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# Information Technology and Libraries

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# Information Technology and Libraries



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# MARC in Museums: Applicability of the Revised Visual Materials Format

**Esther Green Bierbaum**

*The machine-readable cataloging format for visual materials (MARC VM) was revised in January 1987 to facilitate the description of objects (3D) in large collections, such as museums. This research tested the applicability of the revision to museum collections by (1) mapping the MARC VM structure onto the minimum data needs of museum registration and (2) submitting the resulting records to museum registrars for evaluation. The records were found to be generally adequate for the description of objects in paper-based record systems in smaller museums. Collection management issues need to be addressed, however, before the VM format is subsumed in the integrated MARC format. This report is based in part on the report of a project investigating the application of the revised MARC visual materials format to museum registration records that was supported in part by the OCLC Library School Research Equipment Support Program (LSRES).*

Libraries and museums are alike in creating surrogate records to stand for the materials in their collections. Standardization of records is another matter. Thanks to the Library of Congress and its printed card program, library records have a long history of uniformity (at least for printed materials), while museum records have been largely local and idiosyncratic.[1] The library code for descriptive cataloging of nonprint media is more recent: the 1967 *Anglo-American Cataloging Rules* gave separate chapters to films, pictures, and phonorecords; the second edition (1978) of the *Anglo-American Cataloguing Rules* (*AACR2*) treated other formats, including three-dimensional objects (3D) in chapter 10. The lack of standardized cataloging for nonprint had not deterred libraries from collecting these media; it had, however, tended to keep the records out of the public catalog. But with *AACR2*, all bibliographic records could be normalized, and records for nonprint materials brought into the catalog to join the records for print, making library object collections accessible to patrons.[2]

*AACR2* deals with objects separately in chapter 10. However, machine-readable cataloging (MARC) attempts to subsume that medium into the visual materials (VM) format. A MARC format for 3D was late in developing, partly because the Library of Congress does not collect objects and partly because persons organizing object collections did not demand the format: museums, unlike archives, had not sought inclusion in national bibliographic databases. It was not until January 1987 and the fifteenth update to *USMARC Format for Bibliographic Data* (*UFBD*), which included an expansion and adaptation of the VM format, that MARC was deliberately made applicable to extensive object collections, such as those in museums.

The MARC Development Office now proposes an integrated MARC format. The proposal will mean that a single format—one set of protocols and system of fields and subfields—will be used to create the catalog records for all types of media, thus facilitating the description of nonprint materials and their integration into collections.[3,4] With such a radical change pending, it is none too soon to ask whether the enhanced VM format is really applicable to the records of museum object collections.

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## MUSEUM COLLECTIONS

Museums emphasize objects in their collections; hence they have been developing systems of records to control their collections since the time of the Renaissance "cabinets." Museum registration and cataloging procedures distribute the paper-based object records in a variety of files: location, donor, insurance, etc. For the most part, the record systems have been internal, created to enable museum staff to describe, organize, and exhibit the collections, but not designed to make the information available to visitors or other museums. This situation, however, is changing. As Abell-Seddon points out, "public interest and support for museums [will] depend increasingly on the availability of information about their collections."[5]

As noted, museums have pursued their registration procedures more independently and idiosyncratically than have libraries their cataloging information.[6] Proposals for imposing uniformity on museum records have fallen on stony ground; there being neither institutional incentive to share in the creation of records and exchange of data nor a mechanism, such as the libraries' bibliographic databases, to do so. Hence the MARC bibliographic data format, even if used in the libraries of large museums, has not been applied to the object collections. The perception of a fundamental incompatibility with museum object description and museum practice has presented a barrier not readily overcome.

## RESEARCH QUESTIONS

These basic differences between museum and library descriptive records raised two questions, the second generating a test of the first:

1. Does the revised VM format enhance the applicability of the MARC format to museum registration?

2. Are paper records generated from MARC input suitable for the records systems of small and medium-sized museums?

These are the questions addressed in this paper.

## METHODOLOGY

This study tested the utility of the VM format revision applied to museum objects, particularly as supported by the Online Catalog Library Center (OCLC) bibliographic utility. Because many museum registration systems are paper-based, the adequacy of the card format and its data were of primary interest. Hence, the utility of MARC for online collection management was not a primary focus of this investigation, although it ultimately loomed large as an issue for the integrated format.

The research proceeded as follows: (1) the minimum data elements required for a museum object record were mapped onto a structural analysis of the revised MARC VM format; (2) MARC data fields were selected for the museum data elements; (3) the online VM workform for MARC input was expanded into OCLC and full MARC versions; (4) decision sets were developed to orient librarians to museum procedures; (5) the documentation was tested by library practitioners, museum professionals, and advanced cataloging students; (6) OCLC records were produced from data input; and, finally, these records were submitted to randomly selected museum registrars for evaluation.

### MARC and Museum Registration

The first question, that of the applicability of the VM format update to museum objects, was addressed from the museum literature and the MARC format. The museum literature provided a set of minimum data requirements for museum records, that is, the data elements consistently listed as necessary for all objects in all types of museums.[7] The results of this analysis were compared with data derived from structured observations of actual registration procedures in various museums.[8] Table 1 demonstrates how the resulting sets of minimum and essential museum data were linked with candidate MARC fields: old (and continuing) MARC data fields; new fields and new meanings given old fields in the fifteenth *UFBD* update; and the preliminary data in technical reports from OCLC. Fields were selected from the candidates on the basis of their stability (consistency of content over time), familiarity, compatibility with OCLC, and direct applicability to the essential data required in a museum record.

Figure 1 lists the selected MARC variable fields. Of the fifteen fields identified for museum data, the revised VM format provided six (40 percent)—a significant contribution of new or amended fields. In this respect the

*Table 1. Minimum Data Elements in Museum Registration Records*

| Museum Data Elements | Candidate MARC Fields |
|---|---|
| 1. Collection I.D. number (registration/accession #; collection/catalog #) | *09x; *099 |
| 2. Name/s of object | *2XX (212, 240, 245, 246); *130; *65X; 754; *008/33 |
| 3. Name of maker, manufacturer, creator; place and time of making or discovery | *1xx; *245 #c; *260; *250; *6x0; 033; *518 |
| 4. Description, including materials and dimensions | *300; 340; 507; *530; 754/755; *773; 007 (non-3D) |
| 5. Acquisition: date, source, mode | 033; *518; *541 [non-printing] |
| 6. History/provenance | 045; *500; 503/504; *518; *561; 581, 583; 585; *59x |
| 7. Current location, conditions | 506; 540; 583; *773; *59x; 851; *910 (OCLC) |
| 8. Catalog data: subject, topic; associated references | 041; 043/522; 523; 545; *6x0; *650; 653 |

[NOTE: 15 Update fields in **bold**; essential/minimum data elements are underlined; * notes field supplied or supported by OCLC.]

VM revision did address the needs of museum registration records.

Because the VM workform available online is insufficiently detailed, it was necessary to construct expanded 3D workforms based on the MARC fields selected. Two versions resulted—first one for full MARC and then one for OCLC input.

Additionally, the investigator worked out a set of decision rules based on customary museum registration procedures, together with references to *AACR2* chapter 10, illustrating probable decision points in constructing registration records for objects. These decision sets proved useful in providing a museum focus for the librarians and advanced library science students who helped develop the documentation. (Copies of work forms and deci-

**Data Fields Content**

007/: Physical description codes. [Note: available for graphic and projected Visual Materials, not 3D. *Suggest expansion to include 3D.*]
*090: Local LCC-like call number. [Obsolete for MARC]
*099: Local call number; OCLC-defined; 2nd indicator, 9 = local.
**033**: Capture date and place; OCLC does not print or index.
*1xx: Established name and form of name of known "author"(creator/maker)
*245: Title/name and statement of responsibility; contains AACR2 general materials designation (GMD).
*260: Place, date of creation (manufacture), name of maker (manufacturer). [Note: May be omitted for naturally occurring objects.]
*300: Physical description; #a may be specific materials designation.
*500: General note; includes title information.
***518**: Date and place of capture; OCLC prints as note.
***541**: Immediate source of acquisition; OCLC *does not print*.
***561**: Provenance note (i.e., history prior to acquisition); OCLC prints but does not index.
*650: Topical catalog/indexing term.
***773:** Host item entry that might express collection, larger accession, etc. If first indicator is **0**, OCLC prints as *In* note, not heading.
**851:** Current location (if different from 561, provenance); OCLC does not supply.
*910: Local data; OCLC-supplied; prints at bottom left of record.

(**Note**: 15th Update fields in **bold**; * = field supplied or supported by OCLC)

*Figure 1. Candidate MARC Data Fields for Minimum Museum Data.*

sion sets are available on request from the author.)

Once the data work form and decision sets were in hand, persons from several libraries were asked to test the documentation by creating records for objects generously lent by the Iowa Historical Society. With the guidance of the decision sets and work forms, the librarians and advanced library science students experienced no more difficulty creating records for objects than they did for other media.

### Testing the MARC Records

After the documentation had been tested, the second question was addressed: determining the suitability of the resultant paper records to the museum setting.

The number of test sites was limited by cost considerations and by the small number of history or material culture museums that listed a registrar in the standard directory[9] and also appeared to have collections that matched the test objects for which records had been constructed. Ten museums were randomly selected from this population. Five registrars returned usable responses. Five other agencies known to the investigator were substituted for the nonresponding institutions; three responded. Of the eight museums, all but two maintain paper files; one shares a municipal mainframe for its in-house written software, and the other uses a personal computer database package. The exchange of information with other museums was common: 83 percent did so. In only one museum was the library linked with other libraries through a bibliographic utility; in another, there were plans to do so shortly.

Bibliographic records for the objects were input into the OCLC system in the customary fashion, with duplicate card sets produced. Then either the card sets themselves or photocopies of the sets were sent to the registrars at the test site museums, along with a cover letter explaining the purpose of the research and a single-page response form to record their evaluation of the MARC-based records. Registrars were asked to respond in terms of the applicability of the records to their sites and situations.

## RESULTS

Responses are recorded in figure 2, which is also a reproduction of the response form sent the registrars. The small population precludes statistical inferences; hence the results are reported in percentages of responses to a specific question and are discussed herewith in descriptive terms.

Overall, the registrars found the records to be adequate in many areas. For example, 87%

**These are the basic questions being asked: 1. Are these cards suitable for use in your registration/cataloging system? If not, 2. what adaptations or changes would make them suitable?**

**If yours is not a card registration system, we are also enclosing a copy of the computer screen record from which the cards were created so that you can compare the data with that in your system, and answer the questions on that basis.**

| Thank you for your responses and assistance! Please circle response, (Y)es or (N)o. | % Response to Each Question |
|---|---|
| 1. Is the object adequately named or identified? | Y 87 N 12 |
| 2. Is the description sufficient for staff catalog use? | Y 71 M 28 |
| Public use (if any)? | Y 50 N 50 |
| 3. Is the location of the object prominently enough displayed? | Y 66 N 33 |
| 4. Is there enough information about provenance; is provenance clearly delineated? | Y 83 N 16 |
| 5. Are the finding data prominently enough placed? | Y100 N 00 |
| 6. Is the donor record adequate? | Y 66 N 33 |
| 7. Would you include other topics/collections/areas under which to place the records? | Y 85 N 14 |
| 8. Do you exchange information about your objects with other museums? | Y 83 N 16 |
| 9. Does your museum library use an online cataloging utility? | Y 12 N 87 |
| 10. What suggestions can you offer to make this type of record more useful for museums such as yours? | |

*Figure 2. Registration Records Evaluation Form and Tabulation of Responses from Museums.*

found the naming or identification of the object (MARC field 245) to be adequate, suggesting that the title problem may not be insurmountable.[10] Several, however, questioned the *AACR2*-mandated term "realia" in the general materials designation (GMD). MARC note fields 518 and 561 were also successful: 100% of the respondents approved the placing of finding data, and 83% deemed provenance data (origin and context of the object) to be clear and sufficient. Location was placed in field 773 because OCLC does not print 851, current location. Printed as an *In* notation at the bottom of the record, it was less satisfactory (66% positive response.) Immediate source of acquisition, field 541, can be input in OCLC but not printed. Hence donor information was placed in a general note and was positively evaluated by 66% of the registrars. The description of objects is an exacting task in museum registrations; it was surprising that 71% felt the *AACR2* physical description parameters were satisfactory for staff use. Fifty percent, however, felt the public would not find the description adequate. The cataloging (i.e., in museum terms, the provision for subject-related files), placed in the 65X fields, was found insufficient by 85% of the registrars. This finding is not surprising inasmuch as museum cataloging practice is highly localized, dependent upon the mission of the museum and the purpose of its collections.

Two respondents noted that the records, despite shortcomings, would be appropriate for quick staff reference. Marginalia, responses to "suggestions" in question 10, and the tabulated data indicate a need for record changes or additions:

- enhancement with *data labels*;
- more fully developed *provenance data*;
- more extensive *physical description data*;
- extended *location and access data*; and
- more complete *donor and valuation data*.

## EVALUATION

### General Observations

This research has not been the only MARC-based museum registration project: a consortium of medical museums is planning an OCLC-based union catalog; the Museum Computer Network (MCN) and the Syracuse University Art Collection evaluated MARC[11]; and the National Museum of American Art, among other institutions, has investigated specific aspects of the MARC format. Many of the preliminary results and conclusions support or reflect ours. However, the present project—as far as we can determine— is the only one to examine and evaluate the changes in the MARC VM format, its support by a bibliographic utility, and the acceptance of the resulting card records by museum professionals.

The responses indicate that the USMARC VM format used for bibliographic and registration records could, indeed, be applicable to the catalog and registration records of a small, paper-based general history or material culture museum. Local modifications in the printed record output can increase the suitability of the records for particular institutions, as is true with libraries.

However, more attention should be directed to the needs of museum registration in a paper environment because the print and library orientation of *AACR2* is reflected in records generated from MARC input. For example, the inclusion of the general materials designation (GMD) for nonprint materials means that most of the collection records in a natural history or science museum will be graced with a nondiscriminating "[realia]." This sort of datum obscures the potentially most useful feature of MARC: the museum's use of a bibliographic utility both to catalog its library and to register and catalog its object collections. This issue will not go away with the integrated format. A solution might be the provision for non-*a* (i.e., non-*AACR2*) input in Leader 18, Description code: perhaps an *i* (ISBD) input under museum-based standards. Prospects for the museum equivalent of *AACR2* are, however, not bright.

We look now in more detail at the USMARC VM format, then at its support by OCLC, and lastly make recommendations based upon these evaluations.

### USMARC Visual Materials (VM) Format Revision

The VM revision adequately expresses the minimum museum data fields. Moreover, as table 1 and figure 1 indicate, beyond the control and fixed fields that establish the 3D format, the revision changes directly resulted in enhancements to the physical description (e.g., 340, medium); expansion of accession information (033/518, date and place of capture/finding; 541, immediate source of acquisition; and 561, provenance); better recording of location (851); and limitations on access (506, restrictions on access; 540, terms of use and reproduction; and 583, copy-specific actions). Hence, cards produced from the full MARC format, after careful consideration of access points for the local museum's needs, should fulfill most of the requirements of a paper-based registration and catalog system.

As a practical matter, however, delineating and documenting such complex issues as provenance, valuation and insurance, and donors and restrictions extend the MARC-based records beyond the reasonable bounds of one or two cards per heading. In paper-based systems, such voluminous data, to which the public is not privy, are usually maintained in a separate paper or microfilm file keyed to the accession number of the object. These data can, of course, be accommodated in online systems—albeit at the risk of spilling over into multiple screens—and through the electronic equivalent of the file drawers created for restricted information.

In fact, we are here up against what is for many museums the chief drawback of the revised MARC VM format: in order to exploit its data carrying possibilities fully—for example, indexing and retrieving on such fields as location, donor, type of object, or date of creation—the registrar virtually is required to have an online object cataloging system. That the online system also overcomes the great challenge of paper-based object registration records—namely, the sheer number generated when records are created on an item-by-item basis—is an argument for computerization, not MARC format.

There are partial solutions available, however. The linking fields of the VM format make it flexible enough to permit the entry of a collection as a single item and still indicate the type and extent of the separate elements. In the case of large collections of small individual items, the composite group can be treated as an accession and the separate items as members of the whole; the document collection is a useful analogy. Again, the records of the separate items can be carried in paper files offline (but linked to the larger collection by accession number), or in special finding aids, the nature and availability of which appear in the MARC record.

Such linking facilities may, in fact, be an answer to the museum community's major criticism of the MARC format: its perceived lack of collection management utility. Collection management rather than object description and information access was from the beginning the goal and concern of museum computerization projects.[12] Hence, the manipulation and collation of internal data, however idiosyncratically ordered, has had a higher precedence in museums than the creation of records according to some external standard.[13] Therefore, before the integrated MARC format is finally adopted, museum collection management needs should be given further consideration, with, for example, the addition of subfields to facilitate such collection management tasks as maintaining donor files, tracking exhibit locations, and documenting valuation, appraisal, and insurance.

In summary, the increased options and provision for such information as exhibit history and processing actions make the revised MARC VM format more functional than formerly for larger museum collections, particularly in the online environment. However, museums creating paper records from MARC input may not be able fully to exploit the VM revision because of the physical limitations on data-bearing imposed by the card format. Libraries, unburdened by museum collection management needs, should find the revision indispensable in creating an omnimedia catalog.

## OCLC VM (Media) Format

OCLC has several fields that can be particularly useful for object collections. The retention of 090 (now obsolete in MARC) as a local Library of Congress Classification-like (LCC) call number and the option of 099 for local call number are directly applicable to the recording of the accession number, or the accession number *and* catalog number if the museum maintains the dual identification system. (There is provision for the accession number in 541, immediate source of acquisition, subfield #e; however, it does not print and in this subfield position cannot serve as the primary key to the record.) The OCLC-supplied 910, for local data, can also be used for specialized data such as location within the collection, loan history, etc.

On the other hand, OCLC has decided not to support, print, or index some of the other fields made available to museums in the fifteenth update of MARC: 340, medium, is one; 541, immediate source of acquisition, is another. Current location, 851, is valuable information in many museums, and would be especially useful in an online system to reflect changing object locations. (This field is scheduled to become obsolete.) In natural history collections, 754, taxonomic identification, is a necessity.

Still, of the museum data fields judged essential, only 033, capture date and place, and 851, current location, are not supported by OCLC in some manner. Hence, the OCLC MARC format will support museum paper (card) records. Additionally, there are ways to get around most of the restrictions placed on record construction by the absence of the new fields; the general note is the most likely candidate field. Having the fields available, however, is more satisfactory than having to overcome their lack.

**Recommendations**

With a view to increasing and enhancing the utilization of online bibliographic utilities by museum collections, the investigator and other participants in this project offer the following suggestions for MARC records in the VM format now, and later in the integrated format:

1. *Work form*: Expand the media work form; its present configuration is inadequate.

2. *Record level*: Establish a non-*a* level, full (I-level) record that is ISBD-compatible, and in basic conformity with *AACR2* chapter 10, but that overrides some of the more book-oriented provisions of chapter 10, such as [GMD = *realia*] and the publication-oriented structures in the imprint field.

3. *MARC VM revision*: Support the MARC fields provided in the revision: 033, 340, 506, 507, 540, 583, 754, 851.

4. *Nonprinting fields*: Consider printing a field such as 541, immediate source of acquisition, which contains useful—and confidential—information (e.g., cost and donor identity). Online systems can deal with restricted data through two levels of display, one for the public, another and fuller record for staff use. For card-based systems, the printing of 541 and similarly suppressed data would simply mean that records are automatically created for donor and similarly privileged files without the necessity of manually creating a separate record or ordering extra main entry cards, the other possible strategy.

**THE FUTURE**

With the approaching implementation of the integrated format, one hopes that the particular needs of 3D collections—whether museum-based or not—will not be overlooked in the bibliographic shuffle. As indicated by the responses to the question regarding information-sharing between museums (figure 2, question 9), the exchange of data is now more prevalent in museums collections; hence, the accessibility of records is of increasing importance.

The MARC format is not widely regarded in museum circles as an answer to a prayer.[14] The attitude stems in part from the historical difference in purpose and design between museum registration and library cataloging. Constraints on collection management functions imposed by the library orientation of the format and the need further to expand data fields to accommodate museum data are also cited as negative factors.

The constraints imposed in the paper environment on the amount of data that can be crammed on a card are also problematical. However, card files, augmented by other files, are serving smaller museums effectively; cards produced by bibliographic utilities from MARC input are not a great departure in practice. Indeed, the members of the medical museum consortium have both paper and online catalogs and are planning to input records in the OCLC database, with a union catalog as an end product.

As to collection management: whether any single record in a single database can be adapted to all museum functions is a question worth exploring further. With the accession number as the linking data element, data files for donors, current locations, insurance, etc., can be linked relationally to the registration file, freeing the descriptive record from carrying restricted and suppressed information. The Museum Computer Network (MCN) explored some of these questions with the Syracuse University Art Collection[15]; it is also sponsoring work on the International Standards Organization (ISO) standard 2709, which defines the data transmission framework of the Common Communication Format (CCF).[16]

With the publication of other MARC-based projects and research, one hopes the format will be more widely tested by the museum community itself. Such testing may result in acceptance of an externally standardized, universal format for the storage and transmission of information about objects in museum collections. At the least, museums might be persuaded of the feasiblity of retaining internal registration and catalog records in a non-MARC format while linking them to MARC records in a bibliographic database, thus providing remote access to collection information.

Remote access to the records of museum collections and their unique holdings is an issue for the community at large, not just museum personnel and scholars who study artifacts. In the same way that records for audiovisual materials have enlarged the information possibilities in print-oriented bibliographic databases, so the addition of artifactual records from nonlibrary resources will enhance the range of information available to everyone. A subject heading such as "Frontier and pioneer life" might then index books, graphics, sight and sound, computer files, and objects—words, pictures, and *things*—to provide a searcher with an abundance of varied resources. The priceless assets of our museum collections must not be overlooked in building the national database of information resources. With cooperation and negotiation from both communities, the MARC format may well prove to be the key.

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**Statement of Ownership and Management**

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# Special Section: Digital Imagery, Preservation, and Access

*Editor's Note:* Information Technology and Libraries *is pleased to present two reports published originally by the Commission on Preservation and Access (CPA) earlier this year.* ITAL *reprints these reports for a couple of reasons. Perhaps the most important reason is that we want to disseminate, as broadly as possible, important material on information technology. The Commission, of necessity, limits the distribution of its publications. These reports are of the quality and scope that* ITAL *seeks for publication. Because the documents meet our standards and criteria and because of the limited distribution and key importance, we felt that it was important for us to reprint them.*

*Another reason for* ITAL *to include these reports on its pages is to remind our readers that we are concerned with more than bits and bytes and that information and library technology apply to all kinds of libraries and all aspects of librarianship. The reports, dealing with digital imagery and the prospect of universal access not possible with microforms, will be of special interest to many if not all* ITAL *readers, many of whom have expertise in these subject areas.*

*Finally, it is important for* ITAL *readers to read both documents carefully and respond to the Commission, either as individuals or as interest groups. In discussions leading to the cooperative effort between the Commission and* ITAL, *we deemed it important to encourage and solicit expert comments.*

*The editorial board of* ITAL *would also like to hear from readers about the reaction to the appearance of these documents on our pages. Had you seen these documents before? Do you have comments that you would like to share with our readership, through letters to the editor, or do you have your own research to share through a scholarly article or a communication? We hope that this issue of* ITAL *will remind you that such research and writing are not only welcome, they are important to the work of others.*

## Image Formats for Preservation and Access

**Michael Lesk**

*The rapid growth and distribution of scholarly research in the middle and late twentieth century, the limited supply of old books and other paper-based materials, and the deterioration of items printed on acidic paper since the mid-1800s have meant that many libraries lack suitable copies of printed resources their users would like to read. For some time libraries have been converting books, journals, and newspapers to forms that are more stable, easier and cheaper to copy, and more compact. The most important such form has been microfilm, which is a safe, durable, and inexpensive preservation option. Digital imagery is now an attractive alternative, offering great long-term promise, and is rapidly becoming more accessible to libraries. This paper compares digital and microfilm imagery and emphasizes that making either kind of copy is preferable to leaving acidic paper to decay. The primary expense of salvaging a book is in the selection process and initial handling, while the cost of later conversion from one modern medium to another is comparatively small.*

In 1987 the Librarian of Glasgow University complained to me that he had never been sent the first edition of *Tristram Shandy* (1759-1767) to which the university had been entitled under eighteenth-century copyright deposit rules. Since it is a bit late to write to London and berate the Dodsley brothers, what should he do? What should any librarian needing an old book do? Two major problems confront a librarian seeking a pre-1900 book: durability and scarcity. A book printed from the mid-1800s on is probably made of acid paper, bound in a machine-made case, and very fragile. Even earlier books may be in bad shape since the chemical consequences of paper bleaching were not understood when it was first done around 1810, and by 1830 some paper was already deteriorating. Books made in the eighteenth century or before have more durable paper and binding, but the London stationers did not anticipate the number of U.S. libraries that would want copies of these books two hundred years later, and failed to order adequate press runs. Many nineteenth-century books, of course, are also in short supply as well as falling apart.

Paper conservation deals only with the physically deteriorating item, not the supply of copies. Today, most bulk deacidification is in experimental or pilot stages, while page-by-page deacidification is expensive. The alternative of publishing facsimile reprints, such as those made by Arno and Scolar presses, provides both durability and supply, but only the occasional title has an individual demand that will support a new press run. Thus, librarians have favored microfilming as a way of preserving books and other printed items. Microfilming transforms one or more books into a roll of photographic film that is considerably smaller than the original, and that is easy to copy and thus to distribute to other libraries. Microfilm has a very long life, but needs controlled environments. A machine is needed to read it, and many users dislike it.

Digital imagery, where books are scanned into computer storage, is a promising alternative process. Storing page images of books permits rapid transfer of books from library to library (much simpler and faster than copying microfilm). The images can be displayed or printed, much as film images, although with greater cost today. Additionally, digital imagery permits considerable reprocessing: adjustment of contrast, removal of stains, adjustment of image size, and so on. At present the handling of these images still requires special skills and equipment few libraries possess, but there is rapid technological progress in the design of disk drives, displays, and printing devices. Imaging technology will be within the reach of most libraries within a decade.

Digital imagery also may make possible instant reprints, and a new experiment at Cornell University employing very high speed and quality scanning/printing technology will be addressing the feasibility and cost of such an approach. Microfilming deals with preservation, but not with access beyond the library. Digital transmission, combined with workstations in users' offices and nearby printers, offers an opportunity to deliver preserved material in better ways and to more people. Ideally, we might even be able to pay for preservation with revenues derived from improved access.

## TURN THE PAGES ONCE

The practical message for the librarian is that the most expensive parts of most preservation activities are (1) selecting the materials to preserve and (2) turning the pages of the selected book for item-by-item chemical treatment, filming, or digitizing. Whether what is done at each page is to spray alkaline buffering solution, make a microfilm image, or digitally scan, the major cost is the time required to gain access to each page. Thus, each book should be handled only once. Chemical paper preservation done sheet by sheet is expensive, must be done on each copy, and does not help alleviate any scarcity of the book.

Bulk deacidification, which does not require page-turning, holds out the promise of lower-cost preservation, but also does not increase the number of copies, leaves the original item in its fragile state (except for experimental processes that claim to strengthen the paper), and is not yet at a full production stage. Microfilming and digital imagery, by contrast, make surrogates for the book that are inexpensive to copy. Moreover, conversion between microfilm and digital imagery is much less expensive than conversion to either form from paper.

## PRESERVATION ALTERNATIVES

### Chemical Deacidification

Bulk deacidification is promised for perhaps \$5 to \$10 per book. Unfortunately, most mass deacidification processes are currently in either experimental or pilot stages, and some processes involve potentially hazardous chemicals.* (For more information, see

"Technical Considerations in Choosing Mass Deacidification Processes," by Peter Sparks, May 1990, published by the Commission on Preservation and Access.) With the possible exception of a new British Library experimental process, deacidification merely arrests deterioration for a while; if the book was already fragile, it remains so. From a collaborative perspective, if there are ten copies of an old book scattered around U.S. research libraries, it is likely to be cheaper to film or scan the best available copy once and then reproduce it, than to deacidify all the copies—even in bulk. In addition, microfilming creates a copying master and a bibliographic entry that provide broad access to the information.

Deacidification also can be done on an item-by-item basis at individual libraries. The cost of page-by-page paper treatment, by spraying a chemical fog on the page, is more than the cost of copying, even for one copy. The costs of these more elaborate preservation techniques, which require disassembly and rebinding of each item, are basically prohibitive for books that do not have high value as artifacts. Paper preservation and individual book conservation, however, are the only technologies that preserve the original book itself. For books with particular intrinsic value to scholars (e.g., those whose size or format is significant, or those whose readers are concerned with the manufacture of books, paper, or type), the original copies are important. (For further discussion of issues related to books as artifacts, see the reports: "On the Preservation of Books and Documents in Original Form" and "Selection for Preservation of Research Library Materials"—both from the Commission on Preservation and Access.)

**Microfilm**

The process of microfilming a book costs about 10–15 cents per page, not including the cost of choosing the book to microfilm or paying overhead charges to some central organization. Microfilming normally involves producing a roll film master, even if the final version of the book will be on fiche. Microfiche are not considered a preservation format, but can be produced from preservation roll film as an access medium. Microfiche can provide random access to a particular frame faster than roll film, and fiche reading machines are cheaper than microfilm reading machines, which cost several hundred dollars. Fiche are clearly the medium of choice for a microform book catalog, for example. Unfortunately, many readers dislike both film and fiche.

Microfilm, a photographic process, makes a faithful copy of original printed material, including foxing, waterstaining, dark (browning) pages, unsightly borders due to page edges, and faded ink. The use of high-contrast film, which is standard, may help with the faded ink at the cost of aggravating discolorations, making it difficult to reproduce continuous-tone images. The photographic materials used for microfilm are very fine-grain and can reproduce the print quality of the original without serious loss (1,000 dots per inch). The process of preservation microfilming involves a series of quality control decisions and procedures that are executed throughout filming and developing of the exposed film. Quality monitoring, to determine the success of the quality control procedures, takes place during inspection of the film after it is developed. Both duplication of microfilm and conversion of microfilm to microfiche can be done fully automatically (as can the reprinting from microfilm to paper if desired). Preservation microfilming (or other preservation techniques) must be done more carefully than work intended for only transitory use; thus costs for other kinds of filming or scanning may not be directly comparable.

Roll microfilm comes in a variety of formats. The most common roll film formats are 16mm cartridge and 35mm roll, although preservation microfilming is done primarily in 35mm roll format. Many librarians prefer 35mm film, which provides a larger image readable with less expensive optics, and also offers a better quality source for reprinting. The larger size 35mm film is also more resistant to damage from oxidation, scratching, abrasion, mold, or fungus, since the same amount of damage will obscure a smaller fraction of the page on the larger film. In general, 16mm cartridges can be handled faster auto-

*Some libraries further worry that the chemical odor which attaches to deacidified books will be objectionable to their patrons. Good ventilation, unfortunately, is sometimes in conflict with cheap air-conditioning or with fire safety.

matically and take less space to store, but they also cost more. Progress in photographic technology (such as the development of finer grain films) is improving the images we can make on 16mm film, however.

Although developments are occurring in the use of color microfilm for preservation purposes, nearly all filming or scanning currently is done in high-contrast black and white. The practical limits of this large-scale preservation work mean that books with color content, shaded gray scale illustration, or extremely fine printed detail remain, until color filming or better digital technology is available, prime candidates for preservation in their original form.

**Digital Imagery**

The cost of digitizing a set of images from a book is within a comparable range to microfilming. As in the case of microfilming, the primary cost is again handling. For example, a thirty page/minute 300 dots per inch (dpi) scanner itself costs $13,000; the major cost is obviously not the amortized scanner cost but the cost of the operator. This speed is for sheet-fed operation, with an eighty-page stacker, so that attention is required every few minutes. Unfortunately, for old books it is often impossible to process them quickly through a stacker, since the pages are delicate and must be turned carefully. This means substantially higher operator costs on old material or on material that cannot be cut into separate sheets.

The National Library of Medicine has estimated costs based on experiments with a prototype document conversion system developed in-house. This system is designed for bound volumes, fragile paper, and face-up capture. The experiments were conducted with a representative sample of the NLM's collection. The system is a distributed, networked, family of AT-based workstations that do document capture, enhancement, compression, quality control (QC) and final storage on WORM digital optical disks. Conversion costs were estimated for a variety of input conditions and in one typical configuration ranged between 13 and 28 cents per page. For details, see G. R. Thoma, et al., *Document Preservation by Electronic Imaging*, v. I-III, Technical Report of the Lister Hill National Center for Biomedical Communications, NLM, (Bethesda, Md., April 1989)—available from NTIS.

Digital scanning can be done at a variety of scan densities. Roughly speaking, 150 dpi is the lowest scanning density that will yield basically acceptable pages for small print. More commonly, scanning is done at 200, 300 or 400 dpi; higher densities are becoming available. Three hundred dpi corresponds to the resolution of most laser printers and is basically able to produce quite acceptable copies, although not quite up to typographic quality (normally considered to start at 1,000 dpi). Higher definition is possible but adds considerably to storage cost; for example, doubling the number of dots per inch produces four times as many bits per page.

A 300 dpi 8.5 by 11-inch page is about 1 Mbyte uncompressed, and if filled with dense print as in some journal issues will compress to perhaps 0.2 Mbyte (remember 1 byte contains 8 bits). More normal books (e.g., 5 by 9-inch pages) would be 0.5 Mbyte uncompressed and would compress to under 0.1 Mbyte. Since a typical book is 300 pages long, if uncompressed, six books would fit in a gigabyte (one gigabyte, or Gbyte, is equal to 1,000 Mbytes). If compressed, perhaps 30 books would fit in a gigabyte. If 200 dpi rather than 300 dpi scanning were used, these numbers would become 12 books per gigabyte uncompressed and 45 books per gigabyte compressed (at higher scanning density, data compression is more efficient).

**ASCII (Non-image)**

In contrast to all procedures that preserve the page or the image of the page are techniques for obtaining a computer-readable version of the text. These produce an ASCII file of the characters on the pages. The words are preserved, but not their exact format and appearance. With an ASCII file, it is possible to search for names, specific terms, phrases or, with suitable software, to do various kinds of subject searches. Information can be located much more quickly using computer searches than by flipping through the book, and the thoroughness of a search using a complete text file can be much more complete than conventional indexes. For much of the material considered for preservation, moreover, there is relatively little indexing available; few of our bibliographic secondary services existed in the nineteenth century. ASCII storage is also much more compact; a page of text that will use a few hundred Kbytes in image form will contain only one to two thousand bytes of ASCII, or 1/100th of the space. Other advantages of ASCII storage include the ability to reformat and reprint whole or partial documents easily; the ability to extract quotations or other subsections of the documents and include them in newer papers*; and the ability to mechanically compare texts. Editing texts for later publication also needs ASCII rather than image storage. More ambitious applications such as feeding the texts to speech synthesizers to be read aloud are also possible; perhaps someday we will even be able to do machine translation into other languages.

ASCII text also can be displayed on a wider variety of equipment and on cheaper equipment, than can images (the "glass teletype" 80 x 24 character screen display costs perhaps $100 while a quality 1000 x 1000 pixel display is currently over $1,000). Even more important is that ASCII displays can be formatted for the particular screen size or program environment preferred by the user; there is less that can be done to rearrange images for display or printing on different devices. The image quality shown does not reflect any fading or discoloration of the original, but merely the quality of the display system. Unfortunately, display systems using ASCII often provide lower quality than that of an image display system because typographic information is sometimes discarded as the material is converted. Various groups are working on standards for the representation of typographic markup, usually using the SGML format (standard generalized markup language), which will alleviate this problem once in common use. Saving the markup is also important for applications such as reprinting.

Unfortunately, despite many advertisements of OCR (optical character recognition) programs, it is still rather difficult to go from image to character representation. The programs now on the market are adequately fast (10–50 characters per second) for a job that is relatively easy to read (e.g., clear, uniform text), but they are not accurate or versatile enough to handle non-standard type and faded images that are characteristic of old books. Large text conversion projects are still often rekeying, finding this as economical as OCR followed by enough proofreading to maintain accuracy. OCR may well arrive first as a way of doing indexing, where recognizing half the words may well be useful.

## STORAGE CONSIDERATIONS

Although digital storage media are being improved, the length of time for safe storage remains well below that for microfilm when stored under appropriate conditions. Ten to twenty years are the figures quoted for most digital optical storage media, with some mention of 100 years. This compares with claims of 500 years of lifetime for microfilm. Even if digital storage media's lifetime is extended, the means of access to the stored information remains the most serious problem. This is because the technology to read the media often becomes obsolete. Who today has a reader for punched cards, 7-track magnetic tape, or 8-inch floppy disks? A librarian who commits to digital storage must expect to have to copy the data regularly ("refresh" the data) until the technology settles down. Fortunately, the cost of doing so is steadily declining.

In addition, digital storage at this time remains relatively expensive. Remember that we are talking about a few dozen books per gigabyte (1,000 Mbytes). The costs of some kinds of digital storage can be reduced by "demounting"—or moving—them to less expensive storage. However, note that this requires an operator step to access the data. Computer media also have several other problems that are serious for librarians. For example, like books, they often require air-conditioned storage. In addition, it is not possible to tell by visual inspection whether computer media have been ruined.

The possibilities for digital storage, as of April 1990, include:

1. Magnetic disk, usually of the Winchester variety. The current price is roughly $4,000 per gigabyte. Access is fast and all material is online. Either software error or hardware error (such as a disk head crash

*Although it may seem that a large nineteenth century library in machine-readable form could raise undergraduate plagiarism to an entirely new level, it would also be easier to check mechanically for such abuses.

when the reading head touches the disk surface) can destroy the information on a Winchester disk. Thus it is necessary to maintain a copy on some other medium, but the other medium is usually refreshed regularly and does not need to be permanent. The price of magnetic disks has been dropping by almost half each year or so, and the warranty periods doubling. Considerable advances in capacity are still expected: the advent of perpendicular magnetic recording is expected to increase capacity another factor of ten. The equipment is running continuously and some skilled attention is needed.

2. Optical WORM (write-once-read-many) disk. A typical drive costs $10,000 to $20,000 and holds two to six gigabytes per removable cartridge. The cartridge is bulky; typically 12-inch diameter platters are used, mounted in housings roughly an inch thick. They can be dismounted, cost about $200, and are reasonably permanent, with 30- to 100-year lifetimes quoted by the manufacturers. Several different manufacturers produce optical WORM drives, and their cartridge formats are not compatible. It is not clear who is going to win in the marketplace; among the vendors are Maxtor, LMSI and Sony. Technological obsolescence of any specific drive is likely to be far more rapid than physical deterioration. There are "jukeboxes" available that can store more than 100 gigabytes, ranging up to more than 300 gigabytes in one jukebox. The cost of a jukebox starts at $40,000, but larger ones are more likely to be $100,000 or more. These WORM jukeboxes are mechanically very complex devices, and it is not clear whether they will be successful in the long run.

3. Digital videotape. One vendor, Exabyte, has adapted 8mm videotape into a digital storage medium. The cartridges cost about $6 and store two gigabytes. To access them, of course, the data must be copied back onto a magnetic disk of some sort. There is only one vendor of the systems, it is not clear whether the format will survive, and it is not very durable.* Thus recopying regularly will be necessary. The drive costs about $5,000 (with interfaces, software, etc.; if you can do your own mounting and driver coding, the hardware is about $3,000). It takes about two hours to read through a full cartridge.

4. Digital audiotape (DAT). Several vendors have announced DAT as a computer storage device. The cartridges hold about one gigabyte, are even smaller than the 8mm video cartridges (DAT uses 4mm tape), and the drives cost about $3,600. Again, the format is experimental and it is not clear which vendors' devices will survive. It also is not clear what the lifetime of the cartridges is, but it is unlikely to be permanent and will probably be shorter than 8mm videotape, because the tape is kept under higher tension. Access is faster than on 8mm video cartridge, another consequence of the higher tension of the cartridge. This format is brand new and not yet suitable for use by those who are not interested in testing new devices. Jukeboxes for DAT tape have been announced and are likely to remain in production because of the demand for them in the audio market. At present DAT cartridges cost $20, but this is certain to come down quickly as the format becomes common for consumer audio entertainment.

5. Conventional 9-track, 1/2-inch magnetic tape. The physical mechanisms needed to handle such tape are fairly expensive; a sample high-performance drive is priced at $16,000. A reel of tape costs $20 and will hold .15 gigabyte, so the cost is about $120 per gigabyte. Tapes must have air-conditioned storage and must be copied every few years, but at least the format is well established and will survive. The durability is better than 8mm video or DAT.

6. CD-ROM. The CD was designed as a volume production medium but today a single disk can be made for about $1,000. It stores a little over 0.5 gigabyte, and there is now agreement on the format of CD-ROM (the so-called "High Sierra" standard). CD-ROM is long-lived, the reader costs about $500, and the format is in fairly wide use for PC data base access. Unfortunately most vendors package specific search software with the data, often with frustrating limitations (designed partly to enforce the copyright law), and it is rare to find the medium used just for storage. Interfaces to large machines and workstations are rare. It is an attractive me-

*The only experiment I know about is one I did myself. Two Exabyte cartridges placed on my car dashboard in June were unreadable in September (New Jersey climate).

dium for distribution purposes, however, since the cost of many disks is low (a few dollars per disk). The manufacturing process is not suitable for small-scale work, and thus libraries cannot press such disks themselves; the work must be sent out to a company specializing in CD-ROM production. These companies can perform a variety of services, from the relatively simple tasks of mastering and manufacturing a disk, to the more complex work of designing software and retrieval systems for the information provider. Companies include Silver Platter, Meridian Data Systems, Philips-Dupont Optical, and many others.

7. Magneto-optical erasable disk. These disks combine magnetic and optical technology to achieve long life, demountable cartridges, and random access. The capacities are now limited to about 0.6 gigabyte per cartridge (using both sides). Drives cost $5,000 and the cartridges are $250 each, but likely to become cheaper. Capacities are increasing steadily, and jukeboxes are available. It is not clear which companies or formats will survive.

8. Imperial Chemical Industries (United Kingdom) has announced "digital paper," a high-density WORM medium using mylar film that can be provided in various shapes and forms. Extremely high density is promised (double that of CD-ROM) but the entire technology is still experimental, more so than any of the alternatives above. No costs are known. Below are the cost numbers more directly, with assumptions of: (a) 3-year life (2-year for magneto-optical), based on expected obsolescence of equipment; and (b) $10 charge to recopy, required once per year per reel for the non-durable media. Note that these prices are per gigabyte and should be divided by ten or so to represent the cost per book. I assumed that only ten copies are made of a CD-ROM; this technology is much more

| Medium | Basic Cst./ Gbyte | Copying | Total Cst./ Gbyte-yr. |
|---|---|---|---|
| Magnetic disk | $4,000 | $ 0 | $1,300 |
| WORM | 75 | 0 | 25 |
| Digital videotape | 3 | 5 | 6 |
| DAT | 20 | 10 | 17 |
| 9-track tape | 120 | 60 | 180 |
| CD-ROM | 2,000 | 0 | 70 |
| Magneto-optical | 400 | 0 | 200 |

appropriate for larger numbers of copies, but it is not realistic to think that there will be much demand for most of these old books.

Today digital videotape is clearly cheapest if you can deal with the copying requirements; WORM is cheapest if you cannot. Remember that a gigabyte can hold ten books: thus these costs are comparable to the costs of holding a book. The digital videotape and DAT cartridges are substantially smaller than a book, so that they actually represent cheaper storage than on paper. WORM cartridges are fairly bulky and are probably comparable in storage cost to keeping the same material on paper: the cartridge is larger and harder to handle than a book, but it will hold thirty books or so. For all the storage methods above except Winchester disk, the data are assumed to be held "offline" (meaning that an operator step may be required to mount them for access). Jukeboxes are an alternative to operators. Whether to use online storage in a jukebox or offline storage will depend on the expected use and costs in particular situations.

In summary, it is difficult for a librarian today to install a digital image library. It requires both expertise in computer systems integration and a substantial amount of money—perhaps $100,000 in capital equipment. Remember you need some equipment for people to use any of these media. There are certainly some libraries doing such work (e.g., the National Agricultural Library and the National Library of Medicine) but it is not something to be bought off the shelf or with small resources. But if we assume that the expertise and the capital investment are available, digital image storage is not more expensive than microfilm. Like microfilm, it saves space compared to paper, and digital technology is improving rapidly. Thus digital storage is an appropriate experiment today for the larger libraries, or for groups of libraries.

## CONVERSION CONSIDERATIONS

Although the costs of filming and digital scanning (to bitmapped images) are currently within comparable ranges (i.e., filming between 10–15 cents per page; scanning 13–28 cents per page), rekeying the material costs perhaps $1 to $2 or more per page. This is thus an order of magnitude more expensive than any kind of image capture today. On the other hand, rekeying for ASCII access permits rapid search for any particular item within the text. It is valuable to have machine-readable text for old material, but it is not likely to be justifiable for any book for which a new edition is not economically sensible. For any illustrated book, ASCII conversion still leaves behind the question of what to do with the pictorial or graphical material.

Most users of old material will probably be content with the text, but there are some disciplines that need more. As one example, microfilm and digital imagery can cater to people studying aspects of typography, layout, and other aspects of the appearance of old books. Nothing but physical preservation will suffice for those who study papermaking, binding and so on. However, such users are relatively few in number compared with those who want to read the texts. There is a question as to whether even those who wish to read the texts will prefer images of pages to ASCII; more research is needed on this point. In general ASCII storage preserves the words in the text only, not their appearance, and some users express a need for the appearance.

Digital scanning offers flexibility in processing the images: contrast can be adjusted, and image enhancement techniques can be applied either as the image is scanned or as part of a post-processing phase. Some techniques (e.g., thresholding to adjust for faint printing) need to be performed as part of the archiving process, since they require extra information such as gray level, which may be expensive to store indefinitely; but other techniques can be done later. This is particularly significant, since the most important post-processing technique would be optical character recognition, and it is not yet practical. If OCR technology makes advances, and it becomes possible to process the digital images and convert them to ASCII, then it would be possible to search the content of the books and to reformat or otherwise re-use the material at a much lower cost than rekeying.

Given that digital technology has not yet settled down to the point where libraries can routinely buy document imaging systems off the shelf for prices they can afford, what might a librarian do? (Sticking one's head in the sand is not an acceptable option.) Perhaps most important is to note that once the problem of turning each page is taken care of, the remaining data conversion problems are relatively cheap. To go from microfilm to digital image, in particular, currently can be done at a rate of 2 seconds per image with a Mekel M400 scanner costing $50,000. Operator intervention is needed only every roll or cartridge (that is, perhaps once an hour). This machine is not yet at a state where personnel unskilled in computers can install it, but the operator may be relatively inexperienced. Assuming that we amortized the machine over 5,000 working hours (about 2.5 years of one shift), it would cost perhaps $20 per hour (counting interest, operators, etc.) to run; since in an hour it can do 1,000 to 2,000 frames easily, the cost per frame to convert from microfilm to digital should be perhaps 1 to 2 cents. Compared to the 13-28 cent per page cost of scanning, this means that using microfilm is a reasonable intermediate step to getting digital imagery.

Converting from digital image to microfilm is also possible, although most computer output microfilm recorders are not designed to do graphic images at high speed. Going to paper from both microfilm and digital image is relatively straightforward, and very high speed printers are being developed. It is not clear what the cost will be; the quality will be limited only by the original image, whether scanned or filmed.

The balance between cooperation and individuality must also be struck. Deacidifying a book does not provide more access to that book outside of the library in which the copy is preserved. However, bulk deacidification may force a transition to cooperative work, since the demands and hazards of the bulk chemical processes make them inappropriate for use on a small scale. Microfilming or scanning are likely to be done as part of some group project, since small libraries, in particular, are not likely to have the funds or expertise to provide and use the most advanced equipment.

## TRANSMISSION CONSIDERATIONS

If one library has a copy of a book, how can it be sent to another library? Obviously, the physical copy can be loaned, but this deprives the sending library of the book. Microfilm can be duplicated relatively economically (about $10 per reel). It must still, however, be mailed. The combination of duplication and mailing time means that the recipient may wait weeks for a copy. Digital storage has an edge here. In addition to commercial telecommunications networks, such as AT&T's future ISDN service, the United States is developing a nationwide digital network running in the megabit* per second range, with experiments in the gigabits* per second range. Today typical transmission speeds are limited by the end equipment to perhaps 100,000 bytes/second. At this rate, it takes about a thousand seconds (i.e., twenty minutes) to send a book anywhere on the net as digital page images. At present, connection to the high-speed networks (speeds of 1.5 Mbit*) tends to be charged at a flat fee, in the neighborhood of $50,000 to $100,000 per year; at sufficiently high volume the cost of any individual transmission is negligible. The major research universities are already connected at high speeds.

Low-use institutions are more likely candidates for some kind of lower bit* rate, or dial-up, or temporary access. Today this is relatively difficult to arrange at reasonable speed. Service at 9600 baud is quite slow for transmitting whole books as images (it would take a day; my best guess is a cost of $250 or so). If ISDN provides 64 Kbits/sec* service for $10 per hour transmitting 0.1 gigabyte, one compressed book would cost $50 or so to transmit in image format. Of course, many users might want only portions of a book.

Digital transmission around universities is becoming more and more common, and of course computers are now almost ubiquitous and getting more and more powerful, so that with digital storage it will become possible to send copies directly to the offices of many users. Relatively few people, by contrast, have their own microfilm machines. Laser printers capable of printing pages from either image or ASCII storage are also becoming common, offering the possibility of "print on demand" services both centrally, using high speed machines now under development, and remotely, using the user's own equipment. Many office copier machines now being designed, for example, are scanners followed by printers, and could be used for reprinting from digital images. A variety of experiments are being developed to use digital networks to provide current material, and libraries should seek to join with these efforts, using the same networks to provide material that has been preserved.

## CONCLUSIONS

Some disciplines that rely highly on images and on the book as an artifact in their research will prefer image storage. In the long run, however, scholars are likely to prefer ASCII storage of text for many of their informational needs. ASCII storage permits searching, copying, and duplicating in much more powerful ways than any image storage. Online catalogs, for example, are replacing microfiche catalogs throughout the United Kingdom, and we see no libraries moving towards fiche for catalogs (unless perhaps they are moving from cards). At present, however, it is too expensive to get to full ASCII; and, for most of the relatively rarely used material considered for preservation, it is likely to remain too expensive to use ASCII until optical character recognition becomes feasible.

Digital image storage is practical today, but requires considerable expertise and capital investment on the part of a library trying to do it. However, digital technology is improving very rapidly, much more so than filming. Certainly investment and research should be directed toward digital storage, particularly toward the development of systems that can be used by ordinary libraries. Microfilm is in a similar price range as digital imagery, but is today more accessible to the conventional research library. Because microfilm to digital image conversion is going to be relatively straightforward, and the primary cost of either microfilming or digital scanning is in selecting the book, handling it, and turning the pages, librarians should use either method as they can manage, expecting to convert to digital form over the next decade. Postponing microfilming because digital is coming is only likely to be frustrating and allow further deterioration of important books. ■■

*I apologize for the conventions by which storage for computer systems is quoted in bytes while communications systems are measured in bits/second. Remember than 8 bits make 1 byte, although the existence of padding in modems means that 10 transmitted bits make one byte at low speeds.

# Preservation and Access Technology: The Relationship between Digital and Other Media Conversion Processes: A Structured Glossary of Technical Terms

**M. Stuart Lynn and The Technology Assessment Advisory Committee to the Commission on Preservation and Access**

*This document is offered as a structured glossary of terms associated with the technologies of document* preservation, *with particular emphasis on document* media conversion *technologies (often called "reformatting technologies"),*[1] *and even more particularly on the use of* digital computer *technologies. The Glossary also considers technologies associated with access to such preserved documents. Such a glossary is intended for communication among people of different professional backgrounds, especially since in recent years there has been a proliferation of such technologies and associated technical terms, technologies and terms that cut across many disciplines.*

*The use of digital technologies, however, has implications for libraries that extend far beyond the boundaries of preservation and of access to preserved materials. Some of these implications are summarized in the following discussion of "The Impact of Digital Technologies," and are indicated throughout the Glossary. Thus this Glossary may serve a wider purpose than the title itself would imply.*

## THE IMPACT OF DIGITAL TECHNOLOGIES

The digital computer technology revolution continues to open up concepts, many of which are only just beginning to be understood or accepted. These concepts are critically important to librarianship in general and preservation in particular. In a world historically dominated by paper, the same medium is used for document capture (creation, recording), storage, access, distribution and use, and there has been no compelling need to consider these as separate entities. There has also been no compelling need to distinguish between the *format* of a document and the *medium* in which it is embodied, since there is only one dominant choice of medium. Indeed, the terms have traditionally been used somewhat interchangeably and indiscriminately. The introduction of non-paper forms such as phonograph recordings and films has modified this straightforward view somewhat, but traditional cataloging makes every effort to foster the constraint that there is a one-to-one correspondence between the format and the medium, with the objective of identifying the combined format-medium with some physical shelf location.

Further efforts to foster this constraint increasingly break down when digital technologies enter the picture. Digital technologies open a world that paradoxically is simultaneously more complex and, in some ways, simpler. It is more complex because now the same document or document format may intrinsically be represented in different media for different purposes, forcefully motivating the need to distinguish carefully between the format and the medium. Furthermore, different media may be used interchangeably for different stages of document handling, that is, for capture, storage, access, distribution, and use. To complicate the situation even more, the documents may be encoded in a myriad of ways at each of these stages.

And yet, separation of the format and the medium—and treating each stage of document handling separately—may open up a more logical structure free from traditional constraints. In this sense, digital technologies may simplify certain aspects of librarianship.

Digital technologies present many new challenges, however, that must be considered. For example, although these varying formats may be decoded and translated back and forth among each other, many fear that the means of decoding may become lost as a result of technological obsolescence, conceivably making digitally stored documents inaccessible. There are also many who question the longevity of the physical media used in digital technologies. Others suggest that the appropriate way to address both of these problems—as well as to take advantage of the declining costs of computer storage and of increasing storage densities—may well be to copy stored documents periodically onto new media.

Indeed the main advantage of the world of digital technologies, namely that they represent a kind of "esperanto" of mutually comprehensible and interchangeable formats, may, if not properly managed, also represent their biggest weakness, because of the rapidity of change and obsolescence, and because of the wide range of choices available at any given time. Their very attractiveness could lure the unwary or the uninformed into dangerous territory.

Periodic recopying onto new media represents a whole new approach for libraries to the operation and financing of "inventory management" (although such practices are quite common in data centers). The implications could be quite extensive. Librarians tend to think in terms of periods of centuries rather than having (or wanting) to recopy every few years. Such considerations may either hinder the adoption of digital technologies for preservation or other purposes or eventually cause some rethinking of the underlying economics of librarianship.

The incentive for such potential reevaluation, however, is not limited to the preservation of older materials, nor is the influence of technology the only driving factor. The underlying stimulus is a gradual transition over the centuries—perhaps spurred by the exponential growth of recorded knowledge and information—from documents with associated physical or conceptually useful lifetimes, times between new editions, or, more generically, times between "instances," that can be measured in decades or centuries; to documents with associated times between instances measured; in much shorter units of time—even, in the case of "active documents" (see below), measured in minutes or seconds.

In essence, this represents a transition from "batch processing" to "continuous processing."[2] The financial and other implications of this could undoubtedly be far-reaching for libraries (a full discussion is beyond the scope of this Glossary), introducing into the library milieu unfamiliar (or, at least, largely unused) concepts associated with continuous processes or processes with relatively short lifetimes, such as "depreciation" and "lifecycle costing." These are concepts that are familiar to the world of digital electronic processing and quite normal outside of universities, but that have been avoided in worlds—such as research libraries—that depend to a greater or lesser extent upon irregular gifts or grants of varying or unpredictable size, donations directed to the purchase and immediate storage of documents, but not to their maintenance. Indeed, one of the most serious questions facing librarians in the future may be how to effect a match between the changing economic demands of "continuous processes" and the traditional nature of many funding sources. Will donors, for example, be as willing to support the continuous demands of technological processing as they have historically and generously supported the periodic construction of library buildings? What implications does the financing of continuous processes have for the "free" and openly accessible library?[3]

Yet the potential of digital technologies and of the flexibility they offer is boundless. Over the coming decades, these technologies may open up vistas of ever-increasing storage densities to where entire libraries can be electronically stored in the space of a single room; of blinding access and distribution speeds allowing whole documents to be moved almost instantly across the nation's (and indeed the world's) data networks, leading to the concept of the "distributed library"; of ease of replication at very modest cost (another cause for alarm, particularly to those concerned with protection of intellectual property); of "print-on-demand" where paper copies of documents are only printed "just in time" and not inventoried in advance of need; of accessibility at a distance away from where the "digital document" or preservation copy was created or is stored; and of intelligent automated document analysis. Indeed, the means of creation and production of documents have already been revolutionized by these technologies.

These technologies also open up horizons for totally new document formats, such as *active* documents whose contents may combine different media such as text, sound, video or voice; or whose contents may change dynamically with time, what Harvey Wheeler called "the fungible book."[4] The preservation of these new "active" formats is not of direct interest to the subject of preservation of more traditional formats (and therefore beyond the scope of this Glossary), but is of indirect interest because digitally preserved traditional documents can be incorporated into such active documents. Furthermore, contemporary active documents will become a subject of future preservation interest.

Some view the introduction of digital technologies into the world of libraries as likely to cause a revolution as far-reaching as that caused by the printing-press: a massive paradigm shift. Others view the introduction with concern (one cannot help but recall that the monks at first also viewed the introduction of the printing press with equal concern), an intimidating perturbation that disturbs an equilibrium and modalities of scholarship that have served well for many decades or even for centuries.

Either way, digital technologies cannot be ignored. They are already with us. The question is not whether they will have a presence, but the pace and degree to which that presence will grow and influence. The next twenty years are likely to be times of extraordinary change. Our libraries—indeed our universities, colleges, and our scholarly communities—may well be remade by the consequences of this technological revolution.

And yet—in spite of technology's impact and of the revolutionary consequences of that impact—it must be recognized that technology itself is not the ultimate driving force. It is the inexorable pressure caused by the exponential growth of recorded knowledge, and the ever-increasing complexity, costs, and other problems associated with the storage and distribution of, and access to, such information. Technology can provide some solutions: it is not an end in itself.

Furthermore—for many reasons too numerous to detail here—the "digital library" is not about to replace the "paper library." Both will need to coexist in a shifting environment, at least for the foreseeable future. This in itself will present librarians with many economic, organizational, social, technical, and other challenges.

Between the eager apostles of technology and those who approach change with extreme caution lies the mass of professionals who are trying to understand and grapple with the potential of this shifting environment, many of them implementing prototype activities designed to elucidate greater insight,[5] many working to close the gap between promise and reality.

It is to these professionals—from all fields—that this Glossary is dedicated, to provide a common language for dialogue and mutual understanding, particularly as is required to address the problems of preservation, and the potential application of digital technologies to those problems. The Glossary is not intended to be so comprehensive as to satisfy the technologist only concerned with technologies, or the librarian exclusively concerned with librarianship and preservation. It is intended to satisfy the intersection of their concerns. On the other hand, issues of preservation and access raise concepts that have implications for librarianship as a whole, so that, in that sense, this Glossary has consequences that are not limited to the preservation arena alone.

## SCOPE OF THE GLOSSARY

This document is a *structured* glossary, in the sense that the terms have been hierarchically grouped. The term "taxonomy" was used to describe earlier drafts of the manuscript, but that term was dropped since it might imply a degree of completeness and form beyond that envisaged, or even possible, for such a document. This document is not intended to be complete with respect to preservation and access technologies as a whole, but is highly selective (and even highly subjective) in its choice of terms to include, and very much slanted towards the use and impact of digital technologies. Other preservation technologies are sketched in for contextual purposes only. Within these constraints, the Glossary is intended to be comprehensive but not exhaustive.

The Glossary is not intended to solve all issues associated with the definition of technological and other terms associated with preservation and access. It is a conceptual document. Not all terms are defined with equal precision; indeed, the degree of precision is largely directed by the extent to which it is necessary to distinguish among these terms. The Glossary is intended to be adequate to support further research and development on the subject. Indeed, one measure of success of the Glossary will be the extent to which it stimulates additional work in the field, including refinements of the Glossary itself.

For the conceptual reasons outlined above, the Glossary departs from many well-established norms. Furthermore, excluded in any detail are terms primarily associated with *conservation*, such as paper deacidification, where every effort is made to preserve the documents in their original physical form,[6] or hand conservation. The focus, as stated, is on preservation through *media conversion* (traditionally known as "reformatting," a term which we do not favor in this Glossary—see 3.1), where the objective is to preserve the intellectual content of the original document on some other medium, and also if desired to produce at some later stage a close physical facsimile of the original, at least to the extent allowed by the technology.

The focus is also for the most part on *paper* documents requiring preservation. These represent the principal (but not the only) area of national and international attention: paper documents have the longest history and exist in the greatest numbers. They are also in urgent need of preservation because of the 'embrittlement' (see 1.5.4) caused by the high acid content of paper manufactured since the mid-nineteenth century and by improper storage environments. In the years to come, the focus may well shift to other media. There is already, for example, considerable attention paid to film preservation, and video recordings are already deteriorating at an alarming rate.

Different technologies are more or less suitable to preserve different classes of documents or for achieving different access or other objectives. One of the main applications intended for this Glossary is for the classification of ranges of activity that can be used to describe different investigations into preservation and access methodologies. The level of detail varies throughout the Glossary according to what we believe is necessary to make the Glossary most pertinent to this intended application.

## STRUCTURE OF THE GLOSSARY

The Glossary is divided into three main sections: the Original Document, the Selection Process, and the Preserved Copy. The latter is dealt with in the most detail and it in turn is divided into a number of subsections: the first defines the actual preservation or media conversion technologies that may be employed; and the remaining subsections are devoted to the various technologies employed in the different stages of preservation and access—capture, storage, access, distribution, and presentation.

The reader will observe that there is some repetition of discussion of certain concepts throughout the Glossary. This is intentionally introduced, since it is expected that most readers will not choose to read the Glossary from cover to cover.

The overall structure of the Glossary is presented in figure 1.

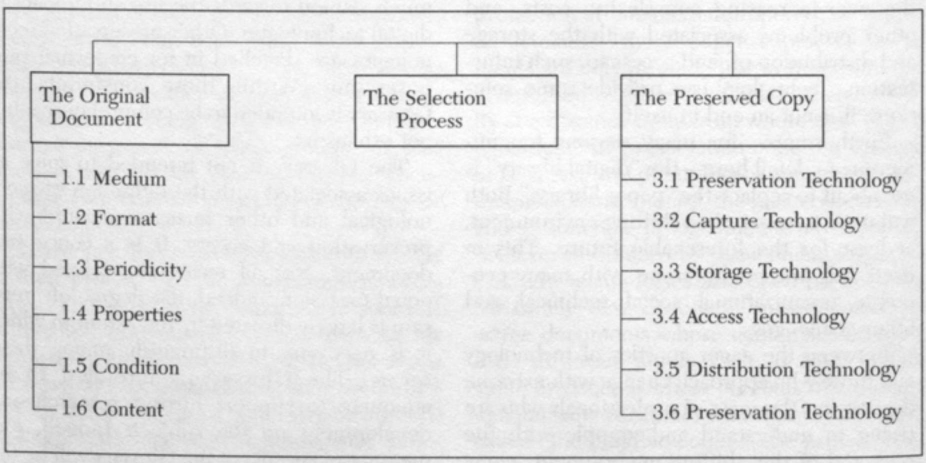


*Figure 1. Overall Structure of Glossary.*

## 1. THE ORIGINAL DOCUMENT

Different preservation or media conversion technologies are appropriate to different kinds of original material. This section, therefore, is devoted to a classification of terms used in describing the original document to be preserved, particularly those terms that need to be referenced in the context of media conversion.

The term *document* is used generically throughout this Glossary to include all forms of books, manuscripts, records and other classes of material containing information or other matter of intellectual content, regardless of the actual medium (1.1) or format (1.2) employed.

The Glossary takes free license with terms that have taken on a traditional meaning in the context of cataloging and other library activities, and in fact frequently departs from traditional norms used in this area. As stated in the Introduction, the reason for this is that such traditional definitions often confuse the *format* and *content* of the document with the *medium* used to record it, terms that have traditionally been used somewhat interchangeably and indiscriminately. This made sense when paper was the primary medium used for document capture, storage, distribution, and use. With newer technologies, however, and particularly with those used for media conversion (3.1), different media can be used for each of these stages, and, in fact, different media can be used for different instances of each stage. In this context, therefore, it makes taxonomic sense to separate format from medium.

For example, a traditional classification is "Motion pictures and video recordings." In our Glossary, the document format would be "motion pictures." The medium could be "film" or "videotape" or even "digital electronic" (such as with digital video). Even a book (document format) could be embodied in different media: "paper," "audio" (the "talking book"), "microform," or "digital electronic." To extend the example, the book could be *stored* in a digital electronic medium, and subsequently *distributed* electronically, and *used* by "printing-on-demand" on paper or microform, or by presentation at a digital computer workstation.

### 1.1. Document Medium

*Document Medium* refers to the material upon which the original document was recorded.

#### *1.1.1. Paper*

*Paper* is a medium traditionally used for printed books and other documents that are the most frequent target of preservation efforts. Paper is defined to be sheets usually made of vegetable fibers laid down on a fine screen from a water suspension. Marks are imprinted on the paper using any of a number of techniques including *handwriting* or *drawing* using a variety of media such as pencil, pen and ink, or pastel; *various forms of printing* using inks (numerous technologies are used to accomplish this); *photographic printing*, where paper coated with light-sensitive emulsion is exposed to various intensities of light; *xerographic printing*, where an electrically charged photoconductive insulating surface is selectively exposed to light and the latent image is developed with a resinous powder; *thermographic printing*, where the paper is exposed to a directed heat source that selectively modifies parts of the surface that may have been pre-treated with a heat-sensitive powder; and *chemical transfer printing*, where the surface of the paper is chemically coated and selectively modified by pressure or other means.

*Parchment* and *vellum* are not paper since they are made from the skins of sheep, goats, or calfskin.[7] We note them here for completeness.

*Hard Copy* is a term often used to denote any document produced on paper.

#### *1.1.2. Microform*

*Microform* refers to a document medium for producing or reproducing printed matter. It records *microimages*, that is, images too small to be read without some form of magnification. In a general sense, microforms may be on film (1.1.4) or paper (1.1.1), but for purposes of this Glossary the definition is restricted to film. Reading a microform requires the assistance of a microform reader (3.6.2.2). Microform comes in different styles including *microfilm* (a film roll that contains microimages arranged sequentially) and *microfiche* (sheets of film in which many microimages are arranged in a grid pattern). Both usually contain a header that can be read without magnification.

Microforms are an economic and compact form of document representation for archival storage, but are inconvenient to read when compared with a printed book. Microform technology is used as a preservation medium (3.1.4), as a means of saving space (such as for the convenient storage of newspapers), or as a means of duplicating scarce or unique documents, that is, microreproductions of other original documents. However, microform is sometimes used for original documents, for example, those created on a computer and directly printed out onto a *computer-output-on-microfiche* (*COM*) device; and for microreproductions of material assembled for the purposes of releasing an original edition in microform.

*1.1.3. Video*

*Video* is normally an analog (see definition under 1.1.6) electronic technology for recording still or moving images, usually combined with sound (cf. 1.1.5). Following standards (which vary across the world) defined for television playback and broadcasting, the images are normally recorded on magnetic tape (3.3.1.6.2), when it is known as *videotape*, but also on other physical media such as optical disk (3.3.1.6.3) (*videodisk*). Playback is usually achieved through a television set or video projector (3.6.2.3), although it is now possible and becoming common to play video recordings back through a computer (3.6.2.6) or multimedia workstation (3.6.2.7).

*1.1.4. Film*

*Film* is a recording medium consisting of thin sheets or strips of transparent or translucent material, such as polyester or acetate, coated with a light-sensitive emulsion. Recording occurs by exposing the film to the light emitted or reflected by the entity being recorded. Film is also the medium used for microfilm recording (1.1.2). A *photograph* (1.2.9.3) is produced using essentially the same technology, except that normally the light-sensitive emulsion is adhered to paper or some other opaque medium.

*1.1.5 Audio*

*Audio* documents are recordings made on a variety of (usually) magnetic media (see 3.3.1.6) of sounds only (as contrasted with video recordings (1.1.3) that also combine images). The evolution of such audio recordings has traversed a large number of different formats and physical media, including *phonograph disks* (*records*) of varying size (78 rpm's, 45 rpm's, 33 rpm's) and *tape cassettes* (of different formats), both of which are analog (see 1.1.6) recording technologies; and, more recently, *compact disks* and *digital acoustic tapes* (*DAT*), which are digitally (1.1.6) encoded.

*1.1.6. Digital Electronic*

*Digital Electronic Technologies*[8] are technologies used to capture (3.2.3), store (3.3.1.6), transform (3.3.2, 3.3.4), distribute (3.5.1.6) or present (3.6.1.6, 3.6.2.6, 3.6.2.7) information in quantized electronic form (normally as a sequence of 0's and 1's known as bits). *Digital*, in which information is quantized discretely, is to be contrasted with *Analog*, in which information is not quantized but maintained in a continuous format.[9] A video recording (1.1.3) is an example of an electronic technology that is analog.[10]

**1.1.6.1. Magnetic Disk** (see 3.3.1.6.1)

**1.1.6.2. Magnetic Tape** (see 3.3.1.6.2)

**1.1.6.3. Optical Disk** (see 3.3.1.6.3)

**1.1.6.4. Optical Tape** (see 3.3.1.6.4)

**1.1.6.5. Magneto-Optical Disk** (see 3.3.1.6.5)

For a variety of reasons, digital technologies are gradually replacing analog technologies. Reasons of importance to this Glossary are the convertibility of digital technologies among each other and into and from other technologies (such as paper and voice), so that digital technologies become a kind of *lingua franca* of communication and storage; and the ease of transmission of information by digital technologies across networks (3.5.5) to facilitate communication at a distance.

Original documents that are of concern for library preservation purposes are not normally encoded in a digital electronic medium.[11] Since this may become a subject of future concern, the category is included for completeness. Definitions, however, are more appropriately included under Storage Technology Medium (3.3.1.6).

*1.1.7. Multi-Media*

*Multi-Media* is a term used to denote documents created using a number of different media simultaneously, usually those with an electronic technological basis: for example, a digital electronic recording (1.1.6) that also combines video (1.1.3) and audio (1.1.5), and that may, as part of the document, intrinsically produce paper (1.1.1) outputs.

**1.2. Document Format**

*Document Format* refers to the class of document with respect to its *style*, *arrangement*, or *layout*.

Although this Glossary emphasizes the distinction between format and medium, some formats are more closely associated with a given medium. Thus, formats such as documentary, short, feature, and newsreel are most closely associated with the medium of film. Consistent with the main thrust of this Glossary, we emphasize those formats that are mostly associated with the medium of paper, even though several of these formats may also be embodied in other media (the "talking book," for example, recorded, say, on tape cassettes).

The term "format" itself may be too all-encompassing. There may be a need to further distinguish between the "type" of a document, such as "book," and the arrangement or layout of the book—such as formatted text on pages, or simply linear text that is not formatted into pages (as in the "talking book" where pages are not distinguished). However, this Glossary does not make this distinction, partly because of its focus on the paper milieu, where such a distinction may not be necessary, and partly because in the emerging world of digital technologies it may be premature to attempt such a distinction.

The use of the term "format" should not be confused with its use in the context of "reformatting." The latter, as described in 3.1, is best replaced by the term "media conversion."

*1.2.1. Manuscript*

For purposes of this Glossary, an original, unpublished document directly created by its author(s), usually on paper or parchment, and often in the author's own hand.

*1.2.2. Book*

A monograph (1.3.1) publication containing more than 49 pages, usually on paper.[12]

*1.2.3. Pamphlet*

A complete monograph (1.3.1) of at least 5 but not more than 49 pages, usually on paper (see reference 12).

*1.2.4. Newspaper*

A serial (1.3.2) publication issued at stated, frequent intervals containing news, opinions, advertisements, and other topical material, usually on paper (see reference 12).

*1.2.5. Printed Sheet*

A single sheet of printed paper such as a poster (but see 1.2.9.4), broadside, folded leaflet, or memorandum, usually on paper.

*1.2.6. Periodical*

A serial publication (1.3.2) appearing at regular or stated intervals, generally more frequently than annually, usually on paper (see reference 12). Includes *magazines* and *journals*.

*1.2.7. Cartographic Materials*

Representations of a selection of abstract features of the universe, most often in relation to the surface of the earth, often on paper but also on other substrates.

*1.2.8. Music*

In this context, printed representation of musical notation for instrumental, chamber, orchestral, and vocal scores, usually on paper (see reference 12).

*1.2.9. Graphic Materials*

**1.2.9.1. Art Originals, Prints, and Reproductions.** Illustrated works, such as drawings, engravings, and lithographs, issued separately from books.

The following terms are included for completeness, but without definition[13]:

**1.2.9.2. Filmstrips**

**1.2.9.3. Photographs, Slides, Transparencies, and Stereographs**

**1.2.9.4. Pictures, Postcards, and Posters**

**1.2.9.5. Technical Drawings (including Architectural Plans)**

**1.2.9.6. Miscellaneous.** The *Miscellane-*

*ous* category includes flash cards, radiographs, study prints, and wall charts.

*1.2.10. Data File*

The term *Data File* is used generically to denote a document consisting of a collection of data, normally organized in some logical fashion so as to facilitate access (3.4). Such data may consist of factual information, statistics, numbers, textual, or composite records to be used as a basis for reasoning, discussion, or calculation. An entity within a data file is known as a *(data) record*. A collection of data files is sometimes known as a *databank*, particularly when the data files are electronically encoded (1.1.6).

Although data files may be encoded in any media (for example, a paper card index file is an example of a data file), the term has most often come to be used in connection with data files that are electronically encoded and stored in digital electronic form (3.3.1.6).

**1.2.10.1 Table.** A data file arranged into two-dimensional form, normally consisting of rows and columns together with headings or labels to depict the contents of the rows and columns. Tables may themselves contain other tables as elements resulting in a "latticed" arrangement of data. A *spreadsheet* is a special form of table originally used for accounting purposes and containing financial data, but which now includes a wide variety of complex reports arranged in tabular form, often with the aid of computer workstations (3.6.2.6).

**1.3. Document Periodicity**

*Periodicity* refers to the number of parts into which the document is divided and the manner or sequence in which those parts are or have been published.

*1.3.1. Monograph*

A *Monograph* is a published work, collection, or other document that is not a serial (1.3.2).

*1.3.2. Serial*

A *Serial* is a publication issued in successive parts, bearing numerical or chronological designations, at regular or irregular intervals and intended to continue indefinitely.

**1.4. Document Properties**

*Document Properties* refers to a classification of various components of documents as to their different tonal or color content and as to the types of objects they contain.[14] Emphasis is placed on those properties most closely associated with documents produced on paper.

*1.4.1. Tone*

*Tone* refers to the color quality or color content of the document or parts of the document regardless of form or material content.

**1.4.1.1. Monotone.** *Monotone* documents (or parts of documents) are printed or otherwise produced using one color hue[15] only, most often black or near-black.

*1.4.1.1.1. Two-Tone.* Those parts of a monotone document that are represented in only two contrasting tones (regardless of the hue of the color, although the term is most often associated with black hues), with no intermediate shades. Thus, for purposes of this Glossary, a book printed with red ink on yellow paper would be considered two-tone. When one of the shades is black or near-black, and the other white or near-white, the document is described as being produced in *black-and-white*.

*1.4.1.1.2. Greyscale.* Those parts of a monotone document that are presented using a range of tones (regardless of the hue of the underlying color). The range of tones may either be *continuous* (such as in a photograph), where all possible values may essentially be taken on, or *discrete*, where only a finite set of values may be taken on.

**1.4.1.2. Highlight Color.** A two-tone (1.4.1.1.1) document, parts of which additionally contain areas highlighted with a second single color of uniform shade.

**1.4.1.3. Two Color.** A document containing two colors, intermixed to create intervening hues, and two extreme tones (normally black and white) used to create a continuous or discrete (see 1.4.1.1.2) range of shades.

**1.4.1.4. Full Color.** A document containing or attempting to contain a full range of colors, normally of all hues, tones, and shades.

*1.4.2. Object Type*

*Object Type* (see also Footnote 13) is a descriptor that conveys information about a given sub-area (*object*) of the document with regard to the manner in which it conveys data or information.

**1.4.2.1. Text Objects.** *Text Objects* are document objects consisting of written or printed (or otherwise displayed) stored words or ideograms.

**1.4.2.2. Data Objects.** *Data Objects* are document objects consisting of factual information normally arranged into datafiles (1.2.10) or tables (1.2.10.1) which are used as a basis for reasoning, discussion, or calculation.

*1.4.2.2.3. Table.* See 1.2.10.1.

**1.4.2.3. Graphic Objects.** *Graphic Objects* are document objects containing image information consisting of artwork, photographs, technical drawings, etc., perhaps containing limited amounts of text usually as captions or for labelling purposes.

*1.4.2.3.1. Line Art.* Graphic objects created entirely from the use of text, dots, and straight or curved lines.

***1.4.2.3.1.1. Graphs.***Line art objects consisting of representations of the interrelationships of data in pictorial form.

*1.4.2.3.2. Halftone.* A representation of a greyscale (1.4.1.1.2) or color graphic object as a series of dots obtained, for example, by photographing or scanning an image through a mesh screen. By limiting the dots to, say, black and white (for example, by using high-contrast film), the illusion of greyscale may be created in a two-tone or black-and-white document (1.4.1.1.1).

*1.4.2.3.3. Discrete Tone.* A greyscale or color (1.4.1.4) graphic object where the tones take on discrete (normally equispaced) values within a range.

*1.4.2.3.4. Continuous Tone.* A greyscale (1.4.1.1.2) or color (1.4.1.4) graphic object where the tones fall continuously across an entire range of values, such as in a photograph (1.1.4, 1.2.9.3).

## 1.5. Document Condition

*Condition* refers to the physical state of the document compared with its state when originally published. The following presents only those characteristics of the physical state of a document that are pertinent to the main thrust of this Glossary, that is, to the paper milieu.

### *1.5.1. Archival*

A document that can be expected to be kept permanently as closely as possible to its original form. An *archival document medium* is one that can be "expected" to retain permanently its original characteristics (such expectations may or may not prove to be realized in actual practice). A document published in such a medium is of *archival quality* and can be expected to resist deterioration.

*Permanent* paper is manufactured to resist chemical action so as to retard the effects of aging as determined by precise technical specifications. *Durability* refers to certain lasting qualities with respect to folding and tear resistance.

See also 3.3.5.

### *1.5.2. Non-Archival*

A document that is not intended or cannot be expected to be kept permanently, and that may therefore be created or published on a medium (1.1) that cannot be expected to retain its original characteristics and resist deterioration.

### *1.5.3. Acidic*

A condition in which the concentration of hydrogen ions in an aqueous solution exceeds that of the hydroxyl ions. In paper, the strength of the acid denotes the state of deterioration that, if not chemically reversed (3.1.2), will result in embrittlement (1.5.4). Discoloration of the paper (for example, *yellowing*) may be an early sign of deterioration in paper.

### *1.5.4. Brittle*

That property of a material that causes it to break or crack when depressed by bending. In paper, evidence of deterioration usually is exhibited by the paper's inability to withstand one or two (different standards are used) double corner folds. A *corner fold* is characterized by bending the corner of a page completely over on itself, and a *double corner fold* consists of repeating the action twice.

### *1.5.5. Other*

There are many other conditions that characterize the condition of a document. Bindings of books, for example, may have deteriorated for a variety of conditions. Non-paper documents may exhibit a variety of conditions (see, for example, 3.3.5 for a discussion of the concept of "Useful Life"). However, with the focus on paper original documents and on media conversion technologies for preservation, a full analysis of document condition would be beyond the scope of this Glossary.

**1.6. Document Content**

*Document Content* refers to the substance of the material or information within the document that is intended to be communicated.

*1.6.1. Intellectual Content*

*Intellectual Content* refers to the ideas, thought processes, artistic expressions, etc., contained within the document.

*1.6.2. Copyright*[16]

*Copyright* refers to a means of legal protection provided to the author(s) of original published and unpublished works that have been "fixed in a tangible form of expression," in order to afford such authors the exclusive right of *exploitation*, in particular the right to control the reproduction, distribution, performance, or display of the work, or to control the preparation of derivative works.[17] Often, exploitation of the work by others requires the consent of the author(s) and the payment of a *royalty* to the author(s), usually in the form of a fixed sum of money for each copy made, shown, or distributed.

For works copyrighted in the United States after January 1, 1978, protection afforded to the author(s) or the author(s)' estate is usually for the author(s)' lifetime plus 50 years. For works created prior to that date, the copyright period was 28 years from the date of publication (or the date of registration of copyright for unpublished works), plus an additional period of 47 years for works whose copyright was renewed during the last year of the first term.

Works published in the United States may be afforded protection in countries that were members of the Universal Copyright Convention or of the Berne Convention for the Protection of Literary and Artistic Works. Conversely, works published in such member countries are protected within the United States.

Most works that are the subject of preservation interest were published before 1978. The copyrights on the majority of those works were not renewed for the optional second term. Thus, the copyrights have expired on most of the works of current preservation interest that were subject to United States copyright protection. However, since this is not true of all such works, the normal practice is to check copyright ownership to verify clearance.

*1.6.3. Structure*

*Structure* refers to the divisions within a document provided for ease of access, reference, and other purposes. The broad structure of a given document is likely to vary according to its format (1.2), and there is also not necessarily any standard structure for a given format. With its long history, the structure of the printed book (1.2.2) has evolved towards a somewhat standard structure. Because of the focus of this Glossary on the preservation of the printed book, a typical book structure is presented here and structures for other formats are omitted.

**1.6.3.1. Abstract** (see 3.4.1.2)

**1.6.3.2. Title Page.** The *Title Page* of a work normally contains the title of the work, its author(s), and the name of the publisher.

**1.6.3.3. Table of Contents** (see 3.4.1.3)

**1.6.3.4. List of Figures, Tables, Maps or Other Illustrations** (see 3.4.1.4)

**1.6.3.5. Preface** (see 3.4.1.5)

**1.6.3.6. Introduction** (see 3.4.1.6)

**1.6.3.7. Body.** The *Body* of a document refers to the main corpus of the work. It may be divided into chapters, papers, articles, or other segments.

**1.6.3.8. Index** (see 3.4.1.7)

**1.6.3.9. Other.** This category includes publisher's notes, credits, frontispieces, and other minutiae of publication.

## 2. THE SELECTION PROCESS[18]

The *Selection Process* refers to the means whereby original documents are selected for preservation purposes. The choice of selection strategy may be intrinsically affected by the choice of preservation or media conversion technology used (see 3.1), since the latter may well affect costs and other parameters associated with the former. Thus, the total costs of preservation will be a complex combination of the effects of selection strategy and choice of technology.

Thus, for example, with the use of microform (3.1.4), it is highly desirable (if not imperative) to obtain a complete copy of the document to be preserved prior to recording. This may require replacing missing or damaged pages from the prime copy being microfilmed, and the expense of obtaining these pages from copies held in other libraries. Microfilming also places a premium on recording only once. With the use of digital technologies (3.1.5), on the other hand, such replacement pages could be scanned at a later date and electronically "edited" into the main electronic document; with digital technologies, it may in fact be cheaper to scan more than one copy to facilitate such "editing" rather than to expend excessive manual labor on assembling the most perfect paper copy possible prior to microfilming.

The following is a brief—and very oversimplified—classification of selection methodologies. It is only intended to sketch the range of possibilities and not to do full justice to the complexity of this subject. It merely indicates some of the main lines of strategy or processes used in selecting documents for preservation. Furthermore, often a combination of approaches is used rather than any single approach, with the actual condition of the document being the dominant factor in the choice.

In all cases, the "universe" of documents to which the selection strategies outlined in this Section are applied is those documents that are deteriorating or are likely to deteriorate, such as brittle books or, more generally, books printed on acidic paper. "Preservation," however, may also be applied to the conversion onto other media of materials that, while in quite good condition, are scarce or unique, thus allowing patrons to handle facsimiles instead of the precious originals.

The term "essentially all documents" is used below to define documents from within the former universe that fit within the indicated selection strategy, while allowing that a number of these selected documents may yet be rejected following review for various reasons (such as having deteriorated to the point that preservation is not possible, or because it has been determined that the document has already been preserved elsewhere).

### 2.1. By Title

Selection is made from among individual works, perhaps by professional bibliographers who, possibly working in consultation with others, make a determination of the value of the selected work to a given collection, discipline, or field of study.

### 2.2. By Category

Selection is made by choosing essentially all documents from within a given category, such as within a given time period, or of a given format (for example, all newspapers), subject classification, special collection, or , say, American imprint. The essence of this approach is that all documents within the category be readily and conveniently definable and accessible, without having to resort to time-consuming selection processes.

Colloquially, this approach is sometimes erroneously termed the "*vacuum cleaner approach*," an appellation that is overly pejorative insofar as some prior review is almost always made to reject materials within a category that for various reasons are not suitable or desirable for preservation. In particular, a check is made to ensure that the material has not already been preserved.

Selection, for example, by time period permits the focus of effort on those periods of highest risk of deterioration with respect to paper-manufacturing processes.

### 2.3 By Bibliography

Selection is made by choosing essentially all documents specified in a published bibliography.

### 2.4. By Use

Selection is made by choosing essentially all documents in poor condition that are actually used by patrons as judged by some criterion such as, for example, frequency of circulation.

### 2.5. By Condition

Selection is made by preserving the documents in the worst physical condition.

The foregoing are examples of selection according to certain established *criteria*. Selection may also be made according to established *procedures*:

### 2.6. By Scholarly Advisory Committee

Selection is made with the assistance of a committee of scholars knowledgeable in a particular field who choose the material they consider to be of most importance to that field.

### 2.7. By Conspectus

Selection is made from institutional collections determined in a program initiated by the Research Libraries Group (RLG)[19] and described in the RLG Conspectus. The Conspectus describes collections on various levels from Level 0 (Out-of-Scope, a level which is in fact nonexistent), through Level 4 (Research), to Level 5 (Comprehensive). Collection development officers (selectors) in about 50 major research libraries in the U.S. have evaluated their own collections to provide such brief descriptions. The Conspectus can be used as one of several means to determine "Great Collections."

## 3. THE PRESERVED COPY

This section addresses technologies employed in the preservation process. The first section broadly classifies different kinds of preservation processes. The remaining sections focus on the different technological stages associated with preservation processes dependent upon media conversion technologies. These are: capture technologies, storage technologies, access technologies, distribution technologies, and presentation technologies.

The divisions among these various stages of technology may, at first, seem artificial, particularly to those used to working with paper. For example, we distinguish between the storage medium (3.3.1), the distribution medium (3.5.1), and the presentation medium (3.6.1). In the world of paper, as stated in the Introduction, these are usually all one and the same, even though the same paper book, say, may play different roles at different times. When it is on the library bookshelf, it is a *storage* medium; when it is being messengered through interlibrary loan, it is the *distribution* medium; and when it is being read by the patron, it is the *presentation* medium. In the world of convertible technologies, the separation becomes more than convenient sophistry—it becomes essential, since different media may well be used at any stage of the process. Consider, for example, a table from a scientific journal article (paper: the storage medium), which is FAXed across the nation using a data network (digital electronic: the distribution medium), and printed out directly onto photographic slides (film; the presentation medium) for projection in a lecture.

Indeed, in the preservation milieu, this conceptual separation also offers considerable flexibility. It offers the flexibility of separating the act of preservation itself from the ultimate means of storage and delivery. Thus, for example, microfilming may be used as a preservation process (3.1.4), but the microfilm contents may be printed later onto paper for user presentation purposes. Or the microfilm may be digitally scanned and the contents stored on computer files for subsequent distribution across networks. As another example of this flexibility, images scanned and stored using digital preservation techniques (3.1.5) may later be interpreted using internal character recognition (3.2.5) or page recognition (3.2.6) technologies.

*The point is that the ultimate use of the preserved document may not be well-articulated at the time of preservation. Thus, preservation technologies that offer the greatest flexibility are to be preferred to those (such as photocopying (3.1.3)) that offer less flexibility, although lack of funds and patron preference often dictates the use of the latter.*

The distinction between the various technology stages is maintained throughout this Glossary.

### 3.1. Preservation and Media Conversion Technologies

Many different technologies have been proposed to address the problems of preservation. These can be divided into three broad categories: those directed at preserving both the content and physical embodiment of the original, those directed at preserving the content and copying the physical embodiment, and those directed at preserving the content only, without concern for the physical embodiment. Conservation and paper deacidification fall into the first category. The remaining technologies described below fall into the other categories.

In the second category every effort is made to copy the physical embodiment or format of the original as faithfully as possible, normally onto another medium. The term *media conversion* technologies is thus used for this class (note: this does not exclude copying a paper document onto another paper document: media conversion has still occurred). Media Conversion includes photocopying (3.1.3), microform recording (3.1.4), and the use of electronic digitization techniques (3.1.5).

The third category makes no attempt to preserve or copy the physical embodiment of the original. For example, merely rekeying the text (see 3.2.8) of a document composed entirely of text preserves only content and nothing else if no attempt is made to capture font and other formatting information.

Among librarians, the term "reformatting" has traditionally been used for "media conversion." The former term is not used in this Glossary because of possible confusion with the concept of Document Format (1.2). Furthermore, "reformatting" does not do justice to the concept of copying onto microform (3.1.4) or of digital scanning (3.1.5).[20]

This necessarily brief glossary of different preservation approaches also summarizes some of the key issues involved in comparing the various alternatives.

### *3.1.1. Conservation Treatment*[21]

The treatment of a document to preserve it in its original form, in recognition that the original medium, format, and content are all important for research and other purposes. Pure conservation approaches are normally hand-tailored to the individual document and, as such, may be relatively expensive. Use is normally, therefore, limited to those situations where such expensive treatment is justified by the research requirements.

### *3.1.2. Paper Deacidification and Strengthening*[22]

The treatment by chemicals to stabilize a document (in paper, by alkalization to neutralize the acid content) and/or to strengthen it (in paper by the use of a support coating or by impregnation). The alkalization treatment also usually entails depositing an alkaline reserve to buffer against further acidification.

Deacidification or strengthening can be applied to individual documents or, with some treatment processes, to a large number of documents at once (*mass* or *bulk deacidification*). The latter is a relatively cheap approach, and pilot plants have been or are being established in a number of countries to support different processes. There is, however, no standard approach at this time even though there appear to be a number of promising alternatives. There are also a number of unanswered questions at this time regarding the longevity of chemical stabilization processes, toxicity, the feasibility of scaling processes to full production requirements, the potential continuing "offgassing" implications to patrons resulting from the storage of thousands of treated volumes in confined library spaces, and other issues. Recent research appears to be addressing many of these concerns.

Deacidification is essentially a stabilization process that arrests deterioration. It does not turn brittle books back to their original state, although coating or impregnation can strengthen the paper to extend its useful life. Its greatest utility may lie in arresting embrittlement in books that are not too far gone, or for prophylactic protection of new or old books that have not yet started to turn brittle. Deacidification may also "buy time" in anticipation of later preservation by other processes.

### *3.1.3. Photocopying*

*Photocopying* refers to the process of preserving the document by making a full-size (usually bound similarly to the original) facsimile copy on archival (1.5.1) paper by creating a photographic copy of the images of the pages contained in the document, possibly using a *photocopier* (3.2.1). As used here, photocopying refers to an in-line process where the original is scanned and one or more photocopies made all in one pass, with no form of retained intermediate storage being *automatically* generated (as contrasted with *microform recording* (3.1.4)) so that more copies can be made in the future. In actual practice, however, when photocopying is used for preservation it is customary to make a second photocopy that is retained in unbound form, so that further copies can readily be made in the future from this master copy.

A distinction is made between straight photocopying, which does not necessarily involve the use of archival paper (1.5.1), and *preservation photocopying*, which does require the use of archival paper.

The advantages of making such a facsimile are that normally a single paper facsimile is produced that is quite faithful to the original, there is no machine interface required other than the photocopier itself, the medium (1.1) and format(1.2) of the original are retained, and the cost is usually less than other processes, particularly if the original is a monochrome document. Furthermore, library patrons prefer paper facsimiles to the use of, say, microforms (3.1.4), except where bulky documents, such as newspapers, are involved. The disadvantages, as compared with microform recording (3.1.4) and electronic digital preservation (3.1.5), is that normally second copies made from the master copy are of poorer quality than, say, prints of microforms made from master microforms. Furthermore, the costs of making subsequent copies is higher than the cost of printing microforms. Another disadvantage, shared to a greater or lesser extent with microforms, is that photocopying does not precisely reproduce all the information in the original, and there is some loss of information, especially for graphic objects (1.4.2.3) involving other than line art (1.4.2.3.1).

### *3.1.4. Microform Recording*

*Microform Recording* refers to the process of preserving the document by filming the original document onto a microform film negative (1.1.2), that is, storing microimages of the pages or segments of the document on film. Positive film copies, which can be produced inexpensively, are made from this original film negative or *master*. Such a positive copy is both a storage (3.3) and distribution (3.5) technology, and is normally viewed using a *microform reader* (3.6.2.2), or paper positive prints may be made from the positive microform using printing devices designed for the purpose. Access to microfilm (1.1.2) using such a reader is serial (cf 3.3.1.6), whereas access to microfiche (1.1.2) is random (cf 3.3.1.6) like a book.

The advantages of microform are that the process is economically competitive with other processes; that film has a long useful life (3.3.5); and that microform copies—made from a second negative[23] (known as the *printing master*) copied from the original negative may be made cheaply and distributed among other institutions, so that access is not limited to a single facsimile. Microform preservation is a well-tried, tested, and accepted method of preservation.

The disadvantages are that there is usually a loss of information in the recording process, particularly in recording continuous tone imagery (1.4.2.3.4), since the film used is usually of high contrast,[24] and that readers dislike using microform readers compared with, say, reading books.

Mircoform-preserved documents can subsequently be converted to other media besides paper. They can be scanned (3.2.3) and converted to digitally encoded documents (3.1.5) to take advantage of the benefits of digital encoding for storage, distribution, and access. However, any loss of information in the original recording process will be perpetuated in the subsequent digital recording.

### *3.1.5. Electronic Digitization*

*Electronic Digitization* refers to the capture of the document in electronic form through a process of scanning (see 3.2.3) and digitization. The scanned image is stored electronically, usually on magnetic (see 3.3.1.6.1 and 3.3.1.6.2) or optical (see 3.3.1.6.3 and 3.3.1.6.4) storage media. The electronically stored image may be further *transformed* for reasons such as compression (see 3.3.2) or information interpretation (see 3.3.3); and subsequently *selected* through the use of access technologies (see 3.4), *distributed* through the use of distribution technologies (see 3.5), or *viewed* through the use of presentation technologies (see 3.6).

When originally scanned, or as a result of subsequent transformations, the document may in whole or in part be stored in *image* (3.1.5.1), *unformatted text* (3.1.5.2.1), *formatted text* (3.1.5.2.2), or *compound* (3.1.5.3) form. The distinction is important insofar as it affects *inter alia* the extent to which information such as text in the scanned document may be interpreted (3.2.5, 3.2.6, 3.2.7) and used for purposes of information access (3.4, in particular 3.4.2, but see also 3.1.5.1, 3.1.5.2, 3.2.4). An *image* representation is an electronic pictorial representation composed of dots (black and white, greyscale, or color) much like a halftone (1.4.2.3.2) printed photograph, and no distinction is made between text and other information (such as graphs, pictures, and so forth) contained in the document—in other words, the letter *b* is not stored as a character *per se*, but as a "*digital* *picture*" of the letter *b*, and the series of numbers stored to represent the picture would be quite distinct among different typestyles used. *Text* representations, on the other hand, represent text as text, with a specific code used to denote the letter *b* independent of what typestyle is used.

Image representations cannot be searched for words or phrases: text representations can. Image representations of text may be converted into formatted or unformatted text representations using OCR (3.2.4) or ICR (3.2.5) techniques, but with loss of accuracy. In the context of preservation, image representations are likely to dominate, since the cost of transforming image into text representations with sufficient accuracy may be prohibitively high, at least in the immediate future. Thus full-text searching, for example, is not likely to be a feature of digitally preserved documents. This is unlike the situation that exists with documents where the text already exists in digital electronic form, such as if the publisher had preserved the original tapes used in typesetting.

If and when OCR techniques are able to convert image format to text format with sufficient accuracy and performance, then the archives of digitally preserved material in image format can be converted to text format using ICR (3.2.5) techniques, provided the original material was scanned with sufficiently high resolution (3.2.3). Furthermore, promising research has been done recently on the searching of documents for retrieval purposes using the "corrupted" (erroneous) text derived from the OCR or ICR scanning of image documents at existing levels of OCR/ICR accuracy and performance.

The advantage of electronic digitization is that it potentially combines the advantages of photocopying and microform recording while eliminating some of the disadvantages. Paper facsimiles can be produced at will by *printing-on-demand* (3.5.4) on paper (or writing the appropriate signals on whatever might be the appropriate output medium, in the case of video, film, or sound), thus eliminating the need for awkward microform readers. Alternatively, the stored images can be reconstructed and viewed at computer workstations (3.6.2.6). Furthermore, the stored digital images can be distributed essentially at will across data networks (3.5.5) for sharing among institutions. The content of the stored images can also be interpreted at any time (3.2.5, 3.2.6, 3.2.7) after recording (whenever it might become economically desirable to do so) for purposes of, say, creating indices for access purposes (3.4.1).

Another key advantage is the robustness of digital encoding. Further copies, including copies made in new formats (3.3.3) on other digital electronic storage media (3.3.1.6) for purposes of extending the useful life of the digital copy (see Introduction and 3.3.5), can be made without loss of information, as contrasted with photocopying (3.1.3) or microform recording (3.1.4). Furthermore, scanned images can be digitally enhanced (3.2.9) to improve the image quality.

The disadvantages are that this is a new and relatively untried technology, and the cost and other tradeoffs are uncertain at this time. There are also concerns about the useful life (3.3.5) of present storage media, both in terms of the physical properties of the media and in terms of the robustness of the recording format (3.3.3) and of the means of access. Some, however, take the view that it will be both functionally and economically imperative in any event to recopy the data from storage medium to storage medium every few years to take advantage of the rapidly declining storage costs and increasing storage capacities of the technology, and that the useful life of a given medium is not the relevant issue (see Introduction and 3.3.5).

**3.1.5.1. Image Document.** A representation of the document *image* is electronically captured (usually with the aid of a digital image scanner—see 3.2.3) or created without interpretation of its actual *content*. This is stored as a sequence of 1s or 0s (known as *bits*), a "digital photograph" as it were. In certain image representations, a "1" indicates "black" and a "0" indicates "white" (*Binary Encoding*), but usually the representation is encoded in more complex representations (see 3.3.4 Encoding Method). In some representations, for example, the average grey level of a small area of the page, termed a "pixel," is encoded (*Greyscale Encoding*. See also 1.4.1.1.2). Such a pixel is a grey dot. The number of dots per inch is termed the *pixel resolution*. This pixel resolution may range from 100 per inch to several thousand per inch.

It is not unusual, for reasons of storage economy, to convert a greyscale-encoded image document into a binary encoded image document of higher resolution at the time an image document is stored. Compression techniques (3.3.2) are used to achieve this. The resultant stored image represents a compromise between scanning resolution, image fidelity, and storage space.

The electronically encoded sequence of 1s and 0s that represent an Image Document is also known as a *Bitmap*.

Image Documents are generally accessed by associating an index entry, such as a page number, with a segment of the Image Document. See discussion following under 3.1.5.2 regarding other issues associated with searching and retrieving Image Documents.

**3.1.5.2. Text Document.** The text of the document only is captured as *character* representations, that is, each alphabetic character has a unique representation (see discussion above) following a standard means of encoding, such as the *ASCII* standard. With electronic digital storage, the amount of space taken to store a *representation* of a character generally takes far less than the amount of space taken to represent a character in image form. Usually, each character representation of a letter of, say, the Roman alphabet takes 8 bits (1 byte) of storage space. When stored in image form, the representation may take several orders of magnitude more storage space, depending upon the size of the character, the scanning resolution, and the degree of compression (see 3.3.2) used. See also 3.3.4.2.

Storing a document as a text document facilitates full-text or partial-text retrieval (see 3.4.2), where documents or parts of documents can be selected and retrieved by searching for the occurrence of keywords or strings of text. This is not possible with Image Documents (3.1.5.1), unless they have been wholly or partially converted to Text Documents using Optical Character Recognition (OCR) techniques (3.2.4, 3.2.5), a process that is not sufficiently accurate for most preservation purposes (see, however, 3.2.4 for a discussion of the use of such techniques for the construction of indices).

*3.1.5.2.1. Unformatted Text.* The character representation of the text contains no information to indicate font style, font size, or page layout. In this sense, unformatted character text representations are an example of irreversible compression (see 3.3.2.3).

*3.1.5.2.2. Formatted Text.* The character representation of the text also contains sufficient information to describe one or more of font type, font size, or page layout. In this sense, formatted text may, if the document segment contains only textual material, represent a form of reversible compression (see 3.3.2.2).

**3.1.5.3. Compound Document.** The document is captured as a combination of image and formatted or unformatted text.

### *3.1.6. Rekeying of Text*

*Rekeying of Text* refers to a preservation technology where the text in a document is literally reentered by hand into a composition or other device for republication or reproduction purposes, often with the use of a digital computer. See also 3.2.8.

**3.1.6.1. Unformatted Text.** In the rekeying of the text, no attempt is made to key sufficient information to indicate font style, font size, or page layout.

**3.1.6.2. Formatted Text.** In the rekeying of text, information is captured to indicate one or more of font style, font size, or page layout.

### *3.1.7. Reprinting or Republication*

The document is preserved by producing a new edition or reprint, possibly by reprinting from retained intermediate forms of the document, such as reprinting a book from photocomposition tapes. Alternatively, the document may be recreated from scratch.

## 3.2. Capture Technology

*Capture Technology* refers to the technology used to transform the images or information contained in the original document into some other form, the form dependent upon the overall *media conversion* technology being used. This term is not relevant to Conservation (3.1.1) or Deacidification (3.1.2), which are *conservation* technologies, and do not employ media conversion techniques. Printing (see 1.1.1) on paper is of course also a capture technology.

### *3.2.1. Photocopier*

A *Photocopier* is a device for making photographic copies of graphic images. A common form of the photocopier involves the use of the *xerographic* process, where light reflected from the original document is focused onto an electrically charged insulated photoconductor, and the latent image is developed using a resinous powder. For the purposes of this Glossary, the term *photocopier* is restricted to devices that use *analog* technologies, such as the use of light lens technology. *Digital* technologies are incorporated separately (see 3.2.3). With photocopiers so defined, the image is normally scanned and printed essentially in a single operation, and an intermediate scanned latent image is not normally stored for reuse at a later stage—although the two stage processes of photography, which indeed may be used for photocopying, do permit the use of the photographic negative as an intermediate storage device (a particular case of which is the use of microform recording technology—see 3.2.2).

*3.2.2. Microform Recorder*

A *Microform Recorder* is a camera or other photographic device for photographing the original document and printing it onto one of several forms of microform (1.1.2). The microform film in essence becomes both a storage medium (see 3.3.1.2) and a presentation medium (see 3.6.1.2 and 3.6.2.1). Other film copies and paper copies may also be made from the microform negatives for presentation (see 3.6.1.2).

*3.2.3. Digital Image Scanner*

A *Digital Image Scanner* is a device for scanning the images contained on pages of a document and transforming the scanned image into digital electronic signals corresponding to the physical state at each part of the search area, that is, into image documents (3.1.5.1). These signals are most often stored (see 3.3) for subsequent interpretation (see 3.2.5, 3.2.6, 3.2.7, and 3.3.2, 3.3.4), access (3.4), distribution (3.5), or presentation (3.6). A single small element of the document (known as a "pixel") is thus encoded quantitatively by a digital number, where the number contains sufficient information to represent the *image* content of the pixel (see 3.1.5.1). A digital image scanner on its own does not interpret the image information. The number of pixels per square inch is considered to be the *resolution* of the scanner. Typical resolutions with current technology range from 100 pixels per linear inch to over 1,000 pixels per linear inch, but there are tradeoffs between resolution, speed, cost, and quality.

Digital Image Scanners may scan in one or more different modes, depending upon their capability and depending upon whether they are scanning monotone or color (1.4.1), or whether they are scanning line art, greyscale, halftone, or continuous tone objects (1.4.2.3, 3.1.5.1). Performance, in terms of speed, accuracy, and resolution depend upon the degree to which these attributes can be accommodated. The speed of digital image scanners ranges from one or two pages per minute to around fifty per minute.

A FAX machine (3.5.3) is a special form of digital image scanner. Other special forms of digital image scanners exist for scanning from media other than paper, such as digital image scanners that scan directly from microfilm (1.1.2). Such images scanned from microfilm, however, can be no better than the original microfilm image itself (see 3.1.4).

Digital image scanners may come equipped with different physical devices for accommodating the original documents. These may include flatbed platens equipped with manual feeds, semi-automatic feeds (one page at a time is fed into an automatic hopper), or fully automatic feeds. Manual feeds offer the greatest safety from potential jamming, a point of importance in the scanning of unique documents. Flatbed scanners generally either require books to be disbound and one page at a time placed on the platen, or require books to be laid open face-down on the platen, which may cause some distortion. They may also come equipped with edge scanners, which scan right up to the binding of the book, avoiding this distortion; or with cradle scanners, where the book is opened in a cradle (such devices are also used in some microform recording devices) and two angled scanning heads are lowered into the open, cradled book. In all cases, quality control of scanning is an issue with respect to fidelity of the scanned image and registration of the scanned image with respect to a defined standard.

*3.2.4. Optical Character Recognition Scanner*

An *Optical Character Recognition* (*OCR*) *Scanner* is a digital image scanner that in addition interprets the textual portion of the images and converts it to digital codes representing formatted or unformatted text (3.1.5.2). The less sophisticated such devices can only "recognize" one or a few fonts of a fixed size, and can only interpret such information as unformatted text. The more sophisticated devices can represent multiple fonts of different sizes, and can interpret limited information as formatted text. At either extreme, no device achieves 100 percent recognition accuracy: accuracy of the better devices typically ranges between 95 and 98 percent, depending upon manufacturer imposed tradeoffs between the sophistication of the device, its speed, and its intended range of applicability.

OCR devices are most often used where scanning errors and unformatted text are acceptable limitations, such as, for example, where the input material can be subsequently proofread and corrected, or where redundant information is scanned and the redundant information used to correct any inconsistencies arising from scanning errors (typically in certain commercial applications). In the context of document preservation, most uses of OCR devices are limited to where text information only suffices, and the form of the original document is not an important aspect of preservation. An important application is for use in the construction of indices for access and distribution (see 3.4 and 3.5), or for full contextual searching of information (3.4.2). Promising research has been done, for example, on the searching and retrieval of documents for retrieval purposes using the "corrupted" (erroneous) text derived from the OCR scanning of documents. The techniques utilized in this approach exploit the redundant information contained in the corrupted text.

Handwriting recognition devices, an extreme form of OCR devices, are not included in this Glossary. At this time, such devices are limited in capability.

### 3.2.5. *Internal Character Recognition*

*Internal Character Recognition* is the term sometimes used when the same interpretation technology that is used in OCR devices (3.2.4) is applied to an already stored digital image at a later date. This separates the functions of scanning the images (3.2.3) digitally, and of *interpreting* the images. Interpreting the scanned and stored images at a later date also allows for using different recognition technologies in the tradeoffs between accuracy, speed, and function. In the context of preservation and media conversion, it also allows for the immediate focus to be placed on scanning and storage (and possibly media conversion), deferring the option of character recognition and its applications (see 3.2.4) to a later date—at such time, massive-volume character recognition and information interpretation is likely to be more economically feasible at higher levels of accuracy than with present technology.

### 3.2.6. *Intelligent Character Recognition*

*Intelligent Character Recognition* is the term sometimes given to Optical or Internal Character Recognition where the scanned and recognized information is further interpreted to take advantage of contextual information, that is, words, phrases, and so forth, rather than simply treating the text as a string of independent characters. Intelligent Character Recognition, for example, may be used by sophisticated computer programs to construct concordances automatically, or to create highly sophisticated indexes. At this stage, intelligent character recognition is a field of research, rather than production, interest.

### 3.2.7. *Page Recognition*

*Page Recognition* is the term given to the automatic interpretation of features contained within the printed page such as titles, subheads, columns, paragraphs, figures, figure captions, footnotes, and so forth. Additional capabilities of sophisticated page recognition algorithms include the ability to determine fonts and font sizes. In essence, Page Recognition "reverse engineers" the image into marked-up copy.

### 3.2.8. *Rekeying of Text*

As an alternative or complement to OCR (3.2.4), textual information can be encoded by directly keying alphanumeric text into computer files manually. This has some advantage in accuracy over OCR, but is slower. It may also be used in situations where the brittleness of acidic documents makes them so fragile that scanning technologies cannot safely be used. See also 3.1.6.

*3.2.9 Enhancement*

*Enhancement* refers to the use of mathematical algorithms to improve the quality of digitally scanned images (3.2.3), such as by computationally adjusting the contrast or brightness of the scanned image. The term also includes techniques that may be used to modify the scanned image for structural reasons, such as *bordering* to remove any unwanted scanned areas surrounding the actual document pages, *de-skewing* to rectify the scanned image to correct for any skew in the placement of the document on the scanner, or *margin adjustment* to ensure that pages are properly aligned with each other.

A full glossary of terms associated with enhancement is beyond the scope of this document.

### 3.3. Storage Technology

*Storage Technology* refers to the technology used to store the images or information obtained through the use of some form of Capture Technology (3.2). This includes the *medium* used for storage (3.3.1), the *compression* methodology used to minimize the amount of storage medium employed (3.3.2), the *format* used to program the image or information onto the medium (3.3.3), the *encoding methods* used to represent any interpretation of the stored information (3.3.4), and the *useful life* of the storage medium (3.3.5).

*3.3.1. Storage Medium*

*3.3.1.1 Paper (see 1.1.1)*

*3.3.1.2 Microform (see 1.1.2)*

*3.3.1.3 Video (see 1.1.3)*

*3.3.1.4 Film (see 1.1.4)*

*3.3.1.5 Audio (see 1.1.5)*

*3.3.1.6 Digital Electronic*

A family of storage devices where information or data are represented by a series of quantized changes to the surface of the storage medium, where such quanta are recorded or modified using electronic means. There are two main classes in this category: *magnetic* devices where, in recording, the magnetic state of a coated surface is altered by the electronic digital signal, and, in reading, the surface is sensed using reading heads conceptually similar to those used in common tape recorders; and *optical* devices where the optical properties of a coated surface are altered (in one such technology, submicrometer-sized holes are recorded and read by laser beams focused by electronic means onto the area of the spot). The recorded quanta normally corresponds to a recorded "1" or a recorded "0," that is, of *bits* (*derived from "binary digits"*), all data and information being constructed from these basic building blocks.

Such devices are further classified according to whether they are *read/write* devices (that is, information may be written onto the device and read from the device, and the information can be modified as many times as desired), *read only memory* (*ROM*) devices (that is, prerecorded information can be read from the device, but the information cannot be modified), or *write-once-read-many* (*WORM*) devices (that is, information may be written once by the consumer onto the device, but thereafter it can only be read). Most optical devices are either read only or WORM devices, but a class of devices that combine both magnetic and optical technologies (*magneto-optical* devices) are indeed read/write devices.

Typically, magnetic devices are of higher performance in terms of *access time* to a given segment of recorded information and *transfer time* of such accessed information to the host device. Optical devices, however, are generally more economic in terms of storage capacity. Magnetic technologies have a longer history than optical technologies, and more is known about their useful life, for example (see 3.3.5). Both technologies seem to be following similar cost/performance curves with performance parameters doubling in capability approximately every two to three years (except for access times, which are improving much more slowly), and cost per bit halving about every two to three years.

Both devices are further classified as to whether they are *random access* devices (such as *disk storage devices*) or *serial access* devices (such as *tape storage* devices). With random access devices, information stored at any point can be directly accessed (much as is accomplished by placing the playing-arm of a phonograph at any point on the phonograph record); with serial access devices, information can only be accessed by passing through information that may be recorded ahead of it on the medium (as in winding through a tape on a tape recorder to arrive at a particular passage).

*3.3.1.6.1. Magnetic Disk.* A rotating circular plate having a magnetized surface on which information may be stored as a pattern of polarized spots on concentric or spiral recording tracks. These plates or platters are usually stacked in *disk drives*, several to a drive. These platters may either be *removable* or not, although in high performance disk drives, the platters are usually not removable. They are, however, read/write devices (3.3.1.6). Some removable magnetic disks of lower capacity are known as *floppy disks*, since originally the recording medium was made of a flexible plastic.

*3.3.1.6.2. Magnetic Tape.* A plastic, paper, or metal tape that is coated or impregnated with magnetizable iron oxide particles on which information is stored as a pattern of polarized spots. These are read using magnetic tape drives. Access times with magnetic tapes are slower than those associated with correspondingly priced disks, since they are serial access devices, but the tapes are almost always removable so that the information can be stored *off-line*, thus making tapes[25] useful for archival storage (but see 3.3.5).

*3.3.1.6.3. Optical Disk.* A rotating circular plate on which information is stored as submicrometer-sized holes and is recorded and read by laser beams focused on the disk. This includes the class of *CD-ROM* devices, which embodies the same 5 1/4-inch diameter format used for CD recordings. CD-ROMs are usually read by inserting the CD-ROM disk into a *CD-ROM player*. Other typical formats involve 12- or 14-inch diameter formats, but there is a dearth of standards. The latter are usually read by inserting them into *optical jukebox* devices, which perform the role suggested by their name. Even when mounted, access times for optical disks are typically relatively slow, because of the lag time needed to "spin up" the disk. However, the cost per stored bit is extremely low. Error rates may also be higher than for magnetic technologies. As such, optical disks are most useful where there is an abundance of redundant information contained in the stored data, such as would be the case with the storage of scanned document pages. On viewing the data, the eye would not likely be troubled by a tiny dot among an ocean of dots being the wrong shade of grey. See also the discussion of magneto-optical devices (3.3.1.6.5). Conversely, magnetic devices excel in the recording of encoded text (see 3.3.4.2), but may be expensive to use for the storage of images even when compressed (3.3.2).

*3.3.1.6.4. Optical Tape.* An emerging class of technology that combines the advantages and disadvantages of tape (3.3.1.6.2) with those of optical recording technology (3.3.1.6.3). Their chief advantage may lie in very cheap cost per bit storage, but at this time they suffer from relatively high error rates.

*3.3.1.6.5. Magneto-Optical Disk.* Disks that combine the use of magnetic and optical technologies. To record data, elements of the crystal structure of the substrate are aligned by using a laser to heat the element in the presence of an applied magnetic field. When the magnetic field is aligned one way, a "1" is recorded; when the magnetic field is reversed, a "0" is recorded. The data are read by reflecting a lower-intensity laser beam off the surface; the polarization of the reflected light varies according to the crystal alignment of the element of the substrate. Unlike regular optical disks, magneto-optical disks are read/write, and have performance characteristics somewhere between those of magnetic disks and optical disks in terms of access times, transfer rates, and storage capacity.

### *3.3.2. Compression*

*Compression* refers to the extent to which the encoded form of the preserved or reformatted document has been modified to reduce the amount of storage space required by the storage medium. The technique takes advantage of the great redundancy that is present in much recorded data, particularly in image documents (3.1.5.1). Savings of storage of factors of ten or more may readily be achieved depending upon the scanning resolution and methodology employed (3.2.3), the type of material being scanned, and the particular compression method used. Although without compression the storage requirements grow rapidly as the square of the scanning resolution (3.2.3), with effective compression methods the storage requirements can be constrained to grow almost linearly with the scanning resolution. This is because advantage is taken of the greater data redundancy accruing from the increase of scanning resolution—compression effectively eliminates or reduces this data redundancy. Thus, the greater the redundancy of information contained in the scanned material, the more compression is possible—continuous tone photographs, for example, often contain large amounts of redundant information. Compression is an important factor in the economics and efficacy of digital preservation.

**3.3.2.1.** No compression has occurred.

**3.3.2.2. Reversibly Compressed.** Compression has occurred so that the process can, if required, be reversed so that the original can be recovered without loss of information. Also known as "lossless."

*3.3.2.2.1. CCITT Group Compression.* Compression standards defined by the International Consultative Committee for Telephony and Telegraphy (Comité Consultative Internationale pour la Téléphonie et la Télégraphie).

*3.3.2.2.2. Reversible Textual Compression.* If sufficiently complete, the representation in whole or in part of documents as formatted text (3.1.5.2.2) may represent a form of reversible compression. The use of a markup language (3.3.4.3) is also a form of reversible textual compression. See also 3.3.4.

*3.3.2.2.3. Page Description Language Compression (PDL).* See 3.3.4.4.

*3.3.2.2.4. Other Compression Standards or Algorithms.* Refers to other compression standards, *de facto* standards, or algorithms.

**3.3.2.3. Irreversibly Compressed.** Compression has occurred so that the process cannot be precisely reversed. The original cannot be recovered without loss of information.

*3.3.2.3.1. Irreversible Textual Compression.* The representation in whole or in part of a document as unformatted or partially formatted text (3.1.5.2) may represent a form of irreversible compression. The content of the text may be obtained but not one or more of its font style, font size, or positioning on the page.

### *3.3.3. Storage Format*

As used in information storage and retrieval, *Format* or *Storage Format* refers to the actual representation of the stored data on the storage medium, that is, the specific way in which it is encoded or programmed onto the medium. Classifying such methodologies is beyond the scope of this document. Indeed, for the most part—and particularly as applied to digital electronic storage technologies—there are few general standards that are accepted by all or most manufacturers. The implication is that access to the information stored on the medium depends upon specific software or computer programs supplied by the manufacturer, software that may become obsolete with the passage of time. One result may be that stored information may need to be reformatted or transferred to newer storage media periodically in order for the information to remain accessible with current software and technology.

### *3.3.4. Encoding Method*

*Encoding Method* refers to the *extent* to which the information *content* of the document has been interpreted and encoded, rather than merely recorded. Such interpretation may be beneficial for a number of reasons including as a means of achieving reversible compression (3.3.2.2); for the construction of document indices to facilitate searching and access (3.4.1); or for efficient distribution of the information across data networks (3.5.5). For example, a document that has been merely scanned as a bit-mapped image (3.1.5.1) has not been encoded (3.3.4.1), even though faithful "digital pictures" of the pages of the document have been obtained. If the images of the document text are later interpreted through internal character recognition (3.2.5), then the digital representation has been *textually encoded* (3.3.4.2).

**3.3.4.1. No Encoding.** No interpretation of the information contained in the original document has occurred. If the document was originally scanned using a digital image scanner (3.2.3), then the document in this instance is generally stored in some image format (3.1.5.1), compressed or not (3.3.2). If portions of the document were originally scanned using optical character recognition (3.2.4), then those portions will be stored as either formatted or unformatted text (3.1.5.2).

**3.3.4.2. Textual Encoding.** The text contained in the original document has been interpreted so that each character has a separate representation (see 3.1.5.2). Such interpretation may have occurred at the time of scanning if an optical character recognition device is used (3.2.4), or later using internal character recognition (3.2.5) programs applied to documents in image format (3.1.5.1). Such textual interpretation may result in either unformatted or formatted text, depending upon the degree of sophistication of the device or program. Recognition accuracy may also be limited.

*3.3.4.3. Markup Language Encoding.* A computer markup language is a means for describing, for an electronically stored document, the complete positioning, format, and style of text and image segment representations (3.1.5) within the document. When combined with textual representation, it is a means for achieving fully formatted text (3.1.5.2.1). When combined with relevant image information about document graphics material (if any), it may be a means of archiving fully reversible compression (3.3.2.2) of the document. An example of a markup language is *SGML* (*Standard Generalized Markup Language*) that has been adopted by the United States Government and by many publishers as a pseudo-standard.

**3.3.4.4. Page Description Language Encoding.** A computer language in which segments of text and images are economically described with respect to form, orientation, size, density, and other characteristics for purposes of economic transmission across networks and between host devices and output devices such as printers. Page Description Languages are another form of compression (3.3.2), as well as a form of encoding.

*3.3.5. Useful Life*

*Useful Life* refers to the archival quality of the storage medium. It usually refers to the period of time during which there is no unacceptable loss of information stored on the medium; and during which the storage medium remains usable for its intended purpose.

The longevity of paper varies considerably depending upon its method of manufacture and conditions of storage (see 1.5). Unless the paper is produced to meet permanent standards (1.5.1), paper may last from a few years or so to hundreds of years. Most paper produced since the middle of the nineteenth century has a useful life of less than 100 years. Paper produced to meet archival standards should last several hundred years. Film, provided it is manufactured, processed, and stored according to archival standards, appears to have a useful life well in excess of 500 years. Videotape appears to be extremely vulnerable and to have a relatively short life of a few decades.

Digital electronic storage media have a varying useful life projected to range from a few years to over 100 years. The latter has not been formally tested by experience, but is projected based on laboratory stress tests. Such media, however, become obsolete for other reasons long before their physical properties render them useless (see, for example, 3.3.3). It becomes economically and functionally infeasible to maintain the information stored on the original medium of capture, since it becomes far cheaper to transfer the information periodically to higher density and cheaper, newer technologies. Concerns also exist regarding the possibility of modifying digitally-encoded documents, particularly when "read/write" (3.3.1.6) devices are used (this is essentially not possible with "read only" or "write once, read many" technologies (3.3.1.6)); and regarding other issues of security.

The implications of periodic recopying for libraries are quite far-reaching. Libraries are not used to having to maintain their inventory by periodic recopying, even though such practices are quite common in data centers. Indeed, the recent impetus of preservation may have caused some librarians to rethink their position in this regard, although librarians still tend to think in terms of periods of centuries rather than having (or wanting) to recopy every few years. Such considerations may either hinder the adoption of digital technologies or eventually cause some rethinking of the underlying economics of librarianship.

Further implications are discussed in the Introduction.

## 3.4. Access Methodology or Technology

*Access Methodology or Technology* refers to the means of selecting information from among all the information that is stored.

*3.4.1. Indexed Access*

A *Document Index* is a systematically ordered file of objects[26] that refers to a collection of documents or to specific parts of those documents, organized in such a way as to facilitate searching the document collection for purposes of selection of single documents or groups of documents contained in the collection. Such document indices may be stored on different media depending upon how they are to be used.

**3.4.1.1. Via Catalog.** Access via a file of bibliographic records, created according to specific and uniform principles of construction and under the control of an *authority file*, which describes the documents contained in a collection. The file is usually organized in a systematic manner to facilitate access and document selection. Catalogs historically have been implemented in card files, but increasingly such card files are retroactively and prospectively giving way to computerized data files (1.2.10) which may be accessed and searched by patrons with the use of computer workstations (3.6.2.6) and data networks (3.5.5). Such computer-based catalogs are increasing in sophistication to support complex queries, including *Boolean* queries, which support logical searching (e.g., all the works of fiction written in Albania published between 1890 and 1919 by authors whose last name begins with the letter *L*).

**3.4.1.2. Via Abstract.** Access via a summary of the document. Most often, the summary is of a contribution to a journal (1.2.6) or other periodical (1.3.2). Such a summary is usually without interpretation or criticism, and may contain a bibliographic reference (or *pointer*) to the original document. A collection of document abstracts may be used for purposes of search and selection (e.g., *Chemical Abstracts*, published by the American Chemical Society and also available in digital electronic form).

**3.4.1.3. Via Table of Contents.** Access via a list of parts contained in a document, such as chapter titles or articles in a periodical, with references by page number or other locator to the starting point of the particular part, usually ordered by sequenced groupings of the order of appearance. Collections of tables of contents may also be used for search and selection purposes.

Other parts of documents that may be used for search and selection purposes include:

**3.4.1.4. Via List of Figures, Tables, Maps or Other Illustrations.** Access via a list of those parts of a document that are either figures, tables, maps or other illustrations, respectively, with location reference by page number or other locator, usually ordered by location of appearance within the document. Figures, tables, maps, etc., may be listed separately. Usually, in a document, these lists follow the Table of Contents in some order.

**3.4.1.5. Via Preface.** Access via a note preceding the body of a document that usually states the origin, purposes, and scope of the work(s) contained in the document and may include acknowledgements of assistance. When written by someone other than the author(s) of the document, the preface is more properly termed a *foreword*.

**3.4.1.6. Via Introduction.** Access via the material that heads the body of a document and that provides an overview of the work that follows, or other introductory material to the text.

**3.4.1.7. Via Index.** Access via a systematically ordered collection of words or other terms or objects[27] contained within a document, with references by page number or other locator to the placement of the object within the document for purposes of accessing the object. The index is usually placed last in a document.

**3.4.1.8. Via Citation.** Access via *reference* to a document or to a part of a document, such as an article in a journal (1.2.6). A *bibliography* is a collection of citations directed to a specific purpose, such as a *subject bibliography* or a bibliography of citations appended to a journal article.

*3.4.2. Full (or Partial) Document Access*

*Full Document* or *full text* searching is where the full text of a collection of documents is stored, and the entire text of all or portions of the documents is searched for specific character strings, usually combined with some Boolean logical searching capabilities. This requires that the document be textually encoded (3.3.4.2) either because it was initially created that way or perhaps more likely in the context of preservation because such textual encoding was obtained from scanned document images (3.1.5.1) with internal character recognition (3.2.5). Thus, for example, a search may consist of searching for all documents in the collection published by a given author or set of authors between certain dates containing the text "all that glitters." Full text searching is normally implemented on computers. For other than small collections of documents, a given search may be very costly in terms of computer processing time.

**3.4.2.1 Via Inverted Text File Index.** The use of *Inverted Text Files* (or other similar techniques) is often used as a compromise between indexed and full text searching. A file of words (*Keyword*), phrases (*Key Phrase*), or other text objects contained in a given collection of stored documents is created from an initial analysis of the full text together with locators as to where all instances of the word, phrase, or other object can be found within the file. In use, instead of the full text being searched for all occurrences of the object,[28] the inverted file itself efficiently gives pointers to the locations. The construction of such an inverted file, however, may be expensive for large collections of documents, as would adding new words or other objects[29] to the file at a later date. Furthermore, the use of the file is only as good as the care that has been given to the choice of objects to be contained within the file.

*3.4.3. Compound Document Access*

*Compound* documents are documents that contain both textually and other forms of encoded information, including image (see 3.3.4). Techniques are being developed for expanding the concept of text searching to searching of full compound documents, including those containing image objects.[30] A full glossary of such techniques, however, is premature and beyond the scope of this document.

## 3.5. Distribution Technology

*Distribution Technology* refers to the technology used to distribute or deliver the stored encoded document from one point to another. Some form of *delivery service* may be used (3.5.2), or, if the medium is paper, it may be distributed using point-to-point or distributed *FAX* (3.5.3). On the other hand, if the medium is digital electronic, then either the document may be converted to paper, by "*printing-on-demand*" (3.5.4) and subsequently distributed using delivery services or FAX, or *data networks* (3.5.5) may be used for distribution to a *computer workstation* (3.6.2), possibly to be converted to another medium, such as paper, at the point of delivery (see 3.6.1).

*3.5.1. Distribution Medium*

The *Distribution Medium* is the medium used to transport the stored encoded document to the presentation or viewing device (3.6.2). The same media that can be used for original documents (1.1) can also be used as distribution media.

**3.5.1.1 Paper** (see 1.1.1)
**3.5.1.2 Microform** (see 1.1.2)
**3.5.1.3 Video** (see 1.1.3)
**3.5.1.4 Film** (see 1.1.4)
**3.5.1.5 Audio** (see 1.1.5)
**3.5.1.6 Digital Electronic** (see 1.1.6)

Whichever technology is used for storage (3.3.1), digital technologies may usually be used as the medium of distribution, as contrasted with using delivery services (3.5.2) to deliver the document. Paper, for example, can be scanned and transmitted by FAX (3.5.3) or across data networks (3.5.5). The only exception to this at this time is video, which is normally distributed by analog electronic distribution networks (as opposed to digital—see 1.1.6), because of the high information capacity (*bandwidth*) required. As the bandwidth of data networks grows, however, it is anticipated by many technologists that analog transmission will yield to digital transmission even for video recordings. Films, too, are often transmitted by converting them to video recordings (with some loss of quality at this time), and transmitting them across analog video networks.

*3.5.2. Messenger Services*

*Messenger Services* refers to the use of local, regional, or national messengering or mail services to hand-deliver documents from the point of inventory or storage to the patron or consumer. One special case of this includes the patrons performing the messengering services for themselves by viewing the document, or by directly acquiring it (purchasing or borrowing), at or from the location of the document's storage.

*3.5.3. FAX*

*FAX* or *Facsimile Transmission* is a system of communication or delivery for paper documents or other graphics material in which a special digital image scanner (3.2.3) scans the pages of the document, compresses the scanned image using CCITT Group Compression (3.3.2.2.1), and transmits the digital signals by wire or radio to a FAX receiver at a remote point. The FAX receiver decompresses the signals received and prints the digital image on paper. FAX transmission is a point-to-point protocol that is normally conducted over voice (3.5.6) or data (3.5.5) networks. Usually, scanning and printing devices are relatively slow (about 5 pages per minute), and the quality is limited. The popularity of FAX rests on its simplicity of use and the relatively low cost of the equipment. With the rapid growth of installed FAX equipment, FAX has recently been extensively used for inter-library loan purposes, and is also becoming used for intra-campus delivery purposes.

### *3.5.4. Print-on-Demand*

*Print-on-Demand* refers to the capability to print documents right at the time they are required by patrons and consumers, rather than following traditional norms of printing documents in advance of need and coping with the need to distribute and inventory printed documents in anticipation of demand. This approach to distribution mirrors the "just-in-time" approach to inventory control. *Print-on-Demand* techniques are normally used in conjunction with digitally stored documents (3.3.1.6) and data networks (3.5.5). The approach offers the promise of closing the gap between the world of digital technologies and those who maintain the superiority or simply prefer the characteristics of paper documents. Documents may be printed right in the patron's office or at a shared local facility from where it is delivered to or picked up by the patron.

### *3.5.5. Data Networks*[31]

A *Data Network* is a communications network that transports data between and among computers and computer workstations (*network nodes*). Such networks may depend upon different physical media to transport the encoded digital signals (twisted pair copper wire, coaxial cable, fiber optic cable, satellite, and so forth); different protocols to encode the signals; and different ways in which the encoded signals are interpreted for use in applications. They also include bridges, routers, and gateways for connecting different media and for translating one protocol into another. Data networks vary considerably in speed and capacity, depending upon the physical media, the protocols used, and the particular architecture of the network. Network speeds and other performance characteristics appear to be more than doubling every two to three years.

**3.5.5.1. Local Area Network.** A *Local Area Network* (*LAN*) is a data network used to connect nodes that are geographically close, usually within the same building. In a wider view of a local area network, multiple local area networks are interconnected in a geographically compact area (such as a university campus), usually by attaching the LANs to a higher-speed local *backbone*.

**3.5.5.2. Wide Area Network.** A *Wide Area Network* (*WAN*) is a data network connecting large numbers of nodes and LANs that are geographically remote, such as within a broad metropolitan area, or between widely separated metropolitan areas. This would also include *regional networks*, such as NYSERNet, which interconnects research and educational institutions in New York State.

**3.5.5.3. National Network.** A WAN, or a federation of interconnected WANs, that spans the nation, such as the NSFNet, BITNet, CSNet, CREN, and, more generally, the Internet and the anticipated NREN (National Research and Educational Network). These national networks often use a high-speed spanning national backbone to interconnect regional WANs. Protocols are established to facilitate routing of information across the national networks to users at connected nodes. The national networks often have international connections and outreach.

### *3.5.6. Voice Networks*

*Voice Networks* are local, national, or international networks used to carry voice or telephone traffic. They may be either analog or digital (see 1.1.6). Because of different technical requirements, the transmission of data and voice usually is conducted using different transmission protocols, although it is increasingly common to share the same wiring plant. In general, there is increasing integration between the voice and data milieus.

*3.5.7. Cable Networks*

*Cable Networks* are local, regional, or national networks normally used for the transmission of analog (see 1.1.6) signals such as video (see 1.1.3) television signals.

**3.6. Presentation Technology**

*Presentation Technology* is the term given to technologies that present the encoded document to the end user or patron, possibly following some conversion of one medium to another. If the storage medium is paper, for example, no conversion would be necessary, and the storage medium and the presentation medium are one and the same (unless the distribution technology used were, say, FAX, in which case there are intervening conversion processes). If the storage medium, on the other hand, were digital electronic (3.3.1.6), for example, and data networks (3.5.5) were used as the means of distribution, then the presentation technology might be a computer workstation (3.6.2.4) or the distributed encoded document could be converted to some other form such as paper.

*3.6.1. Presentation Medium*

The *presentation medium* is the medium into which the stored document (3.3), which has been distributed over the distribution medium (3.5.1), is converted to facilitate viewing or reading by the end user.

**3.6.1.1. Paper** (see 1.1.1).
**3.6.1.2. Microform** (see 1.1.2)
**3.6.1.3. Video** (see 1.1.3)
**3.6.1.4. Film** (see 1.1.4)
**3.6.1.5. Audio** (see 1.1.5)
**3.6.1.6. Digital Electronic** (see 1.1.6)

*3.6.2. Presentation or Viewing Device*

A *Presentation or Viewing Device* converts the distribution medium (3.5.1) into the presentation medium (3.6.1). This includes the class of *computer workstations* (3.6.2.6).

**3.6.2.1. Paper Document.** A paper document, such as a book, must itself be considered a viewing device in this context when the presentation medium is paper (3.6.1.1). See 1.2 for a classification of different formats for paper documents.

**3.6.2.2. Microform Reader.** A display device with a built-in screen and magnification so that a microform (1.1.2) can be read comfortably at normal reading distances. Such devices may be accompanied by *microform printers* that can produce full-size (generally low-quality) paper copies of the microforms.

**3.6.2.3. Video Projector (Television Set).** A device used to project or play back videotapes (1.1.3 and 3.6.1.3) onto a television screen. Normally this is accomplished through the use of a videorecorder (see below) and *television set* or *television projection system.* However, it is becoming increasingly common to play the video back through a computer workstation (3.6.2.6), possibly converting the analog signal to digital form (1.1.6).

The term *videorecorder* is often used to denote a device capable of both recording live television signals onto videotape and for reading recorded videotapes and transmitting the signal to a video projector or television set.

**3.6.2.4. Film, Slide, or Other Projectors.** A device to project motion picture films (1.1.4), still photographic slides (1.2.9.3), or other graphic materials (1.2.9) onto a screen, and, with some device, to reproduce sound from the film soundtrack. *Slide viewers* enable the user to view the slides through background projection on a small screen. Other classes of projectors (such as *overhead projectors*) are designed to project images recorded on transparencies onto a screen.

**3.6.2.5. Audio Devices.** A device capable of playing back audio documents (1.1.5) such as phonograph record players, CD players, and tape cassette players.

**3.6.2.6. Computer Workstation.** A device capable of supporting the creation, storage, access, distribution, or presentation of digital electronic documents (1.1.6), ranging from special purpose devices such as electronic typewriters through microcomputers to high-performance engineering or desktop publishing workstations or even large mainframe computers. They may vary considerably in performance, as typically measured by the computer's internal processing speed, storage capacity, and ability to move data between its various devices. The traditional distinction between *personal computer* (*PC*) and a *high-performance workstation* is blurring, and the term *workstation* is generically used to cover both.

*3.6.2.6.1. Display Monitor.* That portion of a computer workstation used to view digital electronic documents. This may consist of a display module built into the computer or it may be physically separated from the computer, but attached by cable. Display monitors may be black-and-white (1.4.1.1.1), greyscale (1.4.1.1.2), or color (1.4.1.4). They may also come in varying physical sizes typically ranging from about 8 inches on the diagonal to 23 inches or more. They may also display with varying resolution, with the higher (but not highest) performance monitors capable of displaying over 1,000 x 1,000 pixels (spots).

*3.6.2.6.2. Local Printer.* A device locally attached to a computer workstation capable of printing digital electronic documents stored in the computer (3.3.1.6) or distributed to the computer from across a data network (3.5.5). Such devices may utilize a range of technologies including *impact printing, ink-jet printing, thermal printing* and *laser printing.* They may print at varying speeds ranging from 10 characters per second to some tens of pages per minute. They may print with resolutions varying from several dots per linear inch to several hundred dots per linear inch. They may print in black-and-white, greyscale, or color.

*3.6.2.6.3. Remote Printer.* A printer (3.6.2.6.2) that is accessible to a computer workstation remotely across a data network (3.5.1.6). These may typically be higher performance devices than local printers, particularly regarding speed or resolution. Such devices are typically shared among many uses and users. They may have special capabilities for "finishing" documents.

*3.6.2.6.4. Other Local Media Output Device.* Computers capable of supporting multimedia (3.6.2.7) may support other "presentation" devices, such as television monitors for video recordings (although the trend is to combine the television video monitor and the computer display monitor into a single "head"), and audio playback devices for sound signals, including connections to "hi-fi" stereo equipment.

**3.6.2.7. Multi-Media Workstation.** A computer workstation (3.6.2.6) capable of supporting and combining multiple media such as digital electronic, video, sound, and paper.

## REFERENCES AND NOTES

1. See Section 3.1 for a discussion of the use of the term "media conversion" to replace the use of the term "reformatting." We also follow the distinction that while media conversion is not a conserving technology, it is a preserving technology.
2. This analogy was pointed out by Douglas van Houweling.
3. A glimpse of possible implications has already been seen in the tendency of many libraries to charge patrons for searches of electronic databases.
4. Harvey Wheeler: "The Virtual Library: The Electronic Library Developing within the Traditional Library," Doheny Documents, University of Southern California University Library, 1987.
5. Some fields, particularly those propelled by the impetus of commercial endeavors such as medicine, law, and finance, are beyond the prototype stage and are into full production.
6. Conservation may allow for only partial preservation of the original document. The bindings, for example, may be replaced while the body of the document is conserved.
7. Originally, the term "vellum" was restricted to calfskin. The distinction between parchment and vellum has eroded over the years.
8. The term *digital technologies* is also used for brevity throughout this Glossary.
9. The non-technical reader may wish to compare the odometer of a car (a *digital* device which quantizes in precise 1/10th of a mile increments) with the speedometer (an *analog* device which displays speed continuously but which can only be interpreted approximately).
10. However, *digital*(ly encoded) video is now becoming part of the panoply of technologies, where analog video signals are converted to digital signals for purposes of storage, transmission and playback through a computer (3.6.2.6) or multi-media (3.6.2.7) workstation.
11. This assertion, however, may not be true in the future. For example, music is now recorded in digital electronic form, such as DDD Compact Discs.
12. Although an increasing number of books are published on other media (see the Introduction to this Section). This remark also applies to 1.2.3, 1.2.4, 1.2.5, 1.2.6, and 1.2.8. Video magazines and journals, for example, are beginning to appear. A few books are being published only in digital form for playback on a computer workstation.
13. In keeping with the spirit noted in the Foreword that this Glossary is intended to be comprehensive but not exhaustive.
14. The Term "object" is used here in a sense that

is more familiar to computer professionals than to librarians.

15. Strictly speaking, monotone documents should be termed "monohue."
16. Copyright law as it applies to the subject of preservation will be the subject of a forthcoming paper by the Commission on Preservation and Access.
17. For a fuller explanation of copyright laws, see "Copyright Basics," Circular No. 1, published by the Copyright Office of the U.S. Library of Congress, Washington, DC 20559.
18. See also "Selection for Preservation of Research Library Materials," a Report of the Commission on Preservation and Access, August 1989.
19. The Research Libraries Group, Inc., is a not-for-profit corporation owned and operated by its governing members: major universities and research institutions in the United States.
20. It is tempting to use the term "remediate" for "media conversion," a temptation that has been resisted in the formulation of this Glossary.
21. For a discussion of the importance of conservation see "On the Preservation of Books and Documents in Original Form," by Barclay Ogden, Report of the Commission on Preservation and Access, October 1989.
22. For more information see "Technical Considerations in Choosing Mass Deacidification Processes," by Peter G. Sparks, published by the Commission on Preservation and Access, May 1990.
23. The original, or preservation, negative should not be viewed with a microform reader (3.6.2.2) because of potential damage to the negative.
24. Newer processes becoming available appear to remove the obstacle of high-contrast recording.
25. Removable disks, such as floppy disks, are also used for archival storage. However, magnetic tapes are usually cheaper when large volumes of data are to be archived.
26. See reference 13.
27. See reference 13.
28. See reference 13.
29. See reference 13.
30. See reference 13.
31. The Technical Assessment Advisory Committee of the Commission for Preservation and Access is preparing a report on the implications of data networks.

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# Communications

## Utilization of Commands in an Online Bibliographic Editing System

**Raymond G. Taylor and Janet Gebbie Edgerton**

*Using the command trace log of an online bibliographic system in a university research library, the authors analyzed 7,000 editing activities and categorized them into thirty-four groups of functions. From this data, several insights into the effectiveness and efficiency of the editing system were obtained. This article reports the results of the first phase of a larger study concerning online bibliographic editing.*

This report summarizes the first phase of a more extended project sponsored by the Council for Library Resources. The larger project concerns the effectiveness and the efficiency of editing procedures within an online bibliographic system at a large research university library; specifically, it seeks to identify the reasons why editing attempts occasionally fail and what, if anything, can be done to diminish the occurrence of such failures.

The first phase of the project, as reported here, consisted of developing a comprehensive statistical overview of the commands available: how often was each command used; were certain features of the system rarely employed; for what proportion of the time were editing sessions undertaken for the apparent purpose of updating a bibliographic record, and of all those attempts, how many failed? Overall, the first phase of the project gained as much information as possible from a descriptive analysis of edit command traces, with the intention that such information would help focus the more labor-intensive second phase (personal interviews with editing staff, observations of edit sessions, surveys, etc.). Because the first phase revealed a great deal about the system and the behavior of persons using that system, it is offered here as a separate research brief.

### EDITING COMMAND STRUCTURE

Thirty-four commands were available in the system studied. They are listed in the first column of table 1 and are assigned a reference number in the second column. The reference number is used to unambiguously associate the commands among tables, analyses, and phases of the study. Some of the commands may be invoked by pressing a single function key on the editing terminal. Presumably, the designers of the system attempted to anticipate which commands would be most frequently used and assigned function keys accordingly. The third column of table 1 indicates that fourteen function keys were available and two were not assigned. The fourth column, labeled "short form," lists the abbreviation that may be used to invoke the command. Generally, these are two-character alpha abbreviations, although there are exceptions to this. Finally, the edit commands may, in most cases, be invoked by entering the command's full form, as listed in the far right-hand column of table 1. Again, there are several exceptions. One command was available only by way of the function key (Break), and one group of commands was available only by way of abbreviation (Search). Otherwise, the user had some personal choice in the general style and strategy of command form selection. Such choice yields the first set of observations displayed in table 2.

### METHOD

Tens of thousands of command traces were captured from a busy week in early April 1989. These traces were taken as a block from

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*Table 1. Summary of Edit Commands*

| Operation | Ref. No. | Function Key No. | Short Form | Full Form |
|---|---|---|---|---|
| Update | 1 | 1 | up | update |
| Save | 2 | 2 | sa | save |
| Print | 3 | 3 | pri | print |
| Bib/Hold Key | 4 | 4 | N/A | N/A |
| Not used | 5 | N/A | N/A | N/A |
| Reformat | 6 | 6 | rf,re | reformat |
| Not used | 7 | N/A | N/A | N/A |
| Cancel | 8 | 8 | ca | cancel |
| Expand | 9 | 9 | ex | expand |
| Help | 10 | 10 | he,? | help |
| Previous | 11 | 11 | pre | previous |
| Next | 12 | 12 | ne,ns | next |
| Undo | 13 | 13 | un | undo |
| Break Key | 14 | 14 | N/A | N/A |
| Copy | 15 | N/A | cp | copy |
| Delete | 16 | N/A | de | delete |
| Display | 17 | N/A | ba,ho,se,fu | di |
| End | 18 | N/A | en | end |
| Find | 19 | N/A | fi | find |
| Get | 20 | N/A | / | get |
| Add | 21 | N/A | ad | add |
| Highest Copy | 22 | N/A | hi,hc | high |
| Index | 23 | N/A | in | index |
| Move | 24 | N/A | mo | move |
| Yes/No | 25 | N/A | y,n | yes,no |
| Override | 26 | N/A | ov | override |
| Search by: | | | | |
| Control # | 27 | N/A | #,1c,sb,ss,str | N/A |
| Author | 28 | N/A | au,org,pe | N/A |
| Title | 29 | N/A | ti,pt,ser,uni | N/A |
| Subject | 30 | N/A | lcs,mes,loc,sub | N/A |
| Call # | 31 | N/A | lc#,d#,nlm#, local#,nm | N/A |
| Start | 32 | N/A | st | start |
| Status | 33 | N/A | stat | status |
| View | 34 | N/A | vi | view |

the command trace log and then sorted by terminal. The traces from nonediting terminals were then removed, leaving a stream of 6,991 edit lines. Each line consisted of a terminal identifier, a date and time, an edit command, and all other keystrokes made by the user up to the next carriage return. The edit commands were then searched to produce the summary shown in table 2.

The body of table 2 is composed of the frequency of occurrence of each form of each command, together with a total for all forms of each command. Where a command is not available in a particular form, tables indicate that a count was not applicable (N/A); in this manner, unavailable forms of commands are not confused with those that had counts of zero.

## DISCUSSION

Four commands were not used (Print, Break, Find, and Status). Library staff working at editing terminals, however, indicate that printing does occur by way of "Print Screen." This is a temporary arrangement; once ended, the Print command will be used. With respect to Break and Find, these commands should be studied further. Are they superfluous? Are users simply unaware of their availability? Have users experienced problems with these commands and therefore avoided them?

*Table 2. Frequency of Use, Edit Commands by Form Number of Transactions Examined: 6991*

| Operation | Ref. No. | Function Key | Short Form | Full Form | Total |
|---|---|---|---|---|---|
| Update | 1 | 818 | 555 | 5 | 1,378 |
| Save | 2 | 7 | 22 | 0 | 29 |
| Print | 3 | 0 | 0 | 0 | 0 |
| Bib/Hold Key | 4 | 134 | N/A | N/A | 134 |
| Not used | 5 | N/A | N/A | N/A | N/A |
| Reformat | 6 | 75 | 0 | 0 | 75 |
| Not used | 7 | N/A | N/A | N/A | N/A |
| Cancel | 8 | 4 | 8 | 0 | 12 |
| Expand | 9 | 13 | 6 | 0 | 19 |
| Help | 10 | 6 | 16 | 0 | 22 |
| Previous | 11 | 74 | 0 | 0 | 74 |
| Next | 12 | 460 | 59 | 0 | 519 |
| Undo | 13 | 1 | 2 | 0 | 3 |
| Break Key | 14 | 0 | N/A | N/A | 0 |
| Copy | 15 | N/A | 0 | 1 | 1 |
| Delete | 16 | N/A | 56 | 0 | 56 |
| Display | 17 | N/A | 35 | 0 | 35 |
| End | 18 | N/A | 0 | 360 | 360 |
| Find | 19 | N/A | 0 | 0 | 0 |
| Get | 20 | N/A | 27 | 0 | 27 |
| Add | 21 | N/A | 43 | 8 | 51 |
| Highest Copy | 22 | N/A | 2 | 3 | 5 |
| Index | 23 | N/A | 530 | 2 | 532 |
| Move | 24 | N/A | 0 | 2 | 2 |
| Yes/No | 25 | N/A | 93 | 9 | 102 |
| Override | 26 | N/A | 7 | 0 | 7 |
| Search by: | | | | | |
| Control # | 27 | N/A | 450 | N/A | 450 |
| Author | 28 | N/A | 101 | N/A | 101 |
| Title | 29 | N/A | 215 | N/A | 215 |
| Subject | 30 | N/A | 48 | N/A | 48 |
| Call # | 31 | N/A | 0 | N/A | 0 |
| Start | 32 | N/A | 219 | 0 | 219 |
| Status | 33 | N/A | 0 | 0 | 0 |
| View | 34 | N/A | 2 | 0 | 2 |

The function keys appear to be well assigned, with a few notable exceptions. There were a large number of Index commands, almost all using the abbreviated form; a function key for this command would improve the efficiency of the system. The Update command was most often invoked by way of the function key; however, it was occasionally invoked in its full form and often by way of its abbreviated form. Similarly, Save, Cancel, Expand, Help, and Next were often used in abbreviated form instead of being called by their respective function keys.

Staff training activities might profitably focus on this lack of efficiency. Reserved function keys for certain low-volume uses, such as Undo, might better be reassigned to more popular commands such as Delete, Display, End, Get, Add, and Index.

Less than 3 percent of all edits were unsuccessful. This is reasoned as follows:

$$\% \text{ of Failures} = \frac{\text{Save + Cancel}}{\text{Update + Save + Cancel}}$$

The Save command places an edited record into the user's editing file so that it can be worked on again at a later time or can be reviewed by a supervisor. The failure rate for the system under study seems fairly good, especially when some users were in training and were expected to use Save rather than

Update. However, in the second phase of the project, sessions ending in Save and Cancel will be examined on a line-by-line basis and will be the gist for interviews and observations. Ultimately, the researchers hope to understand exactly why edits fail and how the training program or the system itself can be improved to reduce such failures.

There was no use of the abbreviated form of End. This might appear reasonable given that the full form is only one character longer than the abbreviated form. However, the abbreviated form of Add was used five times as often as the full form. It is not yet known whether this phenomenon is idiosyncratic to a particular group of users or is, perhaps, the result of a trainer's preference.

Further, the existence of two-character abbreviations for three-character full names (End and Add) is, in a sense, inconsistent with the provision of three-character abbreviations for certain other commands (such as Previous). It would be beneficial to tidy up the overall command structure by creating consistent first-two-character abbreviations. No memorization would be required. (A change from Print to List would solve the conflict between Print and Previous.)

## SUMMARY

From the condensed data reported above, many important research questions may be generated. Among those questions are the following: Are failures concentrated in certain departments or even within certain work groups, and if so, what are the implications for staff development and supervision? The patterns of use of certain edit commands are almost certainly different between departments due to their respective roles, but what exactly are these differences and do such differences reveal uneven efficiencies? Which types of editing activities precede a Save or Cancel; are there predictable precursors to editing failure, and if so, what are the implications for staff development, especially at the induction level?

The primary purpose of the first phase of this study was to distill a large amount of data into a single summary table and to list the phase-two research questions that such a summary might spawn. The second phase involves a detailed examination of the editing session sequences that end in failure, surveys of library editing staff, observation of editing sessions, and interviews with staff that experience an exceptionally high or an exceptionally low Save or Cancel rate. Suggestions and inquiries from readers would be very welcome. ■■

# Recent Publications

## Book Reviews

**Alberico, Ralph, and Mary Micco.** *Expert Systems for Reference and Information Retrieval: Supplement to Computers in Libraries, no.10*. Westport, Conn.: Meckler, 1990. 395p. $47.50 (ISBN 0-88736-232-X).

This work is more than just another book about expert systems. As expected, the authors cover artificial intelligence and expert systems in the eleven chapters that compose the book, but they also devote considerable attention to the role of data structures, vocabulary control systems, and user interface design in developing computer systems for reference and information retrieval.

In chapters 1 and 2, artificial intelligence and expert systems are addressed as they apply to librarianship generally. Six areas of artificial intelligence research applicable to library-related problems are discussed, including: natural language processing, speech recognition and synthesis, robotics and computer vision (including OCR), intelligent tutoring systems, neural networks, and expert systems. Examples of research projects and operational systems in each area are cited. In chapter two, the authors describe the basic components of a simple expert system.

Although such concepts as knowledge base, goal formulation, inference engine, and logic flow are presented in a clear, straightforward manner and have library applicability, none of the examples given pertains to the library field.

In chapter three, the information retrieval and reference processes are addressed specifically. Models of the reference process (e.g., communications models, human information processing models, etc.) are suggested as possible frameworks for expert systems. Chapter 4 is devoted to a review of efforts to automate reference and online information retrieval.

Knowledge engineering and representation are the topics of chapters 5 and 6. Both sources of knowledge and techniques for obtaining it (knowledge acquisition) are covered. In their discussion of knowledge representation, the authors identify several criteria for evaluating knowledge representation schemes.

By including chapters on vocabulary control systems and user interface design (chapters 9 and 10, respectively) Alberico and Micco present a comprehensive study of the issues to be considered in expert systems design.

The questions of whether or not the average librarian should try to develop an expert system and what can be gained from the experience are posed in chapter 9. These questions are probably best answered by the reader after reviewing the case study of the development of a microcomputer-based expert system for business reference presented there. This chapter also discusses criteria for selecting a software development tool (i.e., artificial intelligence (AI) programming language versus an expert systems shell program) and project management concerns, such as budgets and development schedules. Methodologies for designing large expert systems are addressed in chapter 10.

In the final chapter, the authors forecast future directions in the technologies for building expert systems and the situations in which these systems will be applied. Their predictions with respect to AI software trends fall close to the state of the art in expert system tools (i.e., graphic interfaces, hybrid systems, object-oriented approaches, integration with external programs, access to database management systems, etc.). In terms of hardware, the authors foresee ROM chips containing various electronic thesauri, parallel computing for library applications, and advances in multimedia workstations. This chapter concludes with a number of thoughtful questions regarding the social and ethical implications of library expert system applications.

The authors succeed in their goals of enabling the reader to gain a basic understanding of expert systems and their potential application within libraries. This book is recommended both for readers with little knowledge of expert systems and for those with a moderate knowledge who wish to gain a perspective on the role of expert systems in the reference and information retrieval context. The book contains a comprehensive bibliography drawn primarily from the information science literature and recommendations for additional readings at the ends of chapters.—*Diane Vizine-Goetz, OCLC, Online Computer Library Center, Inc.* ■■

***CD-ROM in the Library: Today and Tomorrow.*** Ed. By Mary Kay Duggan. Boston: Hall, 1990. 126p. paper, $22.50 (ISBN 0-8181-1934-1).

*CD-ROM in the Library: Today and Tomorrow* is a collection of papers presented at a conference sponsored by the University of California, Berkeley, Extension and the Berkeley School of Library and Information Science in August, 1989. The intent of *CD-ROM in the Library* is to assess the impact of CD-ROM on information service and management and to help librarians planning to integrate CD-ROM into information service.

The seven papers explore such issues as CD-ROM for reference, remote and multiple access for CD-ROM, CD-ROM for technical services, planning and decision making for CD-ROM public access catalogs, and search software.

This volume functions best as a readable survey of the technology and product capabilities as they relate to CD-ROM selection as an information access tool for library users. The intended audience is librarians with basic technical knowledge who want to become informed about one solution among the proliferating array of information technologies. Graduate students in library and information science would find the work sufficient as an introductory source on this subject.

Particularly useful as an overview of service considerations was Mary Kay Duggan's chapter, "CD-ROM for Reference: Making the Electronic Library Work for Users," and Alan Ritch's section about the reference experience at the University of California, Santa Cruz.

While requiring more technical experience in order to adequately grasp the content, John Ober's chapter, "CD-ROM Technological Development: Remote and Multiple Access with DOS," and Ray Larson's "CD-ROM Search Software: From Menus to Hypertext" provide satisfying examinations of the networking and interface dynamics of the technology. Both of these sections are enhanced by clear and well-selected graphics. Charlotte Nolan and Vivian Pisano offer useful examinations of CD-ROM technology for public-access catalogs. Advantages and disadvantages in comparison to online systems are effectively articulated.

*CD-ROM in the Library* might have been improved by the inclusion of a more extensive discussion of user instruction and staff training issues surrounding CD-ROM technology. While there is perhaps little argument that mechanical skills for searching, though complicated by a lack of standardization, can be fairly efficiently imparted to users, the conceptual dynamics of search design are, in fact, made complex by the extensive capabilities of CD-ROM products. The ongoing debate among CD-ROM users about effective instructional strategies for teaching searching techniques for online and CD-ROM systems is loud, varied, and, as yet, inclusive. The issue deserves a more central place in any discussion of CD-ROM.

Also missed was a more focused discussion of issues surrounding collection development and CD-ROM. While space and budget savings are identified as benefits of the introduction of this technology, use of CD-ROM as a document storage medium has ramifications that deserve further exploration. Each chapter of this book has a useful references list, and most citations are to the periodical literature of the last five years. *CD-ROM in the Library: Today and Tomorrow* can enhance the practicing librarian's ability to manage this important technological innovation and incorporate its use into a complex information service.—*Randall B. Hensley, User Education Librarian, University of Washington.* ■■

***CD-ROM Professional.*** Ed. by Nancy K. Herther. Weston, Conn.: Pemberton. Bimonthly. $86/yr. (ISSN 1049-0833).

Formerly titled *The Laserdisk Professional* (which began publication in May 1988), *CD-*

ROM Professional* continues its subtitle as "The Magazine of Optical Information Media." The editorial focus of this bimonthly journal is "to inform and assist information specialists in the selection, evaluation, purchase, and operation of CD-ROM titles, workstations, networks and related equipment, as well as provide practical information on all aspects of CD-ROM publishing."

Each issue of *CD-ROM Professional* provides material under the broad headings of "Feature Articles," "CD-ROM Publishing," "Reviews/Product Tests," "Columns," and "Departments." Feature articles provide in-depth analysis and discussion of a variety of topics related to CD-ROMs, including aspects of remote access, security, and standards, while also examining related topics in information media (such as multimedia in the classroom and the NeXT computer). These articles, although not geared necessarily to the novice, are not overly technical and should be readable by a large audience.

The "CD-ROM Publishing" section includes discussions of specific applications as well as coverage of electronic publishing conferences and other useful information, such as a directory of CD-ROM mastering facilities in North America (July 1990). "Reviews/Product Tests" provides a detailed examination of some of the more widely known and used CD-ROM products (e.g., MEDLINE) as well as some specialized products (e.g., National Archive on Sexuality, Health & Adolescence, and Religion Indexes on CD-ROM).

The true CD-ROM professional will find much of value in the "Columns" and "Departments" sections of each issue, where more candid glances into the CD-ROM industry and profession can be found. Included in "Columns" are editorials on the CD-ROM industry, announcements, and short reviews of products, book reviews, and conference reports. Two additional columns of note are the "View from Canada," which provides a summary of news and developments of Canadian applications and products, and "Research Perspectives," offering brief presentations on research in such areas as bibliometrics and comparative economics of CD-ROM and other media.

"CD-ROM News," easily identified in each issue by darker pages, is an excellent source for capsule information on the CD-ROM industry, CD-ROM titles and software, and general news of the field. Although the bimonthly publication schedule of this journal and the rapidly changing nature of this industry makes such news items "old news" by the time they are published, this drawback (which is characteristic of all publications of this type) is offset to some degree in *CD-ROM Professional* by the inclusion of names, addresses, phone numbers, e-mail addresses, and/or fax numbers by which additional information can be obtained about most of the news items presented in this section.

Another useful section is "Journal Watch," which provides recommended reading and summaries of articles on CD-ROM and related topics that have appeared in a number of information technology publications.

Similar in scope to Meckler's *CD-ROM Librarian* and comparable in format to Online Inc.'s sibling publications, *Database* and *Online*, *CD-ROM Professional* combines several positive aspects of these related publications in its coverage and presentation. Although most of the authors of articles in *CD-ROM Professional*, to date, have come from the library profession (not a surprising or negative observation), there is an evolving attempt to provide a broader range of topics and viewpoints on the optical information business. Librarians will want to know of applications in their field, but they would benefit from being exposed to developments in related disciplines as well. Potentially, *CD-ROM Professional* offers this type of exposure. As such, *CD-ROM Professional* is a useful companion publication to the *CD-ROM Librarian*, *CD-ROM End-User*, and other publications of this type. Enough is happening in this field to justify these varied publications, and the quality of articles and columns in *CD-ROM Professional* assures its place among these titles.—*James J. Kopp, Washington State University, Pullman, Washington.* ■■

**Chen, Ching-chih.** *HyperSource on Multimedia/Hypermedia Technologies*. Chicago: Library and Information Technology Association Division of ALA, 1989. 256p.,$27.50 (ISBN 08389-7371-X).

Ching-Chih Chen's new bibliography on multimedia/hypermedia comes at a good time. Librarians have begun to become interested in multi/hypermedia applications (defined by Chen as the computer-based integration of text, graphics, animation, audio, and video images into a single presentation or information package), but find little assistance in their own professional literature. Whether the reader is interested in learning more about what multi/hypermedia technologies are (a useful introduction to the volume covers this topic), the components needed to develop and display multi/hypermedia applications, the talent necessary to produce these new information packages, the companies that market the technologies, or the sorts of applications for which librarians might consider hyper/multimedia, Chen's book contains relevant sources.

*Hypersource on Multimedia/Hypermedia Technologies* (designed as a companion volume to the author's *HyperSource on Optical Technologies* and (with Rae Jean Wiggins) *HyperIntro to CD-ROM Technology and Products*) pulls together over 3,000 references (largely journal articles but also monographs, conference proceedings, and periodical titles) on the topic, 70 percent of them from nonlibrary sources. The bibliography is especially useful in that it brings to the attention of librarians valuable material they might have missed because the information is most often found in journals they may not commonly examine. Chen organizes the book topically (some sample chapter titles include "Computer-based Instruction," "Expert System and Artificial Intelligence," "Hypermedia/Multimedia Applications," and "Interactive Video & Videodisc Technologies") and includes an author index.

Librarians whose responsibilities lie in instruction, media services, and automated systems, as well as those who develop presentations or assist others in doing so, will find this volume essential as they examine multimedia technology's potential for communicating and sharing information. This is particularly true as new authoring programs place the development of hyper/multimedia presentations within the reach of those who may have thus far avoided computer-based approaches.—*Barbra Buckner Higginbotham, Brooklyn College Library.* ■■

**Crawford, Walt.** *MARC for Library Use, Second Edition: Understanding Integrated USMARC*. Boston: Hall, 1989. 376p. $38.50 (ISBN 0-8161-1887-6).

The second edition of *MARC for Library Use* has been updated and expanded to include recent changes made to the USMARC format. Crawford has reorganized the work by providing individual chapters for each type of media (books, maps, holdings, etc.), separating out subfields and indicators from the structure of USMARC and dividing the section on MARC compatibility into two chapters on fully and partially compatible formats and systems.

Chapters on the content of the format address the fields, subfields, and indicators common to all types of media, while individual chapters discuss the fields that appear frequently on MARC records for each type of media. Examples of bibliographic records, drawn from the RLIN database, illustrate the use of the fields and subfields in the USMARC format. A chapter devoted to nonroman texts in USMARC explains the techniques used to identify and link romanized and nonromanized forms of text.

A concise section on the history of USMARC provides a context for the reader and points up the monumental task and vital contribution that librarians from LC and other research institutions have made through the development and refinement of the MARC formats. The chapter is supplemented by an appendix containing the USMARC Formats: Underlying Principles. Crawford's discussion of format integration is probably the most relevant new feature of the book, since implementation of format integration is a matter of current interest and discussion in the library world. It gives the history of the movement toward integration, discusses its effect on the format, and concludes with the implications of integration for the USMARC community. The final chapters of the book discuss the use and extension of the USMARC formats by the major U.S. bibliographic utilities, the importance of compatibility with USMARC in local online systems, and a discussion of the uses of USMARC in the library. These chapters are important ones for all librarians who are involved in the use of automated library systems.

The book concludes with a glossary containing over 100 terms and acronyms, a selective bibliography of articles and books dealing with USMARC published between 1972 and

1988, and an index that includes entries for many of the topics, people and organizations covered in the book. Fields in the USMARC formats are also included but are listed by title rather than by number. For example, the 773 field is listed under "In"; the 505 under "Formatted Contents Note." Since many users of USMARC refer to fields by tag number rather than by title, additional index entries under the tags would have facilitated access.

Crawford has preserved the engaging clarity and readability of the first edition. The format of the book has been greatly enhanced by using eye-catching, yet pleasing, type fonts for various types of information. In addition, the use of footnotes at the bottom of the page rather than at the end of each chapter improves the readability of the material.

Crawford has improved an already excellent product. This handbook is designed for practicing librarians, library students and educators, programmers and planners in the bibliographic utilities, and vendors of automated services and local online systems. I recommend it highly.—*Judith Hudson, Head, Cataloging Department, State University of New York at Albany.* ■■

***The Impact of Rising Costs of Serials and Monographs on Library Services and Programs.*** Ed. by Sul H. Lee. New York: Haworth, 1989. 125p. $19.95 (ISBN 0-86656-885-9).

The eight papers in this collection were presented by six librarians and two vendor executives at a February 1988 University of Oklahoma-sponsored conference on the impact of serials and monographs on library services and programs. The collection also appeared as volume 10, number 1, of the *Journal of Library Administration*. Although more than two years old now, the presentations taken together provide an accurate and thoughtful overview of the state of research libraries' materials budgets in the 1980s and early 1990s. From an interesting variety of perspectives, these papers describe how price in-creases, decline of the dollar, and increased volume of publishing have combined to create stress on library budgets and collection development programs. This collection is not completely balanced, however. There are no papers from publishing community, and while collection management, acquisitions, and technical services librarians and library administrators are represented, no one provides an in-depth analysis of the effect of materials increases on public services programs.

The collection begins and ends with essays by library administrators: Thomas Shaughnessy starts with a discussion of management strategies for deal-ing with financial crises, and Robin Downes concludes with a consideration of the future of research libraries, which may be radically different given the rise of electronic publishing and networking. According to Downes, "There is on some campuses a clear understanding between library and administration that university libraries as we have known them have a lifespan of no more than fifteen years." For Shaughnessy and Downes, the budget crisis of the late 1980s is not a temporary phenomenon but the symptom of serious problems in the traditional structure of scholarly communications and library collection building.

Frederick Lynden, Charles Hamaker, and Sheila Dowd provide more detailed analyses of the causes of rising book and journal costs and their effect on library acquisitions and collection management programs. Lynden describes the major causes of the budget crises and chronicles its impact on acquisitions, collection coordination, and interlibrary loan. Hamaker concentrates on rising serials costs, particularly those generated by a few large, international publishers of scientific and technical journals. Hamaker's contention is that "the universe of serials titles is large, but the critical titles in terms of cost control is small." Sheila Dowd, who recently retired as assistant director of collection development at the University of California-Berkeley, has for many years been one of the profession's most insightful and eloquent advocates for traditional collection building. In her paper, one can almost feel the harm the budget crisis is doing to traditional collection development. For Dowd, a research library is not a node in a databank system, but a living, integrated collection of real books and journals that is, as Oscar Handlin put it, "evidence of a mind at work, making choices in the light of some view of knowledge—past, present, and future."

Jennifer Cargill discusses technical services staff roles in coping with the budget crises, roles that can range from providing management information on serials costs to the redeployment of staff into public services function to help cope with personnel reductions. Leonard Schrift and Douglas Duchin give the presentations a vendor's perspective. Schrift examines publishing costs and profits, while Duchin lists the services vendors can provide to libraries to assist in processing materials and in the preparation of management reports, again as library personnel resources dwindle in the face of budget reductions. All in all, this is a very worthwhile collection of papers on a topic of importance to all academic and research librarians.—*Joseph J. Branin, Associate University Librarian for Public Services, University of Minnesota.* ■■

***Information Industry Factbook.*** 1989/1990 ed. The Information Industry's Annual Report. Ed. by Maureen Fleming and others. Detroit, Mich.: Gale, 1989. 525p. paper, $195 (ISBN 0-927252-01-5).

*Information Industry Factbook*, a directory, defines the information industry as one that is made up of companies and units of companies that sell tangible products and services that are chiefly informational in nature: directories, newsletters, market reports, online services, CD-ROM publications, etc. To qualify for inclusion, the products and services must be sold on a nonexclusive basis to any buyer willing to pay for the information. This definition of the information industry is pegged to the nature of the content of a publication of service, not to the medium, the delivery vehicle, or the source of funding. If a publication's chief purpose is to inform its reader about something, then it is a component of the information industry. Thus the directory defines the information industry as including information publishing, as distinguishable from the two other main publishing industry subdivisions: entertainment publishing and educational publishing. Despite the implication of comprehensiveness, the editors appear to have relied heavily on the Information Industry Association's membership list as the basis for identifying companies. This skews the list of businesses to those that have chosen to join a trade organization. However, industrywide statistics have been gleaned from a wide variety of published and unpublished sources, including governmental sources.

The directory seeks to cover a broad range of components of the information industry as defined, from company profiles to detailed statistical tables about the industry as a whole. Each chapter in the *Information Industry Factbook* covers a different aspect of the industry. The book features two chapters on information publishers, including company profiles and extensive industry financial data; one chapter on electronic information publishing; one chapter on online services; two chapters on CD-ROM (probably the strongest part of the directory, including brief descriptions of products); one chapter on current telco regulations; one chapter on gateways; and one chapter on 900 and 976 services. The Year in Review section, arranged by month, is interesting, but of limited value. There also is a brief, but useful, glossary. Of greater value than either of these is a comprehensive index that includes both company names and topics.

The directory is recommended for large reference collections and special libraries that serve users interested in the information industry.—*Richard W. Boss, Information Systems Consultants Inc.* ■■

**Miller, Rosalind E., and Jane C. Terwillegar.** *Commonsense Cataloging: A Cataloger's Manual.* 4th ed. New York: Wilson, 1989. 179p. $38 U.S. & Canada, $43 elsewhere (ISBN 0-8242-0776-9).

Introducing beginning catalogers to the concepts, techniques, and vocabulary of cataloging is no easy task, nor is assisting those already in the field to remain current. To its credit, the fourth edition of *Commonsense Cataloging* largely succeeds in achieving its stated goals in these respects. It does so with direct and simple prose and by concluding each chapter with a concise review, including a list of terms introduced. Coverage includes library catalogs, the bibliographic record, the development of cataloging codes, descriptive cataloging (including cataloging nonbook materials), classification, subject cataloging, copy cataloging, and planning and organizing cataloging operations. Packing all of this into so slim a volume results in some superficiality, but the major points are presented well, albeit with little in the way of theory.

Although not explicitly stated in the text, *Commonsense Cataloging* is slanted towards the needs of smaller libraries. This is apparent in some of the authors' cataloging advice, particularly in their obvious preference for *AACR2R* Level 1 records. It is also reflected in the amount of space devoted to explaining the use of the Dewey Decimal Classification and Sears List of Subject Headings.

Compared to the previous edition, sections have been added, deleted, and rearranged. Unfortunately, not all these changes have been effected smoothly. The table of contents is at times widely at variance with the text in terms of section headings and even chapter titles. For instance, the section "locating the record" is in chapter 1, not chapter 2, as indicated in the table of contents. Such discrepancies are particularly noticeable in chapters 1 and 2. Many of the illustrative examples are new and these, too, have their problems. Pagination is presented in four different ways (371 p., 371p., 89pp., 285 pages) in sample bibliographic records, where one also finds three varieties of copyright date (c1977, c 1977, c. 1980). These might seem like trivial points, but such variety could leave a novice confused or, worse, thinking that standards were unimportant in cataloging.

Since the authors' stated reason for bringing out a new edition was rapid change in cataloging practices, one might expect treatment of these changes to be a strong point, but here, too, there are problems. While the twentieth edition of the *Dewey Decimal Classification* is mentioned in the text, all of the examples illustrating the use of this tool are from the nineteenth edition. At least *DDC* is correctly cited in the bibliography; the entry for *Library of Congress Subject Headings* gives the title last used in 1966.

The treatment of automation in *Commonsense Cataloging* is limited. Given the relatively low cost of microcomputers and the availability of software to perform a wide variety of cataloging functions, one would have thought that expanded coverage of this topic would be a feature of this edition. Instead, the brief chapter devoted to library automation in the third edition has been eliminated.

Despite the above reservations, *Commonsense Cataloging* remains a useful introduction to the craft of cataloging, especially for those working in a small library. More careful editing and increased attention to automation would make for a greatly improved fifth edition.—*James Tilio Maccaferri, Graduate School of Library and Information Science, University of California, Los Angeles.* ■■

***Palmer, Richard Phillips, and Harvey Varnet.*** *How to Manage Information: A Systems Approach.* Phoenix, Ariz.: Oryx, 1990. 138p. paper, $29.50 (ISBN 0-89774-603-1).

The authors of *How to Manage Information: A Systems Approach* state that most of the world's problems should be identified as information problems and solved by utilizing the systems approach. "The right information at the right time to the right person in the right mode for the right purpose at an affordable cost" is repeatedly given as the solution to information problems. The authors define information as an intellectual construct and point out that most systems are designed around information carriers rather than information itself. A major point is made that each step of the analysis requires time and should not be shortchanged.

The systems approach to solving problems is introduced in the first chapter as a logical, seven-step process that may be applied to any problem situation. These steps are (1) identifying the problem, (2) describing the existing situation, (3) exploring alternatives, (4) selecting evaluative criteria, (5) selecting an alternative, (6) implementing the alternative, and (7) reiteration of the systems approach. Each chapter covers a step in the process by giving a general description of the step in question, listing the major tasks involved, expanding on these tasks in narrative form, and offering charts and figures to clarify certain points.

The best aspect of this volume is its basic structure; however, this structure could be improved by separating the introduction and conclusion from the first and last chapters. In chapter 7, the conclusion becomes confused with discussion of reiteration in the systems analysis approach. The definition of most problems as primarily information problems is an oversimplification. To place a greater emphasis on information use or misuse is rather pointless since the systems approach takes into account all aspects of a situation. The distinction between information itself and the media, format, or materials that carry the information is important. However, the authors imply that information can be considered as a separate entity. This is impractical since information is not currently independent of its carrier. The illustrative cases do not always give enough information for the reader to determine whether utilizing the systems approach was actually beneficial.

Each chapter has a list of supplemental readings for the topic discussed, and the authors have highlighted those readings considered important in understanding the material. The readings are up to date and provide a good background for further study of the systems approach. The subject index, compiled by Virgil Diodato, is also quite useful.The authors targeted their audience as composing three groups: those who use information and need to improve its flow, those who are managing present systems and wish to improve them, and those who are considering becoming information managers. This book is recommended for current information managers. The basic structure outlining the systems approach is clear, and the charts and forms can be adapted for use in practical problem-solving situations. It is not as useful for beginners or individuals who use but do not manage information.—*Debbie Hackleman, Oregon State University, Corvallis, Oregon.* ■■

***Piggott, Mary.*** A *Topology of Cataloguing: Showing the Most Important Landmarks, Communications and Perilous Places.* London: The Library Association, 1988. 287p. $27.50 (ISBN 0-85365-758-0). ALA order code L758-0.

The author's long experience as a practitioner of cataloging and lecturer in cataloguing and bibliography at University College, London, is brought to bear in this work describing the "intellectual environment in which the cataloguer works . . . how language, social organization and the methods of intellectual communication determine the decisions that the cataloguer makes." The environment described is a confused one., however, replete with numerous acronyms for national and international standardizing bodies and with the competing standards produced by them. In addition, Piggott analyzes problems involving nonstandardized representations of the works produced in the spoken and written languages of our world.

As this environment is described from a very British viewpoint, readers in the United States may quickly determine that, as expected, "cataloguing" equates with indexing, and "catalogues" are related means for constructing, arranging, and displaying in various alphabetical sequences those terms relevant to indexing a given collection of "documents." Since American catalogers have for the most part accepted Library of Congress practice as a working standard for description, LC or LC-type MARC as a standard for data communication and predominantly use Library of Congress Subject Headings for catalog indexing, much of the author's discussion of standards will be lacking relevance for U.S. readers. Similarly, assuming that there are but few notable exceptions to following LC romanization tables when providing cataloging in this country for works in nonroman alphabets, Piggott's extended treatment of languages (scripts, linguistics, orthographic reforms) becomes so esoteric as to become uninteresting.

Chiefly then, this work will be of interest to those involved in compiling national bibliographies, developing very large union catalogs, or working toward consistency in indexing large bibliographic data files, so that such information may be communicated across the international barriers thrown up by variations in languages and scripts. Even so,. there is little of immediate practical use offered in this overview since the author will be dealing with the effect of this intellectual environment on cataloging practice at individual institutions in a companion volume. Though the volume considers subject indexing and classification systems and touches on *AACR2* descriptive practice, it considers these in general terms, providing little of use to practicing catalogers. In describing this cataloging environment or landscape of indexing, the book provides only an outline map for those interested in international bibliographic control. Continuing with the metaphor of the subtitle, this reader found the land,marks to be few, the perilous places many, and directions from the author few. One hopes that the compass will be included with its companion volume.—*Cliff Glaviano, Bowling Green State University Libraries, Bowling Green, Ohio.* ■■

***Public Access CD-ROMs in Libraries: Case Studies.*** Supplement to Computers in Libraries, no.17. Ed. by Linda Stewart, Katherine S. Chiang, and Bill Coons. Westport, Conn.: Meckler, 1990. 311p. $39.50 (ISBN 0-88736-516-7).

This collection of twenty-one essays describing use of CD-ROM databases in public service settings in a variety of library types will serve as a useful introduction to librarians considering the possibility of using CD-ROM databases in their libraries. The volume is divided into two parts: "General Library Experiences" and "Libraries with Selected Features." Each part is further subdivided into sections (there are nine in all), with "Academic Libraries," "Medical and Health Science Libraries," " School Libraries," and "Public Libraries" comprising the first part. Part II includes "Separate CD-ROM Facilities," "User Fees," " Networks," "Remote Access," and "When CDs Are Not Enough: Magnetic Tapes Plus CDs." Perhaps the most useful chapter of the book is chapter 1, "An Overview of Public Access Issues," in which principal editor Linda Stewart summarizes and categorizes the following chapters.

What is particularly valuable about Linda Stewart's overview is also what is useful about the whole book: since it is not the kind of book anyone (except maybe a reviewer) would read cover to cover, the overview directs the interested reader to the chapter or chapters that deal with the specific concerns of that reader. If you happen to be a reader interested in CD-ROM networking experience in public libraries, you might just read the table of contents and go directly to chapter 18, "INFO-LAN: A CD-ROM Local Area Network in a Public Library." However, if you want to learn more about a broader issue such as the staffing implications of CD-ROMs in public services areas, Stewart's overview summarizes what each of the ten or so chapters that deal with staffing to any degree has to say about that issue. The interested reader can then go directly to the appropriate chapter for more detailed information.

The chapters are, in general, well written, but tend to be of the "how I did it good in my library" variety. This is entirely appropriate, since the book is a collection of case studies, and the authors do point out errors or problems they encountered that their readers will be able to avoid. In my opinion, the book increases in value towards the end: the complex technical and administrative issues raised by charging fees and networking CD-ROMs gripped my attention more than discussions of whether or not to limit the amount of time any one user could monopolize a CD-ROM workstation.

In summary, this book is a useful collection of case studies. It is well edited and, in particular, it is well designed for the reader concerned with a particular issue who wants to read a case study that addresses that issue.—*David Buxton, Gonzaga University, Spokane, Washington.* ■■

**White, Herbert S.** *Librarians and the Awakening from Innocence: A Collection of Papers.* Boston: Hall, 1989. 382p. $38.50 (ISBN 0-8161-1892-2).

In the film *Local Hero* Burt Lancaster's character is treated by an "abuse therapist," whose therapy consists of insulting and degrading the patient, presumably to some eventual good end. Herbert S. White has come to play a similar role for librarians—managers in particular. There is something here to offend every *ITAL* reader, though in compiling this collection of thirty-seven essays written over two decades, White "was struck by the near absence of material concerned with automation" (p.xvi). Since "all of [White's] writings stem from a number of observations . . . that are of long standing" (p.xiv) and since that number is modest, I will try to save the reader the not-inconsiderable cost of this book by summarizing his thesis: librarians are passive and ineffective; they have a poor reputation and they deserve it. As the title suggests, they are innocents waiting for Herb White's awakening touch.

White worked in libraries long enough to note some real failings among librarians, and examples can be found to illustrate many of his stereotypes. However, he offers no new or realistic solutions to the problems and issues the profession has long been trying to resolve. Low salaries? "Assertiveness and willpower" are all you need (p.90). Assessing user needs? Don't bother; just tell 'em what they want (passim). Resource sharing? Poo; it's a Marxist idea anyway (p.294). All our troubles would vanish, presumably, if only we were intelligent enough to listen to White and courageous enough to do as he advises.

The degree to which White ignores the real constraints of the library's operating environment is illustrated by the essay on "Differential Pricing" (1986), which opens with the perceptive prediction, "here is another in what may unfortunately be an endless series of essays examining the remarkable passivity of our profession." White's solution: boycott the offending publishers and photocopy illegally until they give in. Don't worry about lawsuits; no American jury would convict. That this cannot and will not happen is owing not to the passivity of librarians, but to the natural and undeviating cautiousness of the parent institutions and the success of their corporate lawyers in heading off just such an action.

Throughout the book White eagerly demolishes arguments and attitudes that are nothing but straw men White has constructed himself. He repeatedly faults librarians for uncomplainingly accepting their low salaries and believing the bosses when they say they cannot afford more. Has there ever been a library staff that believed that or that did not complain about salaries?

One wonders why White bothers to stay in a profession for which he has so little respect. Probably he would answer: to improve it, yet this book offers no meaningful contributions to the profession's improvement, only tiresome complaints about its failure and "passivity." In *Local Hero*, Burt Lancaster eventually wearies of the abuse and throws out the therapist. Librarians reading this book will long to do likewise.—*James C. Thompson, University Librarian, University of California, Riverside.* ■■

## Other Recent Receipts

*Listed here are books and other publications received for review that are of potential interest to LITA members. Some of these materials may be reviewed in later issues of* ITAL.

*101 Uses of DBase in Libraries*. Supplement to Computers in Libraries, no.12. Ed. by Lynne Hayman. Westport, Conn.: Meckler, 1990. 118p. $34.95 (ISBN 0 2D88736-427-6).

*1990 Telephone Industry Directory*, 4th Annual Edition. Potomac, Md.: Phillips Publishing (avail. Oryx Pr., Phoenix, Ariz.), 1990. 1,152p. $159 (ISBN 0-934960-76-3).

*Advanced Topics of Law & Information Technology*. Ed. by G. P. Vandenberghe & Y. Poullet. Norwell, Mass.: Kluwer Academic Publishers (101 Philip Drive, Assinippi Park, Norwell, MA 02061), 1989. paper, $65. (ISBN 90-6544-391 2D6).

Auster, Ethel. *The Online Searcher*. New York: Neal-Schuman, 1990. 240p. $39.95 (ISBN 1-55570-068-3).

Brandt, D. Scott. *Small Computers in Libraries, 1990: Buyer's Guide & Consultant Directory*. Westport, Conn.: Meckler, 1989. 100p. paper, $24.95 (ISBN 0-88736-376-8).

Brevick, Patricia S., and E. Gordon Gee. *Information Literacy: Revolution in the Library*. Washington, D.C.: American Council on Education (One Dupont Circle NW, Ste. 800, Washington, D.C. 20036), 1989. 264p. $24.95 (ISBN: 0-02 2D911440-3).

Broadbent, Brenda, and Kent R. Wood. *Educational Media & Technology Yearbook, 1989*, v.15. Englewood, Colo.: Libraries Unlimited, 1989. 350p. $50 (ISBN 0-87287-772-8).

*Campus Strategies for Libraries & Electronic Information*. Ed. by Caroline R. Arms. Bedford, Mass.: Digital Press, 1989. $34.95 (ISBN 1-55558-036-X, EY-C185E-DP).

Chan, Lois Mai. *Immroth's Guide to the Library of Congress Classification—4th Ed.* Englewood, Colo.: Libraries Unlimited, 1990. $33.50 (ISBN 0-87287 2D604-7).

*Classification of Library Materials: Current and Future Potential for Providing Access*. Ed. by Betty G. Bengston and Janet S. Hill. New York: Neal-Schuman, 1990. 275p. $39.50 (IBSN 1-55570-027-6).

Consumer Guide editors. *Computer Buying Guide, 1990*. New York: New American Library, 1990. $7.95 (ISBN 0-451-82211-0).

Corbin, John. *Directory of Automated Library Systems, 2d ed*. New York: Neal-Schuman, 1989. 305p. $55 (ISBN 1-55570-050-0).

Crawford, Walt. *Desktop Publishing for Librarians*. Professional Librarian Series. Boston: Hall, 1990. 370p. $38.50 (ISBN 0-8161-1929-5).

Cummins, Thompson R. *Planning, Measuring, and Evaluating Library Services and Facilities*. New York: Neal-Schuman, 1990. 350p. $39.95 (ISBN 1-55570 2D070-5).

Desmarais, Norman. *Library Computer & Technology Specialists : A Directory*. Westport, Conn.: Meckler, 1990. 150p. $65 (ISBN 0-88736-389 2DX).

*Directory of Telefascimile Sites in North American Libraries*, 5th ed., 1990. Ed. by C. Lee and Pegi S. Jones. Buchanan Dam, Tex.: CBR Consulting Services, Inc. (P.O. Box 248, Buchanan Dam, TX 78609)., 1990. 274p. $32.50 (no ISBN).

Giacoma, Pete. *The Fee or Free Decision: Legal, Economic, Political and Ethical Perspectives for Public Libraries*. New York: Neal-Schuman, 1989.

191p. $35 (ISBN 1-55570-030-6).

Giordano, Albert G., and Christine Disney. *Desktop Dictionary of Information Systems Technology*. Minneapolis, Minn.: Longman Financial Services Institute, Inc. (9201 E. Bloomington Freeway, Minneapolis, MN 55420), 1989. paper, $10.95 (ISBN 0-88462-840-X).

Greenia, Mark W. *Lawyer's Guide to Computer Security: A Sourcebook for Attorneys, Librarians, Researchers*. Sacramento, Calif.: Lexikon Services (8042 Singletary Way, Sacramento, CA), 1990. paper, $30 (ISBN 0-944601 2D29-4).

Harker, S., and K. Eason. *The Application of Information Technology: Case Studies in User-Centered Design*. Case Studies in Ergonomics Practice Series v.4. New York: Taylor & Francis (3 E. 44th Street, New York, NY 10017), 1990. 180p. $56 (ISBN 0-85066-434-9).

Helsel, Sandra K. *Interactive Optical Technologies in Education and Training: Markets and Trends*. Westport, Conn.: Meckler, 1990. 136p. $39.50 (ISBN 0-88736-392-X).

Helsing, Cheryl. *Executive Guide to the Protection of Information Resources*. Washington, D.C.: United States Govt. Print. Off., 1989. 21p. paper, $1.50 (ISBN 0-16-000294-X).

Holloway, Simon. *The Future of Data Dictionaries: Paper Presented at Database 88*. Brookfield, Vt.: Gower, 1989. 125p. paper, $39.95 (ISBN 0-566-09020-1).

*Information Retrieval Service: Information Retrieval Service Definition & Protocol Specification for Library Applications*. New Brunswick, N.J.: Transaction Publishers (Rutgers University, Rutgers University, NJ 08903), 1989. 48p. paper, $35 (ISBN 0-88738-953-8, Z39.50).

*Integrated Planning for Campus Information Systems*. OCLC Library Information & Computer Series, no.12. Ed. by Daphne Layton. Dublin, Ohio: OCLC, 1989. 130p. paper, $13 (ISBN 1-55653-071-4).

*International Yearbook of Educational and Training Technology, 1990*. Ed. by C. W. Osborne. Phoenix, Ariz.: Oryx, 1990. 600p. $65 (ISBN 0-89774-645-7).

Johnson, Richard D., and Johnson, Harriet H. *The Macintosh Press: Desktop Publishing for Libraries*. Small Computers in Libraries Supplement Series. Westport, Conn.: Meckler, 1989. 250p. $39.50 (ISBN 0-88736-287-7).

Josey, E. J., and Kenneth Shearer. *Politics and The Support of Libraries*. New York: Neal-Schuman, 1990. 200p. $35 (ISBN 1-55570-073-X).

Judge, Peter. *Open Systems: The Guide to OSI & Its Implementation*. Wellesley, Mass.: Q.E.D. Information Sciences (P.O. Box 181, Wellesley, MA 02181), 1989. Paper, $39.50 (ISBN 0-89435-310-1).

Learn, Larry. *Telecommunications for Information Specialties*. OCLC Library, Information & Computer Science Series, no.11. Dublin, Ohio: OCLC, 1989. 180p. paper, $15 (ISBN 1-55653-075-7).

Leonard, Carolyn, and Marian Colclasure. *Print Shop Graphics for Libraries, Vol. 7: World Nations and History—Apple Computers*. Englewood, Colo.: Libraries Unlimited, 1990. 40p.(2 disks). $28 (ISBN 0-87287-748-5).

Lesk, Michael. *Image Formats for Preservation and Access: A Report of the Technology Assessment Advisory Committee to the Commission on Preservation and Access*. Washington, D.C.: The Commission on Preservation and Access (1785 Massachusetts Ave., N.W., Ste. 313, Washington, DC 20036), 1990. 10p., paper.

Lewis, Susan C. *North Carolina Microcomputer Index, 1989*. Special Series, no.5. Chapel Hill, N.C.: Institute of Government (University of North Carolina-Chapel Hill, Knapp Building CB3320, Chapel Hill, NC 27599), 1989. paper, $11.50 (ISBN 1-56011-153-4, SS#5).

*Library and Information Technology Standards*. Ed. by Michael Gorman. LITA Monographs, no.1. Chicago: Library and Information Technology Association, ALA, 1990. 90p. paper, $18.50, $16.65 LITA member (ISBN 8389-7431-7).

Library Education and Employer Expectations. (Also published as *Journal of Library Administration*, v.11, nos. 3 & 4, 1989). Ed. by E. Dale Cluff. Binghamton, N.Y.: Haworth, 1990. 246p. $32.95 (ISBN 0-86656 2D896-4).

Machalow, Robert. *Using Lotus 1-2-3: A How-to-do-It-Manual for Library Applications*. How-to-do-It Manuals for Libraries, no.1. Ed. by Bill Katz. New York: Neal-Schuman Publishers, Inc., 1989. 150p. paper, $35 (ISBN 1-55570-033-0).

*MARC Format Integration: Three Perspectives*. LITA Guides, no.2. Ed. by Michael Gorman. Chicago: Library and Information Technology Association, ALA, 1990. 19p. paper, $9.50, $8.55 LITA members (ISBN 8389-7430-9).

Marmion, Dan. *OCLC Workstation (Essential Guide to the Library IBM PC, v.9)*. Westport, Conn.: Meckler, 1989. $34.95 (ISBN 1-88736 2D083-1).

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McIntosh, Toby J. *Federal Information in the Electronic Age: Policy Issues for the 1990s*. Washington, D.C.: The Bureau of National Affairs, 1990. 188p. paper, $75 (ISBN 1-55871-170-8).

*Microsoft CD-ROM Yearbook, 1989–1990* (CD-ROM Library). Redmond, Va.: Microsoft Press

(16011 NE 36th Way, Box 97017, Redmond, VA 98073-917), 1989. 935p. paper, $79.95 (ISBN 1-55615-179-9).

Morris, Leslie R. *Choosing a Bibliographic Utility: User Views of Current Choices*. New York: Neal-Schuman, 1989. 137p. paper, $37.50 (ISBN 1-55570 2D048-9).

Morton, Herbert C. and Anne J. Price. *The ACLS Survey of Scholars: Final Report of Views on Publications, Computers, & Libraries*. Lanham, Md.: University Press of America (4720 Boston Way, Lanham, MD 20706), 1989. $27.50 (ISBN 0-8191-7260-X, Am CLS).

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Olson, Nancy B. *Cataloging Microcomputer Software*. Englewood, Colo.: Libraries Unlimited, 1989. $33 (ISBN 0-87287-513-X).

*OPACs & Beyond: Proceedings of a Joint Meeting of the British Library, DBMIST, & OCLC*. OCLC Library, Information, & Computer Science Series. Ed. by Martin Dillon. Dublin, Ohio: OCLC, 1989. $12.50 (ISBN 1-55653-070-6).

*Operational Costs in Acquisitions*. Ed by James R. Coffey. Binghamton, N.Y.: Haworth, 1990. $22.95 (ISBN 1-56024-008-3).

*Orion Computer Blue Book*, 1990. Compiled by Orion Research Corporation ( address). (Available through Oryx Press, Phoenix, Ariz.) 560p. paper, $124.50 (ISBN 0-932089-42-9).

*Personnel Administration in an Automated Environment*. Ed. by Philip E. Leinbach. Binghamton, N.Y.: Haworth, 1990. $29.95 (ISBN 1-56024 2D032-6).

*Phillips Publishing's 1990 Telephone Industry Directory*. 4th Annual Edition. Phoenix, Ariz.: Oryx, 1990. 1,152p. paper, $159 (ISBN 0-934960-76-3).

*Relation of Sci-Tech Information to Environmental Studies*. Ed. by Ellis Mount. New York: Haworth, 1990. 155p. (ISBN 0-86656-988-X).

*Research Access Through New Technology*. Studies in Library & Information Science, no.1. Ed. by M. E. Jackson. New York: AMS Press, 1989. $32.50 (ISBN 0-404-64001-X).

*Role of Standards in Sci-Tech Libraries*. Ed. by Ellis Mount. New York: Haworth, 1990. 127p. $19.95 (ISBN 1-56024-021-0).

Rosenberg, Kenyon C. *Dictionary of Library & Educational Technology*. Englewood, Colo.: Libraries Unlimited, 1989. $32.50 (ISBN 0-87287-623-3).

Saettler, Paul. *The Evolution of American Educational Technology*. Englewood, Colo.: Libraries Unlilmited, 1990. 500p. $38 (ISBN 0-87287-613-6).

Saffady, William. *High Definition Television: A Bibliography*. Westport, Conn: Meckler, 1990. 121p. $49.50 (ISBN 0-88736-422-5).

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*Serials and Reference Services*. Ed. by Robin Kinder and Bill Katz. New York: Haworth, 1990. 457p. $44.95 (ISBN 0-86656-810-7).

Shapiro, Fred R. *LEXIS: The Complete User's Guide*. New York: Saint Martin's, 1989. 416p. $35 (ISBN 0-312-02942-X).

Studwell, William E. *Library of Congress Subject Headings: Philosophy, Practice and Prospects*. Binghamton, N.Y.: Haworth, 1990. $22.95 (ISBN 1-56024-003-2).

Stueart, Chris, and Linda Ter Haar. *Maintaining the Privacy of Library Records: A Handbook and Guide*. New York: Neal-Schuman, 1990. 260p. $39.95 (ISBN 1-55570-066-7).

*The Bottom Line Reader: A Financial Handbook for Librarians*. Ed. by Betty 2DCarol Sellen and Betty J. Turock. New York: Neal-Schuman, 1990. 175p. $39.95 (ISBN 1-5570-057-8).

*The ESPIAL Canadian Database Directory, A Guide to Current Canadian Information Contained in National and International Databases and Data Banks*. Prep. by H. C. Campbell. Toronto, Canada: Espial Productions (P.O. Box 624, Station K, Toronto, Ontario, Canada M4P 2H1), 1990. 109p. paper, $40 (ISBN 0-919027-07-2).

*The Serials Partnership: Teamwork, Technology & Trends: Proceedings of the North American Serials Interest Groups*. Ed. by Patricia Rice and Joyce L. Ogburn. Binghamton, N.Y.: Haworth, 1989. $34.95 (ISBN 0-86656-991-X).

*Training Issues and Strategies in Libraries* (Published simultaneously as *Journal of Library Administration, v.12, no.2, 1990.*) Ed. by Paul M. Gherman and Frances O. Painter. Binghamton, N.Y.: Haworth, 1990. $19.95 (ISBN 0-86656-937-5).

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*Videotechnology and Libraries*. LITA Guides, no.1. Ed. by Michael Gorman. Chicago: Library and Information Technology Association, ALA, 1990. 30p. paper, $10.50, $9.45 LITA members (ISBN 8389-7429-5).

Warner, Alice Sizer. *Making Money: Fees for Library Services*. New York: Neal-Schuman, 1989. 150p. $39.50 (ISBN 1-55570-053-5).

*Weeding and Maintenance of Reference Collections* (published simultaneously as *The Reference*

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*Women Online: Research in Women's Studies Using Online Databases*. Ed. by Steven Atkinson, and Judith Hudson. Binghamton, N.Y.: Haworth, 1990. $39.95 (ISBN 1-56024-037-7). ■■

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