and copiers). It is likely that the publishers will offer E-only delivery of their P+E-journals if demand for it is increasing. Demand is dependent not only on the behaviour of the users, but also on the solution of the archiving and licensing issue. Only if unlimited access to the digital files of articles is guaranteed (by the publisher or an archiving institution), will the institutional library take the risk of not having its own back-up copy (cf. 7.3.4).

The situation is slightly different in the second case, that is, if the two versions are not identical. Buying the P-version alone may soon be a disadvantage as the users of the library miss out on the enhancements. In the case that the latter become increasingly important in the scholarly discourse (as argued in chapter 6), the paper alternative would soon disappear. It may well be that the journals will change their character along their way to the digital world. For instance, they may turn into "research communications", that is, "their nature and format will evolve away from conceptualisations of the paper or the article into something much more powerful" (LaPorte et al. 1995). The new environment will most likely foster "creative adaptation" (Tomlins 1998) of the journals. It seems very likely that the digital version will become ever more attractive so that there might be even lesser demand for the P-version and eventually no need to keep it.

A recent international and interdisciplinary Delphi study (Keller 2001a; 2001b) came to the (rather optimistic?) conclusion that libraries will cease to subscribe to the P-versions of journals for archival purposes by 2007, hence the P+E-journals are a transitory

phenomenon. Furthermore, the Delphi experts believe that by 2006 the average journal article will have so many interactive and/or multimedia elements so that printing can only represent a fraction of the content.

In both cases (duplication and enhancement), the crucial issue seems to be the image or reputation of the printed publication. Will authors always want to see their article printed on paper? Or will "paper" lose its appeal? See 7.3.2.3 for a detailed discussion of the destiny of the paper prestige (equally important for books and journals).

A third point of lively discussion, triggered by the raising attraction of E-print servers, is the question *whether the journal will survive at all?* The idea is that if the original papers were published elsewhere for free (on this perspective, see also 9.1.3), what role would then be left for the journals? Some predict the end of the journal. While some wonder whether E-pre-prints may eventually make later journal publication superfluous (Odlyzko 1994, 26), others propose a transformation (Tomlins 1998). There may be an important role for the journal format even under the new circumstances: the journal would be the scholarly authoriser and the bundle of valuable resources. Some predict that there will be surviving P-journals, which will just look different (Graetzel von Graetz 2000): instead of original contributions, editorials and comments, sorting of information may become the heart of a journal. Given the present forceful trend to publish ever more journals, this perspective is, however, not convincing. As already argued above, journals will change in character and what Graetzel von Graetz proposes may be part of it, but there is no reason to believe that this would be the domain of remaining P-journals. Rather, it may be the market niche of commercial publishers of E-journals, as I shall argue in 9.1.3.4.

As a preliminary conclusion, I hold that the journal will survive, but rather not in the printed version: both the P-only journal and the P-version of P+E-journals are likely to disappear in the medium run. However, we will have to face, most importantly, sociological issues, but also various other technological and legal problems (Odlyzko 1994, 35). While transforming from P to E, a number of stumbling blocks are on the way (cf. 7.3.2). E-journals "need to recognize and replicate – and even enhance – the important attributes of paper journals if they are to serve their readers" (Tenopir/King 1998, 2). The research journal's character is certainly "a package of communicative properties, including announcement, access and trust" and voices fears that the "move from print to electronic format may erode these properties and thus erode the (perceived) value of the journal" (OECD 1998, 215). The message is clear: while adding new features and opening up new opportunities by the new medium, the academic journal is a mature product which developed over a long time – changing it dramatically may lead to a loss of a corner stone of scholarly communication. What is meant here in particular, is quality control. This is at the root of the pessimistic points of view concerning the prospects of E-journals. However, given the current trend to ever more E-journals that carefully replicate their paper ancestors, the danger of losing the essential characteristics seems small. The more far-reaching innovations, both with regard to quality control (chapter 8) and knowledge representation (chapter 6), are not being put into practice immediately but are evolving over many years in careful experiments.

7.3.1.5 Grey literature

Besides books and journals, researchers also produce so-called grey literature. Roughly, we may distinguish between shorter and longer grey literature, the former being often the predecessors of journal articles and book chapters (1), the latter often early versions of books (2).

(1) *Pre-prints and working papers*: There can be no doubt that, for most purposes, pre-publications will finally cease to be offered in non-digital form. The main purpose of them being to raise priority claims for results or arguments and to feed the ongoing informal (and formal) scholarly communication, speed of delivery, wide reach, low cost and minimal effort for preparation are the essential reasons for deciding to pre-publish. These were already the reasons for even the paper pre-prints and working papers: simple layout for easy preparation and often in-house copying of manuscripts without the involvement of professional publishers made them an appropriate outlet for fast and cheap distribution. Distribution was very targeted, but reach rather limited in the paper world. With the advent of digital file preparation and the Internet as a new delivery channel, the whole process was even more simplified and costs further shrunk considerably while at the same the distribution could be extended to the whole world without any additional effort. At first, digital manuscripts were sent around via E-mail, later uploaded to individual and institutional homepages, finally registered with search-engines and/or uploaded to digital archives (cf. 7.1.2).

The proportion of working papers and pre-prints not delivered electronically is diminishing. There is no reason to believe that this trend would not continue. Similar to the development in the journal sector, many working paper series appear, however, both in print and in digital format. It is difficult to say whether the limited print editions will survive. Both the archiving issue and the paper prestige factor may play a role here, too. The printed copies are mainly distributed among the members of the same institution so that one may argue that they are printed in order to economise on printing costs (as central copying is, in general, cheaper and less time-consuming than decentral, individual printing). Furthermore, the printed copies also seem to serve a social purpose ("bonding", that is actualising special relationships) by offering a special benefit to selected people in the form of a higher quality print instead of a local printout. However, both the quality and cost-per-copy ratio of local printouts is constantly improving. At the end of the day, the print run of working papers may further diminish to an insignificant level, which only serves very special social purposes.

Note that the name "pre-print" would be anachronistic and may disappear once E-publishing is established as the standard procedure since then the texts would eventually not be printed anymore, at least not in the traditional sense. The same may, by the way, be the case with the notion "paper". However, language use may prove to be very stable as the example of "coach" shows which is still used for trains and busses despite the fact that the underlying technology has long since changed.

(2) *Reports* are a final typical output of research. In general, these are longer texts, similar to books. Depending on the wealth of the research institution and the intended reach, these reports have been traditionally either just printed on the local printer and copied a few times for the authors, the archive/library and the commissioning institution(s), or professionally laid out and printed offset or even added to a report series with an own ISSN etc. In the latter case, the difference between the report and a book diminishes and is often only the paper format and the soft cover of the report.

The advent of E-publishing has also reached reports. Increasingly, reports are also on offer in digital form for downloading from websites. As there is always a (small) selected target audience, which should receive the report (from those who financed to those who might do something about the results), it is rather unlikely that reports will not be printed any more in the feature. Printing and binding the report for this group by the authors' institution is practically included in the research contract or, at least, a service delivered to the target audience with a view to lowering the hurdles to actually reading the report. The chances are better, if the target audience has it "in hand" as opposed to the necessity to download and print it first. This is not to say that digital versions of reports will not be available. Certainly they will because it is a convenient channel to reach more people outside the obvious and well-defined target group – but they do not have the potential do displace the P-version altogether. The P-version is, hence, often a good example for (informal) PoD. Also hybrid forms with a nicely printed core report and additional annexes on the Web are conceivable.

7.3.2 Discussion

Now that we have looked at the different forms of academic publications and analysed their properties in relation to E-publishing, we shall discuss the factors that influence the development from P- to E-publishing. Based on my analytical "change model" (cf. 1.2.3), I discuss three groups of intervening factors, namely technical and functional (7.3.2.1), actor-related (7.3.2.2) and institutional factors (7.3.2.3). This will be followed by a synoptic scenario in 7.3.3 which is based both on the discussion of factors here and on the analysis in the previous section.

7.3.2.1 Technical and functional factors

The following specific technical issues play a role on the path from P- to E-publishing:

Unique properties of paper: Paper has certainly "many redeeming qualities" (Fidler 1998b) which are difficult, if not impossible, for digital systems to entirely replace, in particular the preservation capability and the readability everywhere, anytime without special technology. However, the qualities Fidler praises are not convincing as absolute yardsticks for a comparison. Paper can easily get lost by a fire, by humidity, by worms, by acid or whatever. For sure, archiving of electronic documents is not yet solved, but it will probably be in the not so distant future (see 7.3.4). Also, there are many places where paper publications cannot be read, e.g. in the dark. Advanced screen technology will allow back-light screens without the present-day power consumption problems (cf. 2.3.1 and right below). Furthermore, you have to carry the paper around to be able to read it. If you want to read a lot, you will have to carry a lot in paper. By contrast, the future portable reading-devices can store many, many more pages without any additional weight and could be hooked wirelessly to a worldwide information infrastructure to get even more (cf. 2.3.2). Thus, you could read anything you want on a digital device at any remote place you happen to be, even if you have not thought of bringing the right text with you, whereas in a paper world you could not.

On-screen reading: Though improving, screens are still not comparable to reading on paper. The book has been praised as a "marvellous random access device" (Mueller 1997) that is unlikely to be replaced by electronic devices. Others do not think that the flaws

of the present reading devices would influence negatively the transition to scholarly E-books and E-journals. What it would affect, however, is the way in which they are used and the prevalence of parallel paper publishing (Armstrong/Lonsdale 1998, 20; Franks 1993, part I). In section 6.4.3.2, I have already reported an experiment comparing reading paper and on-line documents. The experimenters' conclusions that "the benefits of paper far outweigh those of online tools" and that "paper is, and is likely to remain, the best medium in support of reading" (O'Hara/Sellen 1997, 6) do not seem generalisable since they compared an established practice with a first try with insufficient software. The common denominator of a number of early comparative empirical studies (reported by Riehm 1996, 3) was that it all depends on whether "advanced screen technology" is available.

This seems to be increasingly the case: there may soon be strong competitors to off-screen reading (cf. 2.3.1). It took a long time for technology to provide the tools that made the futuristic dreams of the visionaries possible: only today, the capacity of storage systems is high enough, the transmission speed is fast enough etc. Obviously, academia is not a special case, but only one customer in a large general market for screen technology. Therefore, researchers can trust that screen technology will further improve. Perhaps, some of the reservations put forward within science and research may "be swept along in the general move to the electronic world" (Odlyzko 1994, 18).

Apart from the quality of the screen, it is also the layout which "can make a difference". The visual appearance – whether on screen or on paper – is a crucial element, as readers are used to the "accumulated typographic and layout expertise of five centuries of print culture" (Guedon 1994, 6). The resemblance of articles in an online journal to the reprint from a conventional journal can be seen as one success factor (Wellman/Minton 1998, 8). Also special screen fonts are an issue to improve the readability of E-texts on-screen.[727]

Working habits: The previous point regarding on-screen reading is very much linked to working habits in general. The habit of highlighting, marking and more or less sophisticated storing systems etc., in other words motor type and visual working habits, may inhibit the shift to a non-paper style of working. The question is whether this can be sufficiently emulated in an electronic environment. One answer may be interactive electronic reading devices.[728] It is not yet clear whether these new devices would also be the choice for "intensive reading" (Mittler 1996, 80).

In a fully digital reading environment, technology would have to find answers for yet another aspect: Many researchers display several papers around themselves with a view to having all of them in sight while working (Rink 1999). One possible solution to arrange this in an electronic environment may be several displays. Reading is very important for writing and it is possible that the effort of managing window layout and switching among windows can interfere with reading. Therefore two (or more) opposable reading panels (Schilit et al. 1998b, 3) or two displays, one for reading, the other for writing (O'Hara/Sellen 1997, 6), have been proposed.

Working habits may also be newly developed in order to cope with the new digital environment. With regard to multimedia use, the relationship between the author (with his/her accustomed platforms and favourite tools) and the multimedia developers of the IMEJ journals is a new development zone. It is likely that we shall see a parallel development

[727] See e.g. MICROSOFT's ClearType technology (<Cyberlink=789>).
[728] Cf. Price (1998b), Schilit (1998a) and Price (1998a); see 2.3.2 for a description.

as with word processing (which is typically done by the scholars; cf. 5.1): scholars may also do a large part of their own multimedia production in the future (Burg et al. 2000, 4). Also new web authoring tools etc. will help to alleviate the tension (cf. 2.4.4.3).

Impermanence and instability of E-documents: Already discussed under the label of fluidity (cf. 6.4.1.3), solutions for disappearing URLs and archiving issues are crucial. The accessibility of cited online resources "is potentially a very serious problem in the conduct of research and scholarship, especially if the percentage of references to such sources increases beyond its current very small size" (Harter/Kim 1996, 12). Apart from the archiving initiatives (see 2.5 for the technical aspects and 7.3.4 for a general discussion), a number of technical-organisational solutions are under way under the label "(persistent) identifiers" (cf. 2.1.2).

Technical conditions for multimedia: So far, a number of technological reasons for the reluctance to multimedia publishing can be named (Burg et al. 2000). Among them are bandwidth limitations (the network is still too slow), the speed of technological change (the plug-ins necessary to view a multimedia enhancement may soon become obsolete – cf. 2.5) and compatibility issues (lacking standardisation). Burg et al. believe that the technical obstacles are challenging, but that they can and will be overcome, in particular via offering multimedia supplements in multiple platforms (formats) to accommodate as many readers as possible.

Access: In contrast to P-publications, access is not only a matter of getting into a library, which holds what you want to read. By contrast, this issue has three different aspects in the digital world. First, *access to Internet* is almost no issue in the academic world anymore, but the warnings of a digital divide are nevertheless to be kept in mind. Only after all scholars have (and retain, through changes in the political economy) unimpeded access (regardless of their location on this planet), will the emerging system of posting one's papers for free in the Internet become generalised (Fuller 1998, 138; similar Armstrong/Lonsdale 1998, 18). Second, also *access to software* is an issue as E-publications require from their readers hard- and software, the latter in particular in case CD-ROM is the medium (Armstrong/Lonsdale 1998, 18). Also, the changing software and hardware versions are a problem (cf. 2.6). Finally, *access to fee-based sites* would be crucial if the publishing system went totally online (on the issue of digital divide, see already 4.3.4.3).

A further functional aspect, playing at the disciplinary level, is *whether there is a specific need for multimedia as well as for inclusion of data.* The less text and the more non-textual elements (graphical and figurative representations, data sets etc.) have to be included in order to convey the message, the more likely is a move to digital forms of transmission, as it is obviously much easier, more cost efficient and faster to implement.[729]

7.3.2.2 Actor-related factors

Again, *individual agency* may play a role. In some specialities, there are more cyber-entrepreneurs, that is activists founding E-journals, writing the first E-books or setting up an E-pre-print server, than in others (cf. 3.4.5.1). To encourage transition from the P-book to the E-book, various proposals have been made, among them, that "veteran scholars" should "help create books of a new kind, far more original and ambitious than a converted dissertation" (Darnton 1999, 9). Active publishing in E-journals may be another

[729] Cf. my partly favourable conclusions in this respect in 3.4.2.2 and 3.4.2.3.

route. This would certainly be most effective if the authors belong to the highest-status scholars in the field. However,

> "the highest-status scientists have the least to gain in terms of personal visibility and prestige in such moves. And scholars whose status is just a bit lower are likely to publish in the same journals as the highest-status scientists. And so on down the prestige hierarchies, until one reaches scientists who have trouble publishing in 1st- and 2nd-tier journals, and who have 'less to lose.'" (Kling/Covi 1995)

Scholarly communication takes place within a system of prestige, hence social change will be slowed down.

7.3.2.3 Institutional factors

Based on my analytical framework (1.2.3), I distinguish among the various institutional factors between those playing at the disciplinary level (1) and those relevant for academia as a whole (2).

(1) On the disciplinary level, the *publishing cultures* are most important when it comes to the possible transition from P- to E-publishing. These cultures are diverse in the academic fields, as I have already noted in 3.4.4.4. My conclusion there on the basis of my empirical research was that there is indeed a relationship between the book tradition of a field and its lower assessment of E-publishing. There may be a "healthy conservatism" (Mittelstraß 1996, 27) of the humanities with the effect that E-publishing may take longer or another path there. The differences of the publishing traditions concern:

a. *The average length of a published text*: The longer the texts published (and hence the time needed to read them) the more important parameters like screen technology and readability are. Only if the technology is very advanced, you could expect someone to read a 70-page article or a full-blown book on screen. By contrast, where average article length is only a couple of screen pages, the paper could more easily (or earlier) be done without.
b. *The spread of pre-publications*: As pre-prints and working papers are obviously particularly apt for a move to electronic delivery, those fields which have them are more likely to be open for other forms of E-publishing, too (this was my conclusion in 3.3.6). Some argue that online journals in general only receive very few submissions (perhaps twelve per year)[730] unless they are connected with online archives where authors can post their pre-prints by filling out a form indicating that they wish to submit to the journal at the same time (Burg et al. 2000, 5).
c. *The quality check system*: new forms of peer review which are only possible in the digital network (cf. 8.2) are particularly attractive for those fields which practise peer review in the first place. By contrast, in fields where there is mainly an editorial board driven system, the Internet cannot add much.
d. *The importance of the prestige of the publication channel*: There are probably huge differences between sub-disciplines. For instance, library and information sciences seem not to put such a high mark on prestige as the sciences; however, "where speed of publication is particularly important, even scientists are prepared to contemplate some form of electronic publishing" (Gomes/Meadows 1998, 180f.).

[730] This is, however, only a limited snapshot as other online journals receive many more (e.g. EIoP received approximately 150 submissions in five years).

(2) A number of institutional factors at the level of academia as a whole, play an important role in the diffusion of E-publishing. In particular the *legal environment* has to be non-discriminatory vis-à-vis E-publishing (cf. 9.2.1 and 11.2.2.1); and, at the *economic* level, the development of costs of P- in relation to E-publishing has to be considered (cf. 9.1.1). Furthermore, *institutional inertia* is a very important factor. As long as E-publications are not considered as equal with the P-publications they are designed to replace by the relevant institutions, individual researchers are unlikely to use the new channel. The embargo policies of major journals and associations banning any form of online publishing before submission (Kling/McKim 1999; Marshall 1998c; Bloom 1998a) certainly hamper E-publishing.[731]

Probably, the single most important institutional factor is a cultural parameter, namely the *prestige of paper* and how E-publications may catch up. Many researchers acknowledge that the most important single incentive for their work is "to see the result printed". Probably, they would not say "published". It is the printed form that has a particular appeal: you can touch it, you can feel the imprint of the letters on the surface. Already the new forms of printing based on laser technology have altered the traditional look and feel of printed paper. In addition, the increasing economic pressures on the academic book market led to economies as regards the amount of time which goes into layout and as regards the cover and additional haptic attributes of the publication. Most day-to-day work of academics, by the way, is not done with the traditional printed page, but with low-quality printouts or xerox copies. But still, traditional print has a high standing. The "teleology of the book" (Mueller 2000a, 3) may not be challenged by the advent of the word processor: the telos of writing was to have a printed book of flesh and bones as it were, whereas "the screen does not yet count as flesh, and perhaps never will" (ibid.). Many authors are still not emotionally tuned to pure E-journals and want to see their articles in old-fashioned print (Sietmann 1999, 218). Likewise, those scholarly publishers who have elected not to publish electronically seem to implicitly believe "that the scholar or student is culturally conditioned to use the printed book and that this orientation will persevere" (Armstrong/Lonsdale 1998, 17).

The high prestige of paper is not only due to the haptic and visual characteristics, but equally due to the connection of paper with the long-standing academic publishing tradition. Understandably, authors are reluctant to entrust their work "to a new, unproven medium in place of the one that has served them faithfully for centuries" (1998b, 127). This is because they have the impression that it is "much too chaotic and undiscriminating a medium to be entrusted with the communication and preservation of their substantive ideas and findings" (Harnad 1993, 5). This is linked to the question of "authority" of a text: how to find out about the reliability of a fragment on the screen (Grenquist 1998).[732] By many still, E-media are considered to be "something insubstantial and potentially transient – ghostly, superficial, unreal, and thus untrustworthy" (Kling/Covi 1995).

[731] Kling/McKim (1999) make a few proposals for editorial policies as regards "pre-publication" and explicitly do not distinguish between P- and E-publications. Based on their analysis of the three major characteristics of the notion of "publication" (publicity, access, trustworthiness) they come to the conclusion that not all forms of pre-publications in the Internet should lead to a ban for later journal publication.

[732] See also 5.3 on the tasks of cybrarians.

Therefore, much of the discussion of E-publishing focuses on "the ways to acquire for it the authority and relative stability that print publication has previously lent paper scholarship" (Tomlins 1998, 140). We can speak of a "convergence in recognition of the need for form and authority in scholarly discourse" (ibid., 141). Guedon reminds us that from the very beginning, "print was associated with authority and power" and that access to print "has often been limited, considered a privilege and often strictly controlled". Guedon considers it an important side effect of this history of print "that the authority inherent in the printing process lent legitimacy to all forms of print" (1994, 4). By contrast, E-publishing has "emerged as a direct extension of electronic means of communication". As self-publishing is easily possible, the result is that E-publishing "does not derive any authority from its technological base. Thus, its legitimacy must be constructed through purely social and institutional means." (ibid., 5) There are, however, already some early signs that the inconsiderate belief in the truth of what is in the newspapers (sic!) is beginning to extend to the digital media, too. While academics seem to be rather sceptical so far, one area where this can already be observed is the way undergraduate students take on information found in the WWW.

The prestige of paper can also be shown inversely by the (still widely) lacking overall prestige of E-journals. A *citation analysis* in 1995/1996 (Harter 1996a; Harter/Kim 1996)[733] showed that the great majority of scholarly, peer-reviewed E-journals have had "essentially no impact on scholarly communication in their respective fields". Only a few top E-journals ranked quite high and have a good impact factor. In this sample, the E-journals publish far fewer articles in a given year than most other journals in their disciplines. The authors of these studies concluded that while their high impact factors for a typical article showed "great promise", the overall scholarly impact of these E-journals on their disciplines was not great. They acknowledge, however, that while there is "clear evidence that ejournals presently play almost no role in scholarly communication, as measured by references cited, (...) this conclusion may well be very different in two or three year's time" (1996, 12). This assessment is certainly dated. Experience with a number of E-journals today shows that many of them have become established in their fields and indeed received citations. Another citation analysis in the field of library and information science was carried out for the period of 1994-96 (Zhang 1998) and found that, at this time, citing e-sources depended on authors rather than the journal format in which the authors chose to publish". This study also found that the impact of E-sources on formal scholarly communication in library and information science was much smaller than that of print sources (as measured by E-sources cited in journal articles, ibid.). Furthermore, E-journal articles have been found to be more likely to cite E-sources than are P-journals articles. The user studies performed at the University of Illinois to test their digital library project (DeLIver[734]) revealed that E-journal systems are not used by the majority of people in their target audiences, at least not within the first year or so of a system's implementation (Bishop 1998).

The experts from most disciplines interviewed for this study answered that E-journals have only low prestige. The exceptions of the rule were to be found in linguistics, in parts of political science and in history, where some experts attributed them a medium standing. In some sub-fields of law and of mathematics, the E-journals seem to even have a high reputation (cf. 3.3.2).

[733] They included 39, respectively 74 E-journals.
[734] <Cyberlink=387>.

My preliminary conclusion, therefore, is that paper/print publications are, in general, still more valued in the academic world than electronic forms of publications. This may, however, change. Already Gomes/Meadows (1998, 178) report that over half of their respondents (mainly in science) thought that their research communities would accept E-publications "as being on a par with printed publications fairly quickly". A number of reasons sustain the change hypothesis:

- *Habituation*: Bi- and multilateral scholarly correspondence has already shifted from paper to screen (in particular in the form of E-mail) and this may be an indication of a vanishing reluctance towards working on screen. In addition, there is an increasing number of digital texts (not only E-mails, but also E-pre-prints, E-journals, online documents, output of online databases) with which the average academic, in ever more disciplines, is confronted on a daily basis. It is therefore not unlikely that the digital format would slowly enhance prestige. Perhaps it is a matter of time and experience. In particular, "(p)articipation in the process as authors, reviewers, and/or readers" (Hagler et al. 1998, 7) may change attitudes. It is probably a matter of numbers of online peer-reviewed journals and hence of opportunities so that "perceptions and actualities may converge" (Langston 1996, 4);
- *Agency* of high-ranking scholars (as argued above in 7.3.2.2);
- *Inclusion of E-publications in the traditional bibliographic tools*: This would be a small, but efficient step to make them more visible which does not involve any far-reaching decisions concerning the prestige of these publications, but only their acceptance as a channel of publication as such (cf. 8.4.1);
- *Perception of added value*: E-publications might be successful if they add value and if this is accepted and appreciated by both readers and authors. Interestingly, Siler (2000, 14) found in her empirical evidence from university presses that it is less the economic crisis in scholarly publication (cf. 9.1.3.2) but the technological advances and availability of new technological solutions which drive the development on the side of the non-profit publishers. "University presses are publishing in the electronic format not as a way to save the monograph but as a way to use technology to enhance their products, making them better for the reader." (ibid., 16) In particular, the multimedia journals have to fight a lack of acknowledgement of their added value. This is, however, somehow a vicious circle. It is still difficult to get enough good submissions as long as multimedia journals are not yet well established. Furthermore, it seems crucial that in order to gain scholarly and professional acceptance, editors "must be careful about being identified with commercial or non-academic sites" (Burg et al. 2000, 4); and
- *Meeting the same standards as P-publications*: E-publications have to do more than only adding value, they also have to do the same as P-publications to be adopted as a legitimate scholarly medium on an equal footing – they will have to meet the same standards (Raney 1998, 1). Tenure committees and the like will allow E-publications comparable weight to that of P-publications "once there is some clear sense that a respected imprint on paper can maintain the same standards of selectivity in the networked environment" (Day 1998, 6). The same "essential qualities of print media" (Fidler 1998a) should be incorporated by developers of E-books to compete successfully with traditional ink-on-paper media: portability; simplicity; readability; durability; longevity; portrait-oriented, page-based format; standardisation; affordability; reliability; personalisation. The most important of these are convincing quality checking systems (cf. 8.3) as well as reliable and convincing systems of archiving (cf. 7.3.4).

This is not to say that in a possible future world governed by E-publishing, specially printed editions may still not have the highest prestige of all – similar to the wooden steering wheel in a modern car or the open fire place in a centrally heated city apartment. However, just as standard cars are not made of wood any longer and most people are happy with fully automated heating, the paper publication may become the exceptional case.

7.3.3 The P-to-E scenario matrix

Many argue that established forms of communication media have rarely been discarded when newer forms emerged (e.g. Fidler 1998b). This argument can, however, be refuted: For sure, the horse did not die out when the steam engine and automobile were invented; the telegraph was not completely (but to a very high degree) replaced by the telephone; there are still painted and hand-written books. However, they play a less than marginal role. At least in the advanced industrialised world, practically nobody would think of sending Morse code, of taking a horse to get somewhere on a regular basis, and no standard publisher would let books be hand-painted. This is just hobby or luxury, hence has a completely different *function* in our times. But for all standard applications, the horse and the painting technologies of the past have indeed been replaced.[735]

Hence, it may well be that E-publishing supersedes old P-publishing in academia, leaving some niches only for a restricted print market. This will, however, not be the case in the foreseeable future. The main point of this section on the possible end of scholarly publications on paper is that we have to differentiate. First, the market for academic publications should not be confounded with the one for trade books. Second and even more importantly, there are a variety of publication formats within academia, which have to be treated differently. Third, the various disciplines' reaction to the challenge and option of E-publishing will not be identical. Many factors play a role which impact differently depending on the field-specific case. On a general level, I found that, again, the technical aspects would not be crucial. More important is the destiny of the much higher prestige of paper print as opposed to digital media. This, in turn, depends on a variety of factors. Their power is difficult to predict and so is, in the end, the final result of the ongoing development.

Based on my careful analysis of the various factors and arguments in favour and against, I am nonetheless in a position to venture a prognosis *for the medium run, that is for the next five to ten years*. The following Table 7-3 is a synopsis of the separate answers I have given throughout this chapter on the probably mid-term developments. On the one hand, I distinguish between the different academic publication formats. On the other hand, I propose to distinguish between the three alternative technologies (media) as described in 7.3.1.1 plus the base scenario of P-only publishing. The four options are not mutually exclusive. The suffix "-only" indicates that the publication would not have

[735] There are, however, other often-quoted examples like the cinema, which was not replaced by television. Again, I would argue that the cinema plays a different role today than in the times when television was not yet around. Both do not serve the same market. You cannot see the same films on TV as in the cinema, the latter showing the most recent ones only. In addition, the TV is much more than only films, it is a news medium and has created various further formats for programmes not present in the cinema.

two different versions, but only one. Similarly, "Hybrid" is an independent variant, namely that the publication comes in two (perhaps different) versions. Hence, if for one publishing format there is one "x" for "Hybrid" and one for "E-only", this means that there may be some publications in this category with a double face (P+E) and others with only a digital face.

Table 7-3: The P-to-E scenario matrix

		Publishing media			
		P-only	PoD	Hybrid	E-only
Academic publishing formats	Monograph	x	x	x	x
	Thesis		x		x
	Edited volume				x
	Reader				x
	Reference work			x	x
	Proceedings				x
	Textbook		x	x	x
	Edition			x	x
	Journal			x	x
	Review journal				x
	Working paper				x
	Reports		x	x	x

A few words interpreting the matrix in conclusion of this section:

- In the medium run, the *monograph* will not go entirely digital. The publishing medium for the scholarly monograph will be both print, print-on-demand, digital and hybrid forms. The pure E-book will be the exception for still some time. Only in the longer run, might there be a more important segment of books published as E-only books. They will be not comparable to the books we know today, but they will rather be "hyperbooks" as described in 6.3.4.
- My expectation is that the P-only *journal* will vanish very soon and be replaced by hybrid P+E-journals practically everywhere. The majority of experts included in the Swiss Delphi study (Keller 2001a) expected the P-version to vanish by 2005 already. This may be too early, but I would not count on a long life of the P-only journal. Even those hybrid forms will lose their importance in the medium run. Within the next couple of years, journal articles will be published E-only. *Review journals* will soon not be published other than as E-journals.
- *Article collections* in book form will vanish as printed texts in the not so distant future. Edited books will be replaced by E-journal-like publications, readers by commented link collections and proceedings by database-like websites. *Reference works* will exist in hybrid forms for still some time, but probably go online completely in the medium run.

- *Theses* and *reports* will be on offer both electronically and through PoD. *Working papers* will be distributed only in digital format.
- *All* academic publishing formats lend themselves for E-only publishing, the majority of them, however, not as the only option.

7.3.4 Expectations within the academic community

Today's academic publication system is in flux. Challenges and new opportunities come from technological-organisational innovations as described in this (cf. 7.2), the previous (cf. 6.2) and the next chapter (cf. 8.2), from economic strains (cf. 9.1.3.2), from legal developments (cf. 9.1) and from the ongoing expansion of the whole system (cf. 7.1.1). This results in uncertainty. While most academics readily adopt some of the new techniques, they are reluctant to jump on the new bandwagon as long as the destination of this journey into the unknown is not yet clearly visible.

Consequently, when interviewed or asked to fill in a questionnaire, academics tend to express rather conservative views. For instance, in a survey of Israeli academic researchers in 1994-95, "patterns for obtaining information remain conservative and have resisted transformation. Professional periodicals are still the most important tools for obtaining professional information and monographs still play a major role." (Shoham 1998, 113) The informal channels constitute a major source of information in all of the faculties (ibid., 120). In this sample, "(t)he use of computerized journals and of sophisticated information services (...) is relatively small, as is that of discussion groups on the Internet." (ibid.) Today, this survey is more of historical value as many of the developments discussed in the present study had only just begun at the time of the survey. At least as regards E-journals, which became widespread since, perceptions have partly changed. Indeed, a Dutch study on the use of paper and electronic journals by researchers in 1997/98 (Rusch-Feja 1999, 25f.) came to the conclusion that there are strong differences between academic disciplines as regards the use of printed journals as well as the readiness to discuss a transition from P- to E-journals. However, there was, in general, no negative attitude towards E-journals and that they are used like their printed counterparts. A later study carried out within the German Max Planck Society by the same author (Rusch-Feja/Siebeky 1999) showed that E-journals are readily accepted and that researchers are unwilling to return to paper-only versions. The experts included in the Swiss Delphi study on E-journals (Keller 2001b; 2001a; 2001c) predicted that in 2007 P-journals would cease to be subscribed (see already 7.3.1.4).

By contrast, the experts interviewed for this study were rather cautious when asked whether they thought that in fifteen years time, there would only be electronic academic publications. While the answers were quite split in most of the thirteen disciplines included, only the anthropologists and papyrologists were sure that an all-electronic publishing system would not come in this period of time. By contrast, all medical researchers interviewed expect this, as well as to some extent the political scientists, the lawyers and biologists. Most expected a "fully" electronic publication system, if at all, only for journals, not for books. The reasons listed are those discussed in 7.3.2: most prominently, the reluctance to read on present screens, and the authority of paper.

From these surveys and interviews we might draw two conclusions. First, there will be differences among the various fields, probably not only as regards the length of the transition period. It may turn out that there is no single model for all scholarly communities

(Kling/McKim 1999). There are "important social forces – centred around disciplinary constructions of trust and of legitimate communication – that pull against convergence" (Kling/McKim 2000). This is consistent with my analytical framework (cf. 1.2.3.4).

Second, the transition from P to E may take a very long time, as there is much opposition. In my opinion, this second conclusion would, however, be premature. Most researchers when not only giving a spontaneous answer, but pondering the issue more deeply and on the basis of more information about the possible future of screen technology or the possible solutions (to the archiving problem, for instance) react less conservatively. This underpins the expectation that given the rate of diffusion of these new technologies, coupled with their obvious advantages as compared to the present system, a few more years of experience with the new media will change the tide. Most researchers have not yet thought thoroughly about the pros and cons and even if they have, the chances are small that the necessary alternative (digital) infrastructure is readily in place to be tried out. To underline it again: we are in a phase of flux producing much uncertainty. As developments progress, this will change.

7.4 Archiving scholarly E-publications

Archiving the digital media is an important problem: it is very difficult both in technical and in organisational terms due to the necessity of providing for a very long-lasting, sustainable solution. The reason is obvious: only if there is enough reason to believe that the digital publications will be accessible also in the future, will it make sense to entrust our intellectual products to the digital world. This is equally true for the cultural heritage of the world and academic publications (e.g. Raney 1998, 3f.).

As we have seen in 7.3.2.3, one of the reasons why paper is so cherished by academics is exactly that paper has proven to be a (relatively) good medium of preservation. For sure, there are considerable problems with paper, too, in particular the fact that paper that is not acid-free loses its longevity. On a whole, however, paper publications resist even catastrophic events such as fire or floods, not because paper is indestructible, but because modern paper publications always exist in more than one copy at multiple locations so that its content will survive even if destroyed at one place.

However, as regards digital publications there are many more sources of danger. In section 2.5, I listed: moving and replacement of files (fluidity); hardware problems; evolving data-formats; changing operating systems; and life span of storage medium. In principle, these dangers can be kept under control. It is the same technology that makes wider distribution of scholarly materials possible which also offers opportunities for preserving them (Dementi 1998, 3). We have seen (in 2.5) that there are a number of technical solutions: mirror-sites and back-ups; good old paper; static archival storage; dynamic storage; non-proprietary data formats; software emulation; periodic web-harvesting; and dedicated archiving servers.

When comparing print and E-publishing with respect to their respective archival strengths and weaknesses, one difference is often mentioned: you do not need a technical device to access the archived paper version whereas for digital archives, you always need a machine. This argument is only convincing at a superficial level. The "machine" you need for paper consists of library buildings with miles of shelf space and of an appa-

ratus which keeps environmental parameters (like temperature and humidity) constant. In addition, besides archiving proper retrieval of the information is equally critical. In this respect, print appears rather weak "as it tends to bury information as much as it archives it" (Guedon 1994, 5). And, one might add, to improve access to archived print material, you would again need sophisticated electronic means. You cannot avoid them in the face of an ever-growing archive in order to make it useful. As regards access, the digitised document is very efficient and approaches "the ideal of a fully functional memory as against a mere archiving capability" (ibid.).

While there are technical solutions, sustainability can only be achieved in combination with organisational measures (7.4.2). Before discussing this tricky question, we need to face the equally complicated question of what exactly should be archived (7.4.1).

7.4.1 What is to be archived?

> "In the future, it will be necessary to have guidelines which information should be archived and which not."
> (Drösser 1996, 151)

As regards the Internet as a whole with its many pages and constantly changing content, from chat contributions to little news flashes, from advertisement to private homepages, the issue of selection, namely the question what should go into the archive and what not, is even more relevant. Various possibilities are being discussed. The most far-reaching is a periodic download of the entire, freely accessible Internet content with a view to making the status quo of the web on each and every day in the past, or at least every week or month or so available for future generations. However, even this system would not be complete: first, there are many sites which do not allow for external downloading or where this is technically difficult due to special access procedures; second, there are the necessary download intervals with the result that intermediate changes would not be stored. However, probably one could live with these small limitations, if there were not two further important problems:

- the immense requirements of *storage space*: the Internet Archive, for instance, in operation since 1996 and by far not covering the whole Internet, reports storing to date 100 terabytes[736]; and
- the problems of *proprietary formats*, in particular as regards multimedia content, which will require important additional activities to secure access from the software point of view (cf. 2.5).

To archive the Internet as a whole is an enormous task. UNESCO's project "Memory of the World" revealed that the current organisational effort is gigantic (Risak 2000, 20). The solution has to be that not everything will be included. While we are not discussing the issue of archiving the overall WWW here, we need to acknowledge that even if academic web space is only a fraction of the total Internet, the problem of storage space for the increasing amount of data will become ever more important over time. In addition, access to the wealth of data needs to be structured in order to be helpful. Therefore, while

[736] As of August 2002 according to its homepage (<Cyberlink=779>). That is the incredible number of about 11 billion pages (text only until 1999) or of 100,000,000 megabytes (in comparison, the present text is about 1 megabyte in a condensed "zipped" version).

periodic web harvesting may be a good interim solution, selection and explicit handling of all files to be stored would be the better option for the academic web. In this respect, the initiatives with regard to meta-tagging academic literature (cf. 2.2.2.1) converge with the possible solution of the archiving problem.

On the one hand, it seems more than obvious that all *formally published academic texts* (and, later on, academic multimedia files and hypertexts – together with the software necessary to view them) should be archived. On the other hand, there are a number of less formal products in the scholarly context where we have to discuss whether they should be systematically archived:

- *Academic software*, in particular in mathematics, and *related data collections,* e.g. from geo-satellites, are a particular problem (Grötschel/Lügger 1996, 4). If the data can only be read on the basis of particular software packages, both form a unit that would need to be preserved together. As regards software, often already accessible via special web sites and databases (cf. 7.2.4.3), the special problem of keeping it usable with later computer environments is tricky (see for the emulation approach in 2.5). Apart from this technical problem, we face a serious selection problem here as some of these data collections are immense. A number of disciplines produce huge quantities of new data every day, storing all of them would certainly be impossible and also unnecessary in most cases. A guiding principle could be that only those data that sustain the conclusions drawn should be kept longer than the related project is under way. Data quoted in a scientific publication need to be kept because they have to be available for re-evaluation. For the rest, it is up to the producer to predict whether there might eventually be an opportunity to re-use the data. One further option is to always condense the original data, if possible, with a view to keeping only the aggregated data (e.g. time series).
- *Pre-prints*, *conference contributions* and *working papers*: While it seems arguable not to archive them if they have actually been formally published later on, there are good reasons to insist on archiving them. Conference and working papers became an important means of scholarly communication in many fields and are cited in bibliographies of both other papers and formal publications. The bottom line, therefore, should be that pre-prints and working papers that have been used in further research should be kept in the archive (see also 6.4.1.3). As it is difficult to record whether a paper has been cited, selection according to this criterion is almost impossible. Therefore, only integral archiving is a viable option.
- *Skywriting* (written discussions in lists and newsgroups): Some deny the need to archive these texts: "To feel obliged to retain every human utterance in graphic form makes little sense in the print environment, and none at all in fully networked circumstances." (Atkinson 1993, 207) As regards informal gossip and question and answer lists (cf. 2.4.2), not to archive is certainly a possible solution where academic posterity would not lose essential texts. However, in the case of real skywriting, that is genuine academic debate, the answer may be different. In particular, if it raises in prestige (cf. 7.2.4.4 and 8.4.2), record keeping would be paramount. Archiving E-lists is, by the way, less of a problem as it may seem at first glance because the size of the archive files is not too important as it is only text and because the present standard software has already archived E-lists for a long time.
- *Academic homepages*: Although it seems interesting to browse through disappeared versions of homepages of universities, individual researchers and research institutes, their obsolescent content is, in general, not essential for the functioning of current re-

search. Only a very specialised historian interested in the development of research institutes would be interested in out-dated contact information, old research profiles and archaic project descriptions. As the general initiatives to save the web content (in particular the periodic Web snapshots) are being undertaken anyway, it does not seem necessary to start a specific archiving initiative for academic homepages.

- *Different versions of papers*: As already discussed in 6.4.1.3, if there are different versions of a paper, not only the latest should be archived, but also earlier versions in case there is a chance that some other publication has already referred to them. In dubio pro archiving.
- *Link collections*: As I argue in 7.2.4.2, they may count as a new form of genuine academic publications. In case this were acknowledged by the academic community, link collections would need to be archived, too. A special problem is the inherently dynamic character of such collections. Snapshots of them at regular intervals would be one option to record their development. While the web addresses collected are only of transitory value (because they change and may eventually disappear altogether), the part worth archiving are the descriptions and comments, the structure and perhaps the look and feel (i.e. the layout).
- *FAQs* should, if accepted as genuine academic publications (cf. 7.2.4.2), be equally kept; the remarks regarding link collections and their dynamic character apply mutatis mutandi.
- *Archives of primary sources* have to be considered an important working tool also for future generations of researchers and need to be kept – as their name already implies. In case the archives are not only amended in the sense of adding on new items, but if also items already in the archive are changed over time, then the original version of an item should be kept, too (unless it is only an improvement of the representational quality of, for instance, the image). The same holds for other *databases* except in the case where they only serve as a reference of the actual state of affairs where previous states are of no particular interest (except, perhaps, for a historian).

7.4.2 Responsibility

From an organisational point of view, the responsibility for archiving cannot be left unresolved. While the demand for high-use items will insure that they are archived and migrated, this is much less likely for less-used materials (Dementi 1998, 3).

An individualised solution could be possible, but only in principle: every researcher would be in charge of archiving what s/he has produced and/or quoted. Today, printing out is often deemed not only necessary because of poor screen quality, but also a means of risk management. As long as computer software crashes frequently, it is just very sensible to make back copies (Fuller 1998, 138). However, given the enormous amount of publications and data to be archived, this cannot be left to the individual. There need to be and there are certainly collective alternatives of archiving. At the end of the day, the academic community as a whole would have to arrange for "continuous, systematic uploading and upgrading pari passu with ongoing developments in the medium" (Harnad 1998b).

The following principled options are conceivable:

- *Publishers* do have, at least initially, a big incentive to keep their products accessible and are therefore prime candidates for being held responsible to archive. However, publishers can go out of business without a legal successor who might take over the

responsibility or they may lose interest in the archiving business. After all, archiving is a long-term endeavour, which can become costly and might not be so profitable if a product is old and only rarely demanded. It is particularly risky if the publishers retain the only version of a publication in a digital form because of the following three dangers: first, little-used or unprofitable back-files may be deleted; second, investing in conversion expense as technology evolves may be not feasible in the situation requiring it; and third, changes in ownership may let the publisher lose interest (Buck et al. 1999, 1f.). Hence, publishers can and should not be the only archivists.

- *Electronic second-hand bookshops*? There is not yet any experience with special brokers for (commercially) abandoned databases and archives (Sietmann 1999, 228). While it is conceivable that such bookshops might enter the scene, they would, however, certainly only invest in those databases and archives that could be sold. For many academic databases and archives, this would certainly not be the case. Hence, this highly selective solution is no sustainable option for a broad and reliable coverage of the academic archives of the future.
- *Legal deposit of E-publications*: A rule similar to that governing the paper publications could be established to enforce that every publisher would have to deliver a digital copy of every E-publication to a central library. Apart from the difficulty of coming to a worldwide solution, this can, as a maximum only cover the formally published material. Many of the other categories of academic publications discussed in the rest of this chapter would probably not fall within the realm of legal deposit. In addition, it is all but easy to decide under which conditions the central libraries would grant access to the archived copies, in particular, as long as the original publisher still offers the E-publication (cf. 9.2.3).

  Although there are no legal rules enacted, yet, there are a number of (international and national) activities in this area (for an overview, see Rauber/Aschenbrenner 2001), mainly supported by the major national central libraries (which are, however, not specifically targeting academic publications). Among them are, for instance, the EU's Networked European Deposit Library (NEDLIB) project[737]; UNESCO's programme "Memory of the World"[738] and the related activities of the Long Now Foundation[739] (Brand 1999); the British CEDARS[740] project on digital archives and the German project DEPOSIT.DDB.DE[741].
- *Responsibility of the producers/authors*: Alternatively, the producers/authors could play a role, not on an individual level, but as a group, as the academic community (Owen 2000, 3). The researchers themselves and/or their institutions may be held responsible to register an archival copy. For this to be made possible, easy-to-use academic archiving servers would have to be installed. There is a need for a digital archiving infrastructure, capable of supporting a distributed system of digital archives with trusted/certified organisations capable of storing, migrating and providing access (Armstrong/Lonsdale 1998, 49). However, it seems risky to entrust archiving to the many individuals. But even institutionalised groups of individuals are unlikely to archive each and every item that should be kept.

[737] <Cyberlink=264>.
[738] <Cyberlink=305>.
[739] <Cyberlink=304>.
[740] <Cyberlink=745>; on the activities in the U.K. see, for instance Armstrong/Lonsdale (1998, 53f.).
[741] <Cyberlink=261>.

- *Academic libraries* have been in the business of archiving since their inception. After the expiration of the economic life span of an E-publication (in which the publishers will retain the resources within their own networked archive), long-term storage of resources is likely to "remain a role of the library world, as it always has been with printed documents" (Owen 1997). Atkinson's (1996) proposal of the worldwide digital academic library as a "control zone" is one such example (cf. 9.1.3.3). While many cybrarians have already made this task their own, a world-wide consensus in this respect is not yet established:

  > "Electronic archiving tends to fall between the cracks as publishers redefine products to address new markets, and librarians respond by redefining their traditional roles. In the scramble to reorient ourselves, the critical task of ensuring the future accessibility of information with enduring value frequently gets pushed aside by efforts to enhance access to current and more actively used materials." (Dementi 1998, 2)

  One important model activity in this respect has been undertaken by originally US academic libraries with regard to P- (not yet E-) journals in the project JSTOR.[742] Today, libraries, academic associations and publishers work together to keep the backlog of an increasing number of academic journals accessible in electronic format.

However, even if there was already such a consensus, we have to face a big co-ordination problem. A single source of archived material is, in principle, both enough and cost-effective (Owen 1997). Catastrophic physical events (Buck et al. 1999, 2) could be safeguarded against through data-securing measures (redundant copies as backups which are not accessible or multiple copies which are accessible in co-ordinated mirror sites). This granted, we would need a worldwide division of tasks between the libraries, e.g. according to thematic focus or regional origin or language. Owen thinks this to be the role of a limited number of large libraries specifically appointed this task – just like the national libraries so far, which are appointed the legal deposit task for non-digital publications.

Although this certainly needs more debates worldwide in the academic associations and the librarians' circles (cf. 11.2.2.3), it seems likely that the academic libraries will end up being in charge. The solution would probably be a *specialised, multi-centred, but non-duplicating archiving system*. It would be specialised, as the cybraries may well offer general access to all kinds of information, but have only a tiny specialisation as regards long-term archiving. It would be multi-centred, as it is much too huge a task for even the largest libraries to cope with all academic material to be archived. Finally, it would be a non-duplicating system, as it will not be necessary to have redundant responsibilities (which does not exclude technical redundancies to make the system more secure).

[742] <Cyberlink=322>.

7.5 Assessment and outlook

Looking at my scheme of six functions of scholarly publishing, as developed 1.2.2.1, it seems clear that technological dynamics will influence all of them. The impact will be in the way these functions can be performed in the future (Kircz/Roosendaal 1996).

(1) *Certification*: As will be argued in more depth in the next chapter (8), there are both a trend towards less quality control in some areas and a trend towards re-invention and reform of refereeing in cyberspace. As regards formal publication, the "quality stamp" given by the community will be equally trustworthy as in the paper world (cf. in particular 8.3.2). As I have argued in 7.3.2.3, the pure fact that certification is no longer done on paper anymore, but in a digital medium will slowly lose its importance as regards the authority of this new certification.

(2) *Registration*: Recording research results and registering their relations to particular authors will be done electronically with the help of worldwide databases even more efficiently and more timely than the paper system can. In particular, "time stamps" for priority claims are more exact as they are recorded automatically upon arrival of an electronic submission, for instance, in an E-print archive.

(3) *Diffusion*: The distribution and broadcasting of academic knowledge is not only much easier in a digitally networked environment, but also more efficient as you can reach more people in a fraction of the time needed in a purely paper-based system (cf. 7.2.1). This not only includes pure distribution, but equally awareness building and, hence, real diffusion of new knowledge, as there will be a variety of targeted and customisable announcement services. These will allow each researcher to stay tuned, up-to-date and well informed about what is going on in his/her field (cf. 7.2.3). In addition, even if a publication has not initially reached the whole of the intended target audience, it will be much easier to find it by means of digital searches in the Web and in dedicated online databases (cf. 7.2.2).

(4) *Transparency*: The disclosure of results with a view to both legitimising the research, allowing for connecting research (cf. 6.4.4.2) and opening it for control and reassessment could be greatly enhanced in a digital publishing system as restrictions of space (cf. 6.4.1.2) and representation cease to apply. In particular, innovative journal formats may transgress the text orientation of academic publications (cf. 7.2.4.1). Hypertext modularisation (cf. 6.4.1.4) and meta-tagging of traditional, but electronic publications (cf. 2.2.2.1 and 7.2.2) may increase transparency.

(5) *Discourse*: The function of publications in the framework of the wider on-going communication process in research communities could not only be preserved, but even enhanced. As argued in 6.4.4.1, the communicative potential of digital publications is much greater than that of traditional paper media. In addition, new forms of record keeping of pre-formal scholarly communication are about to be established, as "skywriting" gains ground (cf. 7.2.4.4).

(6) *Preservation*: There should be no denial that archiving scholarly publications with a view to building up a sustained memory of academia is still an unsolved business. However, as argued in 7.3.4, it is both technically feasible, and durable organisational models are already being discussed to guarantee the future performance of this vital function of the academic publication system.

In sum, I may line up with Morton who argues that the functions or the scholarly communication system "predated the first learned journals; so, too, can they post-date the

paper paradigm" (1997, 6). All of the central functions can not only be fulfilled in a digital environment. There are even good reasons to believe that we shall end up with an even more efficient performance in cyber-times.

On this basis and keeping in mind my assessment of the expectations of the scholarly community (cf. 7.3.4), it seems that we shall see my "P-to-E scenario", as developed in 7.3.3, unfold in practice, in the not so distant future. While rightly reserving the label "revolutionary" for the scenarios discussed in the previous chapter on knowledge representation (described in 6.3 and assessed in 6.5.4), we should nevertheless not underrate the changes discussed here. In a few years time, the scholarly publication system will probably be fundamentally different from what we came to know. A number of publishing formats may have vanished (like article collections in book format, cf. 7.3.1.3); others will have changed their character profoundly (for instance the review journal, cf. 7.3.1.4); so far unheard of publishing formats will be an established part of the system (such as virtual journals, cf. 7.2.4.1, or "skywriting", see 7.2.4.4); and perhaps "crossover publications" will have seen the light of the cyber-day (cf. 7.2.4.5).

Maybe the most important qualitative change ahead of us is the advent of a *mixed-mode communication* (Owen 2000, 7), as opposed to the current information chain which mainly disseminates research results. The mixed mode would be based on an integrated information infrastructure that allows sharing of source data, access to archival materials, networked participation in (or at least discussion of) ongoing research activities, in addition to access to formal research results. In other words, the new mode provides for two-, or multi-, way communication as opposed to unidirectional dissemination.[743]

[743] Owen (2000, 8) himself also points at the obvious parallels between mixed-mode communication as facilitated by ICT and the so-called Mode-2 knowledge dissemination as described by Gibbons et al. (1994).