

2

The Paper Library

PAPER TECHNOLOGY

PROBLEMS OF THE PAPER LIBRARY

Local nature of paper documents

Space for paper documents

Flexibility of paper documents

Catalogs in the paper library

Separation of catalog from text

Separation of users from catalogs and documents

Opening hours

Already in use

Time

Scale

PIONEERS

The Paper Library has problems associated with it that need to be set forth in order to provide a basis for a balanced view of the Automated Library and of the Electronic Library and for a clearer appreciation of the contrasting capabilities of the Paper Library, the Automated Library, and the Electronic Library.

PAPER TECHNOLOGY

Paper is an instance of a traditional, "hard copy" medium. Strictly, paper is not the only traditional medium in libraries, but, since other traditional media, such as vellum and microfilm, have characteristics that are substantially the same, we can, for our present purposes, subsume them under paper. We use paper as the predominant example and the symbol of hard copy media in general.

Library services as we know them best are based on the technology of paper. Card, as in card catalogs, is but a stiff form of paper. Libraries' technical operations are steadily being computerized and, thereby, paper libraries are now being transformed into what we are calling Automated Libraries. The Paper Library proved effective and durable for an extended period. Nevertheless, the problems inherent in the Paper Library are real and substantial. Through sheer familiarity, we may cease to be conscious of the constraints of what we regard as normal. People worry, as they should, about the advantages and disadvantages of using computers, but the advantages and disadvantages of using paper, which is thoroughly familiar, get little attention. The serious limitations of the paper library need to be reviewed explicitly if we are to make an informed and balanced appraisal of the other options, the automated library and the electronic

library. (See endnote 1).

1. Paper is a strictly localized medium. It and the user must be in the same place at the same time. A copy elsewhere cannot be used. It or a copy must be in the same place as the would-be reader. This may sound foolishly simple, but it has enormous practical consequences and dominates the design and operation of the Paper Library, of the traditional library.

2. A single paper document can, in general, only be used by one person at a time.

3. Paper copies of documents can be made by reprinting and by photographic and more modern reprographic means, but the same limitations apply to a copy as to the original. It is as much a localized document as the original. Facsimile transmission ("fax"), which is becoming popular for short documents, can provide a remedy, but only by getting away from paper and using the transmission of an electronic copy of the document as an intermediary between the paper original in one place and creation of a paper copy in some other place.

4. Paper as a medium is rather inflexible. Individual copies of a document can have annotations added to them and, with sufficient standardization, paper documents can be interfiled. But paper documents really do not lend themselves to being merged, divided, reformatted, and restored to earlier versions.

5. Collections on paper become bulky and create storage problems.

PROBLEMS OF THE PAPER LIBRARY

Local Nature of Paper Documents

Because paper is a strictly localized medium, a copy in the Vatican Library is of little immediate benefit to a would-be reader in Hong Kong. It follows from this limitation that, in principle, there ought to be a copy of every needed document in every local collection where it is going to be needed and that copy should have been collected and processed for use before it is needed. Stated differently, every individual library collection ought, in theory, to include a copy of every document that its users will want. It is the localized nature of paper that makes us want our library to be conveniently local and our (and every other) library to contain a collection of materials that is not only skillfully selected but is also as large as can be afforded.

The localness of paper documents remains an unsolved constraint. A consequence is that each library collection is more or less skillfully selected to match the needs of those using it, which is a great advantage over finding oneself in a vast warehouse of indiscriminately assembled materials, whether paper or electronic.

Disadvantages of the collection development practices of the Paper Library are that all libraries are more or less duplicative, complete collections cannot be afforded, and libraries that aspire to completeness become prohibitively expensive.

Librarians and library users have long wished for rapidly-available, inexpensive facsimiles. Television was promptly recognized, at least as early as 1925, as demonstrating the potential of electronic telecommunications for remote access to library materials. "But what a revolution for information retrieval and especially for libraries television can bring," exclaimed the German librarian Walter Schürmeyer in 1935. "Perhaps one day we will see our reading rooms deserted

and in their place a room without people in which books requested by telephone are displayed, which the users read in their homes using television." (See endnote 2).

Space for Paper Documents

The sheer bulk of the paper library remains a major problem. The amount to be stored increases relentlessly. Which library is not chronically short of space for its paper documents? Even in the U.S. library-building boom of 1967 to 1974, construction was not keeping pace with the amount of space needed to house the reported increases in the number of volumes held. (See endnote 3). In California, the cost of constructing and equipping conventional academic library space is approaching \$20 per volume. That the University of California needs twelve miles of additional shelving each and every year to house the growing paper collections of the nine campuses is a significant problem.

Books can be stored more compactly than on standard, open access shelving which supports around 12.5 volumes per square foot of floor space. Unfortunately compact storage techniques such as denser forms of shelving or relegation to remoter, cheaper space reduce the accessibility which is the primary purpose of a library service.

Microphotography developed almost as early as photography itself and its potential as a compact alternative to paper was soon recognized. Microphotography also offered a solution to another serious technological constraint of paper technology: the making of copies. Microfilm achieves both compactness and easy reproduction. These virtues were noticed by those who worried about the deficiencies of the Paper Library. The Belgian documentalist Paul Otlet, for example, proposed the use of standardized microfiche in 1906. He saw microforms not as a replacement for the book, but rather an expansion of the paper book into a new and more versatile form. In 1925 Otlet and the Belgian inventor Robert Goldschmidt described an easily manufactured "microphotographic library". It comprised versatile "pocket-sized" viewing equipment and a portable cabinet one meter wide, one meter high, and about ten centimeters deep holding, on microfilm, 18,750 volumes of 350 pages each, the equivalent of 468 meters of conventional library shelving. (See endnote 4).

Flexibility of Paper Documents

A constraint of paper documents is their inflexibility. Microfilm is little help in this regard. Microfilm can be copied, but alteration of the text on it is even more difficult than altering text on paper.

Paul Otlet anticipated the idea of hypertext, whereby texts are fragmented in smaller units (nodes) to be related to each other in complex and changing ways. Unfortunately, the dismembering and rearranging of paper documents, although feasible in principle, has severe limitations in practice, especially if one seeks to go beyond bibliographies and encyclopedia articles.

Catalogs in the Paper Library

The standard form of catalog for most of the nineteenth century was bookform. Occasionally a small printed edition was produced to distribute knowledge of the library's holdings to users and to other libraries. But book-form catalogs are inflexible and inconvenient to update. One has to write in additions and deletions, insert new pages, re-space existing entries, start separate supplements, and/or produce a new edition. Card catalogs as an innovation offered scope for the continuous and unlimited insertion, alteration, replacement, and removal of entries, but multiple copies of card catalogs are uneconomical and difficult to maintain.

Similarly, with any hard-copy form of catalog, each form of access requires a separate sequence: one card for the author; another card for the title; another card for each subject heading. Whether interfiled or in separate sequences, the bulk increases relentlessly. For access by call number an additional set of cards are required. The usefulness of a catalog could be greatly extended by providing separate "analytical" entries providing direct access to parts within books and journals, but many more cards would be needed. To search by date, which would sometimes be useful, would require yet another set of cards. The cost of the creation, housing, and, especially, maintenance of ever larger files increases steeply; so does the effort required to search in them. There is no technical reason not to have lots and lots of cards providing many different kinds of access in card catalogs, but the economic disincentives are persuasive.

During the first half of this century punched cards, edge-notched cards, and similar mechanical searching devices were developed for simple and Boolean selecting (i.e. searching for arbitrary combinations of index terms). However, they were not widely adopted for bibliographic purposes. Fritz Donkers Duyvis, the Dutch documentalist, observed in 1931 that punched card equipment was simply inadequate for bibliographic searching and noted with foresight that a new type of equipment based on the type of digital circuitry then being developed for telephone systems was a more promising line of development for the sheer complexity of the Boolean and faceted subject access techniques developed for bibliographic retrieval from the 1890s onward. (Endnote 5).

Separation of Catalog from Text.

In the Paper Library the catalog is physically quite separate from the text. One could find a book on the shelves but might be unable to find the entry for it in the catalog. Finding a catalog entry does not mean finding the book, merely a record of the official shelf location at which the book might or might not be at any given time. Card catalogs deal with ownership (actual or believed) as much as with the actual location of documents. The real solution is to develop an "integral" system in which the catalog entry and the text were somehow physically linked: Find one and you have found the other.

Having noted the dramatic saving of space that would result from using microform texts, the American librarian Fremont Rider asked "Why might we not combine the micro-texts of our books, and the catalog cards for the same books, in one single entity? In other words, why could we not put our microbooks on the (at present entirely unused) backs of their own catalog cards?"

(Endnote 6). The argument was that if you found the catalog card, you would have found the text and, in addition, the storage of the paper collections became unnecessary. Rider foresaw dramatic reductions in acquisitions and space costs from the adoption of his proposed "micro-cards" combining catalog record and text. In a variation on this theme chips of microfilm were sometimes mounted on index entries in punched and edge-notched cards ("aperture cards"). (Endnote 7).

Instead of adding the text to the catalog record one could add the catalog entry to the text, as was the case when index entries were added alongside the images of texts on a microfilm, much like the adding of a soundtrack to a movie. The use of photoelectric cells for searching microfilm for desired indexing terms and, thereby, the desired texts constituted an early form of electronic document retrieval designed by 1927 in Germany by Emanuel Goldberg (1881-1970). This technique was later enhanced and popularized by Vannevar Bush, Ralph Shaw, and others as the "microfilm rapid selector" and formed the technological basis of the imaginary "Memex" information machine. (See endnote 8).

Separation of Users from Catalogs and Documents

For the Paper Library the assembling of substantial, well-selected local collections is a necessary, but not sufficient condition, for effectiveness. Local means "near to users" but, as Robert T. Jordan stressed, there is in practice a significant difference between "near to users" and "where the users are." (See endnote 9). Studies of the use of sources of information (libraries included) have invariably revealed that usage is in practice highly sensitive to physical accessibility: Usage falls off quite steeply even over quite small distances such as a few blocks in the case of a public library and the other side of campus for academic libraries. Jordan's 1970 book, *Tomorrow's Library*, is interesting as a poignant, pre-automation attempt to redress weaknesses inherent in technology of the Paper Library. With the Paper Library the user must make a journey to the library to consult the catalog and, short of a personal document delivery service, must visit the library to consult a document if it is, in fact, believed to be there.

Both the desire for proximity and the desire for reliable control fuel the popularity of departmental libraries in universities and neighborhood branches of public libraries. Administrators may worry that such decentralization is inefficient, wasteful, and an indulgence of users' inertia. But cost-benefit (in contrast to cost minimization) depends heavily on the amount of use. User-friendliness in library service includes providing service to (or close to) wherever the intended users are.

Opening Hours

The Paper Library and the collections in the Automated Library need human beings to use them and to supervise them. Computers can be left unattended. Paper Libraries cannot. Even with "extended" hours, few Paper Libraries are open twenty-four hours a day, seven days a week. Most Paper Libraries are closed, allowing neither access nor service, most of the time.

Already in Use

Because only one person at a time can use a single paper document, there is always a chance that the document you want is being used by someone at the time when you want it. The high cost of purchasing copies ahead of time, the difficulty of predicting demand, and the limited possibilities for making copies make this problem difficult to resolve. Further, because of the highly localized nature of paper and libraries' limited opening hours, most libraries facilitate the use of paper documents by permitting them to be borrowed, commonly for weeks at a time. The effects of lending documents are intensified because the demand for documents in every library is highly skewed: Some books are more popular than others and users tend to want the same documents. The combined effect of these features of the Paper Library is to reduce drastically the chances that the book you want will be available when you want it, even if the library is open. Study after study of academic libraries has indicated that the chance of finding a book that you want is around 60 percent, assuming that the library does own a copy. In other words, standard performance for a Paper Library is little better than a 50-50 chance that a document actually in the collection will be available when one looks for it. (See endnote 10).

Time

As paper-based systems become larger and more complex, their use becomes more and more time-consuming. The physical separation of catalog from text and of user from both catalog and text increase. Distance to and within the library become greater. It may be necessary to wait to use what someone else is using. Reasons multiply why the elapsed time from initial impulse to completed use can be expected to be more and more protracted.

Scale

The problems of the Paper Library are in part a problem of scale. There are diseconomies of scale because unit costs of filing, finding, and reshelving increase as collections become larger.

PIONEERS

We have illustrated our account of the problems of paper libraries by mentioning some examples of pioneering attempts to use other forms of information technology to remedy the limitations of paper. Apart from rather simple uses of microforms and, for a while, punched cards, these proposals had little direct impact. They and their inventors have been largely forgotten. Yet it is noteworthy that the features currently assumed of the Electronic Library of the twenty-first century—compact storage, ease of reproduction, remote access to full text, hypertext, equipment capable of sophisticated searching in complex indexing systems, and other thoroughly contemporary notions—were foreseen at least in outline by practical idealists by 1935, before the invention of electronic digital computers.

The ideas of these innovative bibliographers, documentalists, and librarians are of interest

for our purposes because they demonstrate that the significant weaknesses of the Paper Library were recognized, at least by the more perceptive observers. Further, they are encouraging because they indicate that steadfast attention to what is needed can provide a plausible basis for effective planning even before adequate new technology becomes a practical reality. If form should follow function, then concentration on the function should help us anticipate future forms.

Notes on chapter 2: The paper Library

1. Michael K. Buckland, "Library Materials: Paper, Microform, Database," *College and Research Libraries*, 49 (March 1988):117-22.

2. Walter Schuermeyer, "Mitteilungen über einige technische Neuerungen und Anwendungsmethoden fotografischer Hilfergeräte für das dokumentarische Arbeiten" [Communications concerning some technical innovations and applications techniques for photographic tools for documentary work] *I.I.D. Communicationes* 3 (1) (1936):cols. Schü. 1-10 (1936). (Paper presented at the 13th Documentation Conference, Copenhagen, 1935).

3. For the space needs of the paper library see Gore, Daniel, ed., *Farewell to Alexandria: Solutions to Space, Growth, and Performance Problems of Libraries*. (Westport, CT: Greenwood Press). Within this book, the paper by Claudia Schnorrig provides data for 1967-1974 on pages 6-21.

4. For Paul Otlet, see his *International Organization and Dissemination of Knowledge: Selected Essays*, trans. and ed. by W. Boyd Rayward (Amsterdam: Elsevier, 1990). For microfiche see pp. 87-95 and for the microphotographic library see pp. 204-13. Also see W. Boyd Rayward, *The Universe of Information: The Work of Paul Otlet for Documentation and International Organization*. FID Publ. 520. (Moscow: VINITI, 1976). Robert B. Goldschmidt and Paul Otlet, *La conservation et la diffusion internationale de la pensée: Le livre microphotique*, IIB publ. 144 (Brussels: International Institute for Bibliography, 1925). On p.6 Otlet and Goldschmidt note that electronic telecommunications had great potential for access to documents: "Que ne réserve la télévision après les découvertes récentes?"

5. Fritz Donker Duyvis' comment is on p. 53 of his "4th Report of the 'Commission internationale de la Classification Décimale'" *Documentation Universalis* 1/2 (1931): 46-54.

6. Fremont Rider, *The Scholar and the Future of the Research Library: A Problem and its Solution* (New York: Hadham Press, 1944) 99. See also Lodewyk Bendikson, "When Filing Cards Take the Place of Books," *Library Journal* 58, no. 20 (15 Nov.1933):911-13.

7. See, for example, Robert S. Casey and others, eds., *Punch cards: Their Application to Science and Industry*, 2d ed. (New York: Reinhold Publishing Co., 1958), 74-81.

8. Microfilm selectors were first described in English in E. Goldberg, "Methods of Photographic Registration," *British Journal of Photography* 79 (2 Sept.1932): 533-34. Michael K. Buckland, "Emanuel Goldberg, Electronic Document Retrieval, and Vannevar Bush's Memex," *Journal of the American Society for Information Science* 43 (May 1992): 284-94.

9. Robert T. Jordan, *Tomorrow's Library: Direct Access and Delivery* (New York: Bowker, 1970).

10. Michael K. Buckland, *Book Availability and the Library User* (New York: Pergamon,

1975). Paul Kantor, "Availability Analysis," *Journal of the American Society for Information Society* 27 (1976): 311-19.