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Central to the management of scholarly communication in the sciences are libraries and museums which share common charges in each being service institutions which retain and provide information and are thus vital to ongoing scientific scholarship. By analyzing these two institutions in general ways, patterns of scholarly communication emerge that link more similarities than differences between science libraries and science museums. Electronic information technologies have become all too common in libraries as they have moved from collection-based institutions to access-based resources. The movement towards interactive technologies has become equally common in museums, thus goals for resource sharing and greater cooperation and collaboration in the planning for enhanced developments in services and collection management bridges libraries and museums in new ways to foster better methods for scientific and scholarly research.

If science is indeed the "engine of modern society," as David Halberstam writes and "knowledge, primarily scientific knowledge, provides the new raw material for prosperity," then scientific information is essential, not only for the scientist, but the public at large. A society only exposed to general information may be considered illiterate and the specialist information needs must be digested by not only the learned and exposed but the layman and public at large. How such major gaps in society will be bridged remains the concern of government officials and policy shapers, scientists, academics in all disciplines, businesspeople and economists, journalists and nearly everyone to whom science, information, education and innovation are critical partners.[1]

Scientific and scholarly communication offers the combination of curiosity and creativity and the issues surrounding that are what concern us in this paper, as libraries and museums are among institutions to foster a sense of both. My co-author will offer insights into how the museum side responds to many of these issues. As we see more and more links between computing facilities or centers and libraries and museums it is very natural to offer this joint collaboration.

How can institutions respond to the daily changes in technology and network development and new electronic and multimedia products and formats issued by the individual, scholarly and commercial publishers? Meeting those challenges poses great dilemmas for scholarly communication for it not only is a library issue, but more importantly, an institutional issue and restricting the comments of this paper to the sciences offers only a focus, not intending to discount applications in other disciplines. I will share some observations about general themes and library applications, followed by some contrasts and similarities in the museum environment.

My experience this year as a Fulbright Librarian at the Imperial College/Science Museum Libraries allows me to share some impressions from observations from being in the UK for a short period and contrast them with the American experience with which I am most familiar.

Creating systems that are interactive and manipulative, yet have strong foundations in holdings information with a future towards immediacy and fulltext, remains a goal for libraries and museums. Issues for promoting scholarly communication and computing environment needs and trends may include dramatic increases in functionality and performance; different types of information technology increasingly digitized; high density storage; network technology development; artificial intelligence software; rapid dissemination of new information; powerful searching tools; sophisticated information manipulation and analysis tools; downloading capabilities; simultaneous access to system resources by multiple users; remote access; round-the-clock availability.

A popular application for academic libraries is the Campus-Wide Information Service (CWIS) that is used for transmitting a variety of campus information and communication, including OPAC access and other special library services. Developers of such systems should aspire to perfect transparency for the user making systems as "user-friendly" as possible but containing as full a descriptive or bibliographic record as it can, and when possible display or offer the fulltext of the needed document with text, graphics and other printed support, assuming that copyright and intellectual property has been dealt with and licensing has been arranged. This potential contradiction does not make things simple to any novice user or system designer nor suggest any greater compatibility between systems as already experienced by having a large variety of instrumentation and protocols in nearly every institution at present. Currently, librarians and users struggle with an opac, inhouse operational/functional systems, 2-3 mediated search database providers, 6-8 CD-ROM software interfaces, 6-10 opac compatible or tape loaded/site licensed databases, 1-4 specialized databases or publisher-specific databases. Thus, ease of use and compatibility are some of the criteria most valued when resources are examined for selection, acquisition, and implementation in addition to content.

The example of increasing cooperation and collaboration among science librarians and museum information personnel has been demonstrated in many settings. One environment that is testing ways that scholarly communication can be considered more seriously is the federating of service points and merging of collections in the newly joint libraries of Imperial College of Science, Technology and Medicine and the Science Museum, London, where a common library system has been created by erasing physical barriers and altering space to allow for one enhanced information center where functions such as information retrieval, reference services, document delivery and manipulation, integration, transfer and archiving and retention can be done at one location serving the information needs of both different and diverse constituencies and maintaining the integrity of the special needs of the various users and collections. This unifying of services and collection management is done by respecting that there are changing communication activities in the scientific community that must be reflected in libraries and museums. What is easy to establish is that libraries have lots to share with museums since they have somewhat paved the way for museums to learn from their early experiences and not repeat the mistakes, some costly, that libraries made before sufficient directions demonstrated obvious trends in scientific and scholarly communication.

Academic libraries and museums usually share the caveat that they contain and maintain national and local treasures holding the institutional memory for future generations and have an obligation to serve other public sectors, such as support for primary and secondary school curriculum and study, serve alumni and the public to the extent possible; thus access may cost or be restricted but somehow the information can be retrieved and delivered, loaned and borrowed whether for fee or not. At Imperial College, like many other institutions, many library functions previously done by staff can now be initiated by library users, such as placing ILL or document delivery requests, learning circulation status, reserving materials, connecting to the OPAC and CWIS from anywhere on the campus (many institutions have remote dial-up access as well), links between CD-ROM networks and OPACs, Later on you will learn more about network capabilities in particular.

In summary, goals for a developed network environment in libraries and museums stress compatibility, higher levels of knowledge creation and use, expanding connectivity, technological diversity, improving performance, efficiency and relevance and developing user self-sufficiency.

Clearly the trends can be linked to a proliferating field of knowledge management predicated on the advent of smaller, yet more powerful computers and competing networks and electronic libraries that can offer a "wide range of text and graphics-based information resources and the appearance of on-demand publishing systems that make huge collections of periodicals readily available or allow scholars to customize their works."[2] Borman identifies and discusses the merits of issues like the non-peer-reviewed electronic journal or more scientific papers that are disseminated over a computer network, thus sidestepping the often tedious peer review and journal publication processes. Examples of how publishers are creating databases of electronic journals are becoming more numerous as nearly all major science publishers are developing electronic products, especially in and for the serial and textbook fields. As physical space shrinks in libraries and museums, the deselection process is not always practiced as actively as selection, with storage facilities, weeding, contributing to exchange programs each viable options, and results in creative use of space planning to ergonomically contain the emerging technologies.

Libraries and museums are beyond exploring basic technology applications with most institutions well fitted with sophisticated integrated systems and LANs. Examples of emerging technologies using scholarly communication are equally numerous. They may include the just released new e-journal, Interpersonal Computing and Technology (ICPT) which joins several dozen already established electronic journals, or the Human Genome Project, an international biological science initiative which has four goals: "1. construction of a high-resolution genetic map of the human genome; 2. production of a variety of physical maps of all human chromosomes; 3. determination of the complete sequence of human DNA; and 4) development of capabilities for collecting, storing, distribution and analyzing data [3]; CORE (Chemistry Online Retrieval Experiment) done by the American Chemical Society at Cornell; Springer-Verlag and the Red Sage Project at the University of California, San Francisco; Elsevier with TULIP and nearly 15 campus sites worldwide; Springer-Verlag's journals preview service on the INTERNET, different joint ventures initiated by OCLC and the AAAS to continue issuing Online Journal of Current Clinical Trials, plus many more in developmental stages or trying to issue new and sophisticated information products. In Britain, testing begins this summer on INSIDE INFORMATION, a joint venture the British Library is promoting for faster document delivery.

Various timely reports indicate that you can't be a world leader in science today without being global. The National Academy of Sciences in the US, just published Science, Technology and the Federal Government: National Goals for a New Era, and most readers of and contributors to that report will confirm how difficult it is to devise any kind of national policy that makes sense. There needs to be greater understanding of how science gets done in the 1990s and how it will be done in the next century. In practically every major science domain, global research networks have transcended and superseded national boundaries. A national science policy may be laudable but in practicality, the logistics suggest how unrealistic it really becomes because collaboration is so much more international and that the transmission of scientific findings transcend all boundaries with several international magapublishers having major slices of nearly all science pies.[4] For the library community seeing how the Coalition for Networked Information (CNI) has become truly a global meeting of minds in just a few years.

The British have released a "white paper" on science and technology in recent months as well. Again, the direction seems to be more how local industry can benefit more from science without contributing more funds and what kind of innovation can be created by conducting research in more partnerships with the academic community. Underfunding and cuts by government in research are hardly addressed in these reports forcing one to wonder what kind of national treasures we can expect in years to come and how they will be managed.[5]

New pieces of American federal legislation, such as the Boucher Amendment (H.R. 1757) have been composed to commit federal US dollars to network developments that link all the various constituencies and developments such as the recently released MOSAIC software and about 100 other products, which along with Gopher, Archie, Veronica will integrate access to the documents, graphics, photographs, animation and video that are stored on the 1.2M computers (expected to be close to 3M by the turn of the century) that are connected to the Internet making for a more expansive worldwide web that utilizes hypertext links to bring together related documents stored on different computers around the world.[6]

In the UK, many constituencies are eagerly awaiting the final report of the Scientific Information System in the 1990s, a study conducted in 1992-93 by the Royal Society, the British Library and the Association of Learned and Professional Society Publishers (ALPS) to learn how publishers, information intermediaries and users, being the scientific community, meet their STM information needs and what gaps there are in providing the anticipated or needed information.

According to the new bible on the topic issued this year in print and electronically, The Cummings study commissioned for the

Mellon Foundation and the Association of Research Libraries, scholarly communication has five intrinsic processes in scientific research, which "describes the library landscape as it appears today, in its collecting, operating, financial and electronic dimensions. It is used for 1) identifying sources of information; 2) as a means of communication with one's colleagues and students, to pose queries, propose answers or solutions or to conduct informal dialogues; 3) to interpret and analyze data; 4) as a medium to disseminate one's research findings and 5) the lasting or archival purpose to prepare curriculum to instruct the next generation of scholars and scientists."[7]

Meadows and Buckles, a British team at Loughborough, articulate the changing communication activities in this community in an article that notes the factors that contributed to such drastic changes. They suggest that the single development most changed in the last decade is the informal communication processes.[8] It is not that scientists are talking more to one another but how they are conducting these transactions. Electronic networking contributes to this achievement, making time and geography nearly transparent to all parties and with increased dependence on e-mail and electronic file management. The consequences have been recognized with greater international cooperation among scientists, access to the greatest and richest collection resources worldwide and publishing trends changing towards more electronic products and faster distribution of information. It remains premature to determine whether the increased informal communication has altered how scientists use libraries, but speculation suggests that it has indeed reduced foot traffic and created more demand for remote services and file transfer.

Factors such as the economics of information, specifically the economics of journal publishing by both the commercial and scholarly publisher, and retaining information in the traditional bound volume way have shifted to more electronic dependence requiring libraries to be better equipped with hardware, telecommunications and compatible software gateways to offer the scientist access to information in a faster, more cost-effective way. Very successful efforts by members of professional societies in physics and mathematics to share preprints electronically have virtually eliminated the reprint request postpublication and forced the academic community to rethink the value of citation analysis over time.

Libraries are experiencing this paradigm shift by restructuring their information centers to be more responsive to having staff familiar with electronic resources and provide instruction and better access to more relevant documentation and information in a timely way, anticipating information needs rather than after the fact. The "Just in Time" metaphor is very appropriate when "Just in Case" becomes less permissible and financial planning becomes more strategic as one can determine what the costs of necessary materials are for an academic or fiscal year. Collection development policies can be more relevant and precise and readership data more meaningful.

Issues such as the information explosion and the increased costs of and to publishers, contract negotiations, refereeing, and a lack of clarity about copyright and intellectual property only distort the degree of complexity that libraries and museums face. Related issues such as scientific fraud, plagiarism and misconduct encourage a keener look at how to asssess the impact of new technologies on publishing. The increased potential for alteration of printed works in electronic media scares the academic community because we have come to place an enormous dependence on citation methods and ability to retrieve the needed work, hoping that it has not been altered or erased.

By attempting to better understand the information needs of the scientific community, there appears to be the link to plan a strategy of what libraries and museums will be like in the future. The resistance to new technologies may haunt the academic and scientific communities for a long while as the demand for resources becomes more competitive and the concensus is harder to reach about what an institution's priorities and mission are defined as.

Herbert White in an article just published this summer suggests how difficult it is to reconcile the vast increase in publication volume with the number of scholars undertaking and reporting their research and how scholarly publication has developed serious cracks causing breakdown in the traditions we know well and depend upon.[9] He goes on to say that academic libraries may not be developing the best strategies to deal with the problems, "...libraries cannot continue to spend every last cent on material purchase and then also implement virtual libraries."[10]

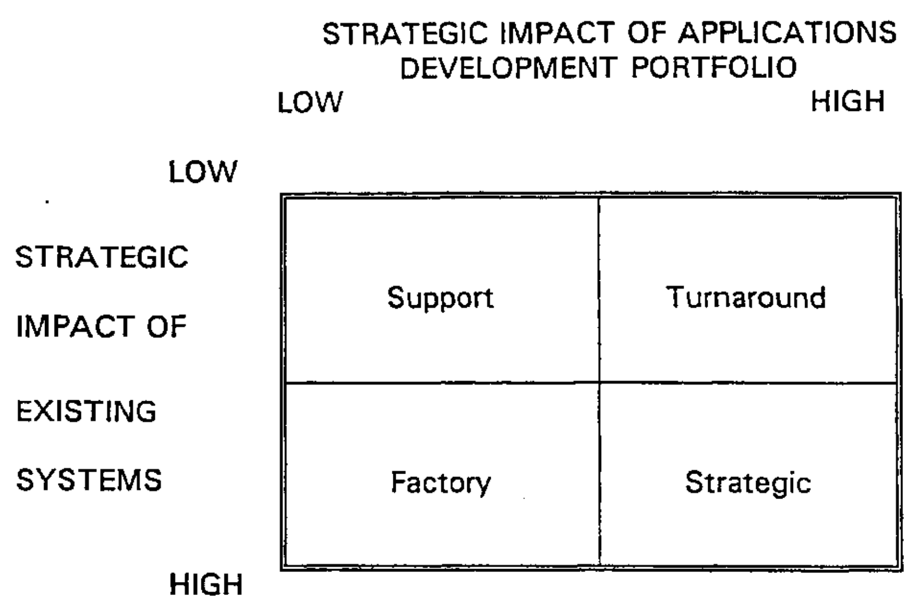
Le Coadic lists four facts about scientific information which may be analogous to how libraries should consider planning for better cost-containment of scientific information, and it is this author's contention that they may be extended to museums as well:

> "1. An analogy was proposed between scientific information and blood: scientific information was said to be the blood of science. That means that the vital principle for science and for the scientist to, through, for example his/her publishing activities;
> 2. Among other things, communication activities play an important role in scientists' activities: more than 40% of time is devoted to communication;
> 3. Information technology which affects society in general is also affecting the research process and specially scientific creativity. The use of expert systems helps to form conclusions, judgments or inferences from facts;
> 4. A good representation of science and technology in museums, that is transfer of information through objects, posters, photographs, videos, conferences, books, labels is one of the key problems in the successful public understanding of science."[11]

Themes of how scientific and technical information interact and how relational central themes are to peripheral themes is analogous to how libraries and museums determine how to invest in technology and allocate resources for meeting information demands now and in the future.

The present climate is indeed a challenging one for museums; they must respond to and assimilate new technology, and provide for increasingly diverse and sophisticated publics. This is perhaps not the place to labour the debate on why libraries have in general proceeded ahead of museums in these areas - it may be because of the often discussed dichotomy between their roles as "cabinets of curiosities" or centers of information[12], or perhaps because the schemes devised for museum automation have been so complex as to be self defeating. There has nevertheless been a lengthy history of electronic cataloguing for museums, much of which has been aimed at making the collections and related information more widely available[13]. In the Science Museum, automation originated in the Library, but with Information Systems recent administrative relocation to the Resource Management Division, (which already contained finance, human resources and estates), the strategic importance of information systems has been recognized. It is perhaps the appreciation of this strategic role which has been lacking from museum's planning in this area. Whereas libraries, as suppliers of information, and with an increasing dependence on information technology for its delivery, have seen these as strategic in terms of McFarlan and McKenney's grid[14], (see figure 1) museums have tended to perceive information technology as merely providing support to the business. The model which can be applied to museums is similar to that argued for the humanities in general; that is that there is considerable potential for the use of information technology, but it is yet to be realized, in contrast to other disciplines including the sciences and social sciences[15], where this potential has already been recognized. However, museums are now attaching importance to this area, as

FIGURE 1



IT Strategic Grid
(After McFarlan & McKenny)

is witnessed by the recent publication of conference proceedings on sharing information resources[16].

The overall trend in information systems at large, which is being followed by museums, is one of decentralization in terms of both systems and organization, with priorities in information systems being determined by the users, as they come more to control the facilities which they utilize. (We should however beware that in records terms the priorities may be being set by the custodians of the records rather than the eventual users of the records, and that consequently the "tyranny by IT manager" is merely being replaced by "tyranny by records manager"). Users in the broadest sense are now negotiating service level agreements with systems providers, aiming to produce a consistent service according to agreed parameters[17]. The trend for decentralization, coupled with greater user sophistication, is leading to a movement of staff and resources away from the central information systems providers; whilst this places the providers nearer to the users, it can lead to problems both in standards for data, and for technical standards.

Increased processor speed and storage capacities have made image storage a realistic option for all, and moving images (together with sound) are also now being made available.

The ability to network both locally and over wide areas has been with us for some time, but only now does it have the reliability and capacity to cost ratio which can make effective network access universally available. Present networks are able to manage the volumes of text data which are being sent, future initiatives such as the National Research and Educational Network

(NREN) in the United States, and SuperJANET in Britain, will facilitate image transmission, and it is also claimed moving images.

Several large museums have responded to these challenges by carrying out a strategic review of their information systems needs. These studies have tended to stress the potential of networking for both internal and external communication, and the role to be played by such new technologies as multimedia[18]. Many museums now have the facilities to make available images as well as text describing the items in their collections. These include the National Museum of Denmark, where a pioneering project has stored images in analogue format on a video disk, and more recent initiatives employing digital storage at the Design Museum in London, where the entire collection is available through a hypermedia application, and the National Railway Museum, York, where the large holdings of glass photographic negatives are being digitized. The Micro Gallery at the National Gallery in London has digital images for almost all of the entire collection of over 2,000 paintings[19]. With the widespread use of video technology, and increasingly common use of digital methods, the public now expect to see images as well as text, as demonstrated by the video disk of a large collection of slides assembled by the Paris public libraries. It is arguable that in a museum context, a text only OPAC application such as that at the Department of American Art at the Metropolitan Museum of Art, New York[20], would not now be acceptable to the public. Kodak's Photo-CD has set the standards for digital images[21], but still lacks the necessary database support for manipulating the very large numbers of images which many museums have.

Interactive exhibits, allow the public to manipulate image, text and sound, and perhaps also to touch real objects. The origins of this "touch and feel" experience became widespread in the children's museums in the late 1970s, some of the ideas being prototyped in the Science Museum Children's Gallery of the 1930s. An example of such an interactive approach is the natural history discovery center at the Liverpool Museum; a similar facility for science is planned for the new education center at the Science Museum in London. The potential of multimedia has been explored in a research report from the British Library by Signe Hoffins[22]. The present state of multimedia is however not a mature technology, and has been likened to spaghetti[23].

A means of distributing information which is being explored by museums is CD-Rom, where Chadwyck-Healey Ltd have been particularly prominent[24]. However, it is this author's opinion that whilst CD-Rom provides a very significant advance on microfiche, access to on-line databases via networks will be the prevalent means of data distribution in the future, except where network access is not possible. Similarly, whilst there have been some successful implementations of centralized databanks (for instance the Canadian Heritage Information Network - CHIN, and the FENSCORE natural science collaborative database)[25], it seems likely that network access to variously located databases will provide users with a "virtual database", which has the characteristics of the union databases which have been sought for so long, so that the user has the illusion of access to a much larger collection of information than is really present

Several museums are now implementing networking strategies, and it is perhaps useful as an illustration to look at the various approaches being adopted amongst the South Kensington museums in London. The Natural History Museum has recently installed a comprehensive network infrastructure, to which all of the staff in the museum may be connected. The first priority was to provide access by scientists to external databases and messaging facilities, but the museum will also be providing access to its own databases. Use of the network for internal electronic mail has grown surprisingly quickly in the few months since the network has been available.

The Science Museum will be installing a comprehensive network at its three main sites and storage facilities early in 1993. Initially the priority is to make major internal databases available to staff, and to foster synergy through internal communication; but access to external data sources is likely to become important, particularly as other museums data resources become accessible via the networks. It is planned to make the museum's information resources available to external users as well. Another example of cooperation is that the Science Museum Library holdings will soon be available via the Libertas computer system operated by Imperial College.

The Victoria and Albert Museum is pursuing a policy of incremental networking, which will provide shared access for workgroups, and via bridges, access to central facilities and external services.

Access to JANET is available to these museums in South Kensington via Imperial College, and there is a proposal to link the South Kensington Museums to SuperJANET via an optical fibre "Metropolitan Area Network," connected to the Imperial College SuperJANET node. Imperial College has been selected as one of 8 introductory test sites for installing SuperJANET. Whilst these three museums with different collecting areas are pursuing networking from different perspectives, the eventual result will be comprehensive internal networking, with access to and from the outside world; when SuperJANET is available this will mean access at a bandwidth permitting the transmission of large volumes of data including images. Similar efforts are being made among the museums and libraries of the Smithsonian Institution in Washington DC.

As well as providing information via electronic means, and through conventional Library outlets, museums are looking at other ways of making information available. One such initiative is "Science Line", a collaborative approach supported by a range of UK bodies concerned with the public understanding of science, which will provide telephone callers with answers to queries relating to Channel 4 Television's DINOMANIA weekend. This service has grown out of an experimental Science Information Service which was trialled at the Science Museum in 1989 and 1991. Another proposed initiative by the Science Museum is the "Collections Records Center", where the public will be able to consult a range of on-line and paper records relating to items in the Museum's collections.

Scholarly communication takes on wider dimensions when applied not only to scientific publishing. What kind of developments are on the horizon for both libraries and museum?

If the present is any indication, we can predict more interactive technologies promoting better use of resources on global higher capacity networks by more diverse users spread over a greater geography. Less foot traffic is anticipated as remote information transfer becomes common and scholarly communication practices continue to evolve forcing institutions to carefully analyze competing solutions to providing scientific information.

As John Swan says in an opinion piece last year in the Scientist: "If scientific insiders and information management insiders find a way to cooperate, we might well discover a healthy symbiosis that would promote, in collegial, nonintrusive and efficient ways, a free and ethical environment for both inquiry and communication."[26]

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NOTES

1. EIJSVOOGEL, Juurd. The Discipline of Curiosity: Science in the World. Amsterdam: Elsevier Science Publishers, 1990. pp.1-7.

2. BORMAN, Stu. Advances in electronic publishing herald changes for scientists, Chemistry and Engineering News, 14 June 1993: p. 10.

3. U.S. DEPT. OF HEALTH & HUMAN SERVICES & U.S. DEPT. OF ENERGY. Understanding Our Genetic Inheritance: The U.S. Human Genome Project, 1990. DHHS Publications #A05; available from NTIS, Springfield, VA. 22161, USA.

4. See Science, Technology and the Federal Government: National Goals for a New Era, Washington, DC: National Academy Press, June 1993. Also, GOULD, Constance and PEARCE, Karla. Information Needs in the Sciences: An Assessment, prepared for the Program for Research Information Management, The Research Libraries Group, Mountain View, CA: 1991; and Communications in Support of Science and Engineering, A Report to the National Science Foundation from the Council on Library Resources, August 1990.

5. See Realising Our Potential: A Strategy for Science, Engineering and Technology. London, HMSO, May 1993.

6. DELOUGHRY, Thomas J. Software designed to offer internet users easy access to documents and graphics. Chronicle of Higher Education, 7 July 1993: p. A23.

7. CUMMINGS, Anthony M., et al. Universities Libraries and Scholarly Communications: A Study Prepared for the Andrew W. Mellon Foundation. Washington, DC, Assoc. of Research Libraries, 1992. 205p.

8. MEADOW, A.J. and BUCKLE, P. Changing communication activities in the British scientific community. Journal of Documentation, 20(3) 1992: p. 280.

9. WHITE, Herbert. Scholarly Publication, Academic libraries and the assumption that these processes are really under management control. College and University Libraries, 53(4) July 1993: pp. 203-301.

10. Ibid: p. 300.

11. LECOADIC, Yves-F. A science policy for scientific information. Journal of Information, 19, 1992: p. 171.

12. Often debated. For instatnce in a documentation context see STEWART, J.D. Museums - 'cabinets of curiosities' or centers of information? In MARTLEW, R.. ed. Information systems in archaeology. Gloucester, Alan Sutton, 1984, pp. 77-89.

13. For instance, LEWIS, G.D. Obtaining information from museum collections and thoughts on a national index. Museums Journal, 65(1), 1965: pp. 12-22, and CHENALL, Museum cataloguing in the computer age. Nashville, American Association for State and Local History, 1975.

14. MCFARLAND, F.W. and McKenny, J.L. Corporate information systems management: the issues facing senior executives. NY. Dow Jones Irswin, 1983, discussed in EARL, M.J., Management strategies for information technology. London, Prentice Hall, 1989.

15. See Technology, scholarship and the humanities: the implications of electronic information. Santa Monica, CA, J. Paul Getty Trust, 1993; British Library Board and the British Academy, Information technology in humanities scholarship. Oxford, Office for Humanities communication, 1993; MICHELSON, A. and ROTHENBERG, J., Scholarly communication and the information technolgy: exploring the impact of changes in the research process on archives. American Archivist, 55, spring 1992: pp. 236-315.

16. ROBERTS, A.D., ed. Sharing the information resources of museums. Cambridge, Museum Docuemtation Association, 1992.

17. CCTA, Service level management. London, HMSO, 1990, and other volumes within the CCTA (The UK Government Centre for Information Systems) IT Infrastructure Library.

18. SMITHSONIAN INSTITUTION, Information resource management strategic plan 1992-1996. Washington, DC, Smithsonia Institution, 1992; BOOTH, B. Developing an information systems strategy for the national musuem of science and industry. In: WILOCK, J.D., ed., Computer applications in archaeology. Stafford, Staffordshire University, in press, 1993.

19. RUBENSTEIN, B., Designed for study: The Design Museum's study collection database. In Roberts, pp. 141-143. See also HEAP, D.J. and BOOTH, B. Image storage at the national railway museum, York. In: Computers in Libraries International 93. pp. 25-40. (Rubinstein's company, Cognitivie Applications was also responsible for technical aspects of the National Gallery system.)

20. VOORSANGER, C. Hoover. An automated collections catalogue: The department of american art at the metropolitan museum of art. In: Roberts, pp. 64-70.

21. CHEN, C. Photo CD and other digital imaging technologies: what's out there and what's it for? Microcomputers for Information Management, 10(1) 1993: 29-42.

22. HOFFINS, S. Multimedia and internactive display in museums, exhibitions and libraries: libraries and information research report 87. London, British Library, 1992.

23. ARTS COUNCIL OF GREAT BRITAIN, Very spaghetti: the potential of interactive multimedia in art galleries. London, Arts Council of Great Britain, 1992.

24. CHADWYCK-HEALEY, Charles Marketing museum data. IN: Roberts, pp. 149-151.

25. MCGEE, E.C. Sharing information: a canadian perspective. IN: Roberts, pp. 165-169; PETTIT, C. The FENSCORE initiative. IN: Roberts, pp. 114-116.

26. SWAN, John. Scientists and librarians: an ethical bond must unite them. The Scientist. 13 April 1992, p. 11.