

often turned brittle, and consumed much stack space. In nearly all instances these microreproductions were on 35 mm. roll film. Other film widths are 16 mm., 70 mm., and 105 mm.; the 16 mm. size is frequently used in industry, yet so far only infrequently in libraries, although an increase in 16 mm. film use may be expected. For instance, *Chemical Abstracts* and the journals issued by the American Chemical Society are on 16 mm. film.

Several decades ago some librarians began to think that microforms should have a wider use and in particular that the use should not be limited only to items which are not in great demand. In his widely discussed book, *The Scholar and the Future of the Research Library*, Fremont Rider points out that academic libraries have been doubling their collections within sixteen-year spans.¹ To keep the expansion within manageable limits, Rider suggested the use of microcards. In appearance these cards would be similar to ordinary catalog cards and would have catalog information in front. The book or other library item would be microreproduced on the back side of the card and, if necessary, be continued on trailer cards. Microcards were used, but mainly by government agencies as media for recording research reports.

Microcards, on paper or other opaque material, appear in various sizes: 3 inches by 5 inches (the catalog card size), 4 inches by 6 inches, 5 inches by 8 inches, 6 inches by 9 inches, and others. The microcard image may be produced entirely by photographic process, or cards may be printed from plates made from negative microfilm. This latter procedure is used by the Readex Microprint firm. Readex Microprint cards (size 6 inches by 9 inches) are printed on only one side while most other microcards are printed on both sides. The Readex Microprint cards contain about 100 pages while the smaller size microcards contain from one to ninety pages on one side. The generally favored reduction ratio is 1:18, the reduction ratio employed by Readex Microprint ranges from 12x to 20x.

While the microcards are sturdy and can withstand heavy use without being damaged, there are certain disadvantages connected with their use. Some kinds of microcards are more susceptible to message obliteration by scratches and erasures than microfiche. Reading machines require relatively powerful light sources. With film (fiche) one can obtain a sharper image and a higher reduction ratio than with micro-opaques, and since microfilm is now much more widely used than micro-opaques, manufacturers have devoted more

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attention to the development of film readers and printers than to readers for micro-opaques. Micro-opaques had been the favorite medium of the various United States government agencies for micro-reproducing reports until this form gave way to the film in sheet form.

Microfilm in sheet form was developed in France and in Germany before World War II. Intensive experimentation was also undertaken in Holland. It is interesting to learn that the word "card" was used both for microreproductions on film and for microreproductions on paper or other opaque material. The photographic expert of the British treasury, H. R. Verry, objected to this indiscriminate usage and urged that the French word "fiche" be employed for film in sheet form, and the word card for microreproductions on opaque material. Verry prevailed and after 1954 the literature distinguishes between micro-card and microfiche. The Dutch founders of the "Microkaart Stichting" (Microcard Foundation) became largely involved in experiments with microfilm in sheet form. They found it therefore quite fitting that internationally their organization became known as the Microfiche Foundation.²

In the early 1960s the United States government agencies became convinced that microfiche is superior to the microcard as an information carrier. While in Europe 3 inch by 5 inch and 3½ inch by 4¾ inch are favorite fiche sizes, 4 inch by 6 inch has been adopted as the standard size by the United States government for the reports issued by its various agencies. There was experimentation with other sizes. For instance the National Aeronautics and Space Administration originally used the 5 inch by 8 inch size.

It should be noted that the same size fiche—4 inch by 6 inch, for instance—will contain various numbers of frames (images), depending on the manufacturers' preferences. For example Bell and Howell microfiche provides for up to 72 images (6 rows of 12 images), and consequently can accommodate a document consisting of up to 72 pages. The same size COSATI (Committee on Scientific and Technical Information) microfiche provides for up to 60 images (5 rows of 12 images), and the COSATI trailer microfiche (intended for documents longer than 60 pages) provides for up to 72 frames (6 rows of 12 frames). The NMA (National Microfilm Association) microfiche may contain up to 98 frames (7 rows of 14 frames). Trailer microfiches are used when a document exceeds the number of pages that the main fiche can accommodate. Since microfiche unitizes information it has become the favored medium for reproducing reports.

Microfiche may also appear in an aperture card. In standard form a single film frame is placed into a window-like opening of an IBM card. This frame can contain up to eight document pages. Aperture cards are mainly used for engineering drawings. It is easy to send drawings in this form and then to regenerate them at their destination.

Also used as information carriers are jackets made of very thin transparent material such as polyester, designed with chambers or pockets into which chips or strips of microfilm are placed. The microfilmed items can be unitized in the same fashion as if they were in a file folder. Transparent jackets are available in various sizes. They may be arranged in an alphabetic or other predetermined sequence or at random. The film in the jacket can be reproduced by contact methods without needing to be removed from the jacket. Microfilm jackets are especially useful when the information is subject to modification since the information in the jacket can be updated by adding or removing strips of film in the sleeves of the jacket.

At this point it may be noted that the several types of microforms have been described in various published sources. Especially helpful discussions regarding the characteristics of the several kinds of microforms may be found in the *Proceedings* of the National Microfilm Association.³ Also releases by the microfilm producers often contain brief descriptions of their product. A few of these promotional publications, such as *The Microfilm Technology Primer on Scholarly Journals*⁴ by Franklin D. Crawford, are broad in concept and stand out as clearly written general introductions to the field.

The documents—books, periodicals, reports, etc.—may be reproduced at varying reduction ratios of their original size: $\frac{1}{14}$, $\frac{1}{15}$, $\frac{1}{18}$, $\frac{1}{20}$, $\frac{1}{25}$, $\frac{1}{60}$, etc. The reduction ratio stipulated for government-sponsored (COSATI) microfiche is 18x. Up to this time the reduction ratio for materials used in libraries has generally, though not exclusively, been at 20 or below. While there is no generally accepted line of demarcation between regular and ultra-microminiaturization, ultra-microminiaturization generally means the reduction ratio exceeds 50x. However, some writers consider 60x as the lower limit while still others consider reductions exceeding 40x as ultra-microminiaturization. If the miniaturization exceeds the stipulated reduction ratio—60x, 50x, or 40x—the form created is an ultra-microfiche (also called ultra-fiche). It is expected that normative agencies will ultimately establish the exact line of demarcation between regular and ultra-microfiche.

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Ultra-microminiaturization would bring on one fiche not 60 to 100 images, but several hundred or even several thousand, depending on the reduction ratio. It is still necessary, as it was over a century ago, to produce ultra-microfiche in stages. Some of the problems of ultra-microminiaturization of library materials are discussed by the two firms which have embarked on such a venture: Library Resources, Inc., an Encyclopaedia Britannica Company,⁵ and NCR.⁶

Library Resources, Inc., utilizes a 3 inch by 5 inch size fiche which has a capability of up to 1,000 pages. It employs a reduction ratio of 1:55 for book pages of approximately 5 inches by 7 inches and up to 1:90 for books with larger pages. The fiches are laminated on both sides for protection. As reading devices Library Resources, Inc., will have available an internal projection reader for use in the library and a portable lightweight reader, also called a lap reader. The portable lap reader has been designed to work at a fixed ratio of 75x, the desk top model at 90x.

A fundamental concern of Library Resources, Inc., has been a realization of the principle of bibliographic unity—to have one book or other bibliographic unit contained on one fiche, or, what may be necessary occasionally, a fiche followed by a trailer fiche. The fiche (or fiche and trailer fiche) could be placed in an envelope which has in front a reprint of the LC information pertinent to the fiche(s).

NCR uses a 4 inch by 6 inch fiche and a reduction ratio of about 1:150. One fiche can hold over 3,000 images, the equivalent of seven to ten volumes. NCR employs photo-chromic-micro-image recording. For protection the NCR fiches are also laminated. NCR considers it an advantage that one fiche can hold the images of several volumes. For instance, one fiche may contain seven or eight volumes all dealing with one aspect of psychology. NCR uses the term ultra-fiche for its product while Library Resources, Inc., identifies its fiche as microbook fiche.

The pamphlets and descriptive folders issued by Library Resources, Inc., and NCR describe the selection policy used in assembling their respective ultra-microfiche collections. At this point it will merely be noted that these two firms differ not only in their technical approaches to microform production, but they also have very different bases for the selection of the materials to be microfilmed. The first library in the Library Resources microbook series will contain about 20,000 volumes, while the first group (consisting of five collections) of NCR will have a combined strength of about 3,500 volumes. Since at the

time of this writing the exact composition of either collection is not known, it is not possible to attempt valid comparisons between the two.

When the uses to which the various microforms are put are examined, it is found that roll microfilm with or without cartridge is generally used for collections of items such as whole periodical files and series of books. Ultra-microfiche at the 1:150 reduction ratio also accommodates series since six to ten books may be placed on one fiche.

Bell and Howell, COSATI and NMA microfiches are mainly intended for one to one relationships, one microfiche to one document, as are aperture cards with one engineering drawing on one card.

While a microfiche usually is large enough to contain the usual government research report, ordinary microfiche cannot accommodate the average library book of 300 to 400 pages. Arthur Teplitz therefore recommends a new size library fiche, a fiche with a reduction ratio of 1:50 or 1:60.⁷ This fiche which Teplitz calls the library fiche would be either a 50x fiche which would contain about 390 pages (13 rows of 30 pages) or a 60x fiche which would contain about 475 pages (15 rows of 35 pages).

While the ultra-microfiche requires several stages for its preparation, the library fiche envisaged by Teplitz would be prepared in a single stage operation. He sees no difficulty in using present-day fiche equipment nor obstacles in manufacturing suitable readers and reader-printers. While ordinary COSATI or NMA fiche would be large enough to accommodate most periodical issues (average size 70 pages), he would nevertheless recommend the use of the library fiche for all library items in order that equipment for only one reduction ratio be needed.

One of the principal efforts of librarians has been to effect an increase in the use of microforms. A number of writers have long felt that only a change in the copyright law could bring about such an increase. According to the present law the copyright holder (usually, but not necessarily the author or publisher) has the sole right over the copyrighted property. He retains this right also after graphic data have been converted into microform. Zurkowski, among others, feels that the person who converts printing or writing into a microform should be rewarded by being given copyright protection for the form he created, along with the owner of the original copyright.⁸ Zurkowski further suggests that third or fourth persons who convert the information into still other microform formats should likewise obtain copy-

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right protection for their respective formats. The original and the format copyrights need not be coterminus; the original could be for a longer period than the format copyrights. In another article the same author underlines how necessary it is to make it financially attractive for a publisher to convert graphic data into microforms, and he would therefore consider introducing a licensing system where those who use the microforms would pay a fee which would at least in part be turned over to the copyright holder or copyright holders.⁹ Zurkowski further suggests that to forestall unauthorized copying it may be necessary to apply protective over-coating which would prevent contact duplication of the film sheet with ordinary equipment.

One of the strongest advocates of microform use in the library, Lawrence B. Heilprin, believes the aim of making the full range of the extant literature accessible to interested persons could be attained if copyright law were to be changed.¹⁰ The currently prevailing form of making a book available is by circulating it through removal from the shelves. Instead of proceeding in this fashion, Heilprin urges that libraries maintain collections of materials in microform, leave them in their files and make copies of the units (books, articles) wanted. The library would no longer be a circulating (C) library but would become a distribution (D) library. A proposal by J. ver Hulst¹¹ would reduce the cost of acquiring microform collections by libraries and their dissemination to the user at the local library location. The system would be an integrated high/low density microform dissemination library. The library would receive ultra-microform printing masters for retention at anywhere from 60x to 200x reduction ratio. From these masters the library would reproduce low density dissemination microfiches at approximately a 20x reduction ratio. The dissemination microfiches would become part of the personal library of the user. The participating library would have a document indexing system, an integrated ultra-microform retrieval unit and a microfiche printer.

In the library microforms are not only utilized as carriers of miniaturized books, periodicals, pamphlets and similar communication materials, but also for the listing of miniaturized catalog cards and related data. An example is the Micrographic Catalog Retrieval System (MCRS) of the Information Dynamics Corporation.¹² This system is designed for speedy searching and locating of cataloging data. The complete MCRS contains on microfiche the National Union Catalog from 1953 on, and the 1970 to present Union Catalog filmed in its entirety. Each title is listed under its LC card number; the

titles are also noted in a main entry and title index. Printouts can be made with a reader-printer.

The Demco Educational Corporation furnishes the Microdata Cataloging System which is similar in nature and purpose.¹³ It does not have as extensive a retrospective file as the MCRS. It differs also in scope of coverage for the current materials and the frequency in which cumulations appear. The fiche employed by Microdata is larger than that used for the MCRS. While Information Dynamics retains ownership of its MCRS service, Demco sells the Microdata system outright. Last but not least, there is a considerable price difference between the two, Demco's being the less expensive service.

To speed up library acquisitions, Bro-Dart, Inc., has devised a Direct Input Ordering System, "a computer microform interface."¹⁴ On one 16 mm. roll of microfilm it lists all titles (in all editions) now in print of all (about 4,500) publishers as well as recent out-of-prints. The author and title files each number about 300,000 entries. This service is intended mainly as an aid in the acquisition of books through the Bro-Dart firm.

MICROFORM EQUIPMENT

The discussion concerning microforms has shown that there are many sizes and patterns. By the very nature of the microforms the communication carried by the form is reduced to such a degree that it cannot be read by the unaided eye. Readers are needed to make the message legible. The librarian is faced with the problem of selecting the reader which is proper for his collection (present and potential). He does not have a single set of performance standards against which he could measure the product. In the microforms and equipment section of the Library Technology Reports series, the ALA's Library Technology Project has been providing the kind of guidance librarians urgently need. In this section there are evaluative reports, each fully devoted to one individual piece of equipment, plus general articles. Until recently the reports in the microforms and equipment section were prepared by William R. Hawken Associates. The most recent reports were supplied by R. A. Morgan Company, Inc. The article entitled "Microform Readers for Libraries,"¹⁵ like a similar earlier article,¹⁶ should prove especially helpful in alerting the librarian to factors to be considered when acquiring microform equipment.

The Library Technology Project consultants selected readers which were designed to enlarge and project (to a size capable of being read)

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images in microfiche, micro-opaque cards, or 35 and 16 mm. reel or strip microfilm formats commonly found in libraries. The devices evaluated are manufactured and/or distributed on a nationwide basis in the United States.

The first part of the Morgan article is devoted to a discussion of the general factors considered in the selection of readers and reader-printers and to a description of the test procedures, tests, and their results. The second part of the article gives in tabular form an evaluation of individual microform readers and reader-printers. The Library Technology Project consultants as well as other experts stress the following considerations when equipment is selected:

When a reader is to be purchased, the librarian must first of all consider the kinds of microforms the library has or is likely to get. Does the reader need to accommodate only 35 mm. microfilm or also 16 mm. microfilm and microfiche? Some readers can accommodate several types of microforms, others can accommodate only one kind.

Another important consideration is the compatibility of the reduction ratio employed in the preparation of the micro-image with the magnification ratio of the reader. If the magnification ratio and the reduction ratio are identical, the image produced with the reader will be of the same size as the original. Ideally the screen should hold the full text. If a reader serves for instance to display a newspaper image, it should be 15½ inches wide, the original size of the average newspaper. For clarity of image the screen should be uniformly clear from edge to edge. The screen brightness likewise should be at a uniform level. Image rotation capability is necessary when maps and charts must be examined because they are often arranged in a different position from the text. Simplicity of operation is essential because often the user may not get expert help, as is ruggedness of construction because library equipment is exposed to hard wear.

This suggested list of criteria against which readers and reader-printers may be checked could of course be enlarged. For instance, it might be of significance to discover whether a microfilm reader features a multiple lens turret which at the "flick of a finger" offers a choice of one of several magnifications or has several different lenses which must be stored apart; or it might be of importance to know whether a microfilm printer can deliver dry positive prints from either positive or negative microfilm.

The promotional literature which is issued by practically all the

manufacturers of equipment deserves special notice as an aid in evaluation. In this text there is occasion to refer to just a few of these publications. In practice it should often prove most rewarding to examine releases, folders, pamphlets and other publications which describe a manufacturer's product. Quite often the manufacturer's account is the most detailed one available and frequently it is illustrated.

MAGAZINES (CARTRIDGES)

In the use of microfilm it has long been considered a deficiency that film had to be threaded, sometimes awkwardly, and exposed to soiling and scratching. Several manufacturers have developed containers variously called magazines (Kodak) or cartridges (3M, Bell and Howell). It is especially noteworthy that present reels (35 mm. or 16 mm.) can be converted to magazine format without much effort. Film in magazines such as the Eastman Kodak "Thread Easy" will thread itself through an "open-close" glass gate onto a take-up reel and will automatically rewind the film.¹⁷

DASA

The United States Office of Education, recognizing the need for a new inexpensive, lightweight microfilm reader, awarded the development contract to the DASA Corporation.¹⁸ The reader, DASA-PM R/50, weighs only 7½ pounds and the manufacturers say it can be held in the lap. Using the PM R/50 "is almost like reading a book." It has an 8½ inch by 11 inch viewing screen. It accepts 4 inch by 6 inch microfiche with interchangeable grid formats, including COSATI, DOD and NMA. While it had been expected that the cost of the reader could be held below \$50.00, the advertisement lists it at a unit price of \$89.50, with quantity discounts beginning at fifty units.

ASPECTS OF MICROFILM SYSTEMS

In the discussion so far I have emphasized the microforms and the microform equipment useful in a typical library serving an educational institution. One should be aware of the fact that a complete microfilm system consists of more than microforms and microform readers and reader-printers. A complete system includes the equipment needed for the production of microfilms. L. A. Smitzer describes a complete typical microfilm system in detail.¹⁹ He gives both the present state of the art and ventures predictions for the future.

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The typical complete microfilm system consists of these elements: a document to be reproduced, either a paper document or a synthetic document (a document reproduced from a viewing screen); the cameras, planetary and rotary, the selection of the type depending on such factors as the document form, and the speed required for reproduction; and other equipment needed for the processing and duplicating of the film. All of these elements are part of the preparation stage. The use stage involves the storage of the film, its retrieval, its viewing and/or copying by means of readers and reader-printers. The interdependence of the various components of the system is duly stressed by Smitzer. Along with many others he expects wide acceptance of the cartridges, for he thinks they will be used not only for film but also for fiche. He is also convinced that the computer-produced synthetic document will come into very wide use. The author gives special weight to the development of large-scale integrated electronics because it "will permit any requirement of logic, sensing or film manipulation to be packaged into the small space requirement of desk type units."²⁰

RETRIEVAL

Retrieval of microfilmed information is as important as its storage. Information is useful only if the searcher can find it conveniently and speedily. Producers of film and equipment are aware of this need and some have developed location devices. These devices may be crude or highly advanced; the degree of sophistication sought by the user will depend on the kind and amount of material to be retrieved and on the speed with which it should be located.

In the library field the retrieval procedures employed by the Chemical Abstracts Service deserve special mention. *Chemical Abstracts* employs four different coding systems to reach the desired portions of information. These are the binary code, the image code, line scale and odometer coding. Binary and image codes allow the use of keyboards in connection with reader-printer equipment, line and odometer coding are intended for non-keyboard assisted searching. To accommodate these different coding systems, *Chemical Abstracts* is issued in two forms, Edition I for the binary coding system and Edition II for the other systems.²¹

So far the more advanced automated systems have been used mostly in industry and special library situations, but with the expected increase in the use of microforms in libraries of educational institutions,

advanced search methods will undoubtedly have to be more and more widely employed by them.

Sophisticated indexing and locating devices are well described by David R. Wolf.²² He notes that automated microfilm files may generally be divided into two types: those requiring an external index and those that may incorporate the index information by recording it in coded form with the document itself. Wolf lists and evaluates representative examples for each type. Included among the examples of the second type is the MIRACODE System, a system which currently is being successfully utilized by Northwestern University's Medill School of Journalism for the retrieval of information contained in a miniaturized clipping file. Kenneth Janda and David Gordon describe in detail the operational problems encountered in preparing the index codes and in coding the clippings, and they outline the retrieval capabilities of the system.²³

COMPUTER OUTPUT MICROFILM

One of the potentially most significant developments is the technology which establishes interconnections between microfilm and computer. In his excellent comprehensive survey of the field of reproduction of library materials and graphic communications for 1968, Robert C. Sullivan puts computer output microfilm (COM) at the head of the list.²⁴ In his equally comprehensive review for 1969, the same author can report that the COM field has been continuing in its rapid growth.²⁵ He estimates that by the end of 1969 there were about 300 COM recorders in use in the United States.

By joining the microfilm to the computer it has become possible to take advantage of the tremendously increased speed and power potential of the newer computer models. Until recently the computer output was recorded on paper by means of mechanical printing devices. Even though an avalanche of paper records was created, the impact printer could not keep pace with the computer processing potential. The COM recorder has provided the long sought remedy with an output equivalent equal to about thirty impact printers working simultaneously. The computer output microfilmer converts the digital computer symbols into language understandable to humans and generates a microfilm copy directly without an intervening paper copy. There are two methods of recording directly on microfilm: the cathode ray tube (CRT) system and the electron beam recording

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(EBR) system. A concise explanation of these two systems may be found in Don M. Avedon's recent overview of the COM field.²⁶

USER STUDIES

Librarians in educational institutions of all levels of education, as well as those serving special and public libraries, have been greatly interested in the extent of microform use. The increase in microform production was expected to be accompanied by a corresponding increase in microfilm utilization. As Norbert Stahl notes in a recent article, microfilm can no longer be relegated to a mere archival role; it must become action oriented.²⁷ But in general the increase in use did not keep pace with the increase in the quantity of microfilmed materials.

Various studies concerned with microfilm utilization in libraries have recently been undertaken or have been planned. Four of these will be briefly discussed here. On behalf of the Association of Research Libraries Donald C. Holmes made an exploratory study designed to identify the needs of microform users.²⁸ He interviewed eighty-nine persons at twenty-five institutions in all parts of the country. The findings offered no surprises. The reasons given by the interviewees for using microforms were conventional, such as: materials not otherwise available, to avoid keeping magazines and other serials in bound form, to preserve deteriorating material, to store bulky material, and to provide printout in hard copy form in lieu of use of rare or expensive originals. The comments on needs and shortcomings likewise were the expected ones and revealed why microforms so far have not been employed to their full potential. The lack of an optimum physical environment for microfilm use—suitable lighting, humidity control, suitable furniture, etc.—was deplored. It was also noted that there exists a large variety in types of readers and that there is no universal reader which would accept all kinds and sizes of microforms. It was further considered a deficiency that there are no inexpensive good readers which could be withdrawn for home use. The interviewees also indicated that users, when given a choice, preferred the hard copy. Users, however, did not show any preference for a particular kind of microform. Many of those questioned felt that bibliographic control must be greatly improved in order to facilitate access to the materials.

The suggestions made by the interviewees formed the basis for the nine recommendations of the study. These recommendations gave

direction to research projects designed to overcome the difficulties which have hampered microform utilization. The Office of Education was willing to supply continued financial support to the Microform Technology Project of the Association of Research Libraries, and this association decided to concentrate on two of the several problem areas. Holmes was to concern himself with the impact of environmental conditions on the utilization of microforms. He presented his findings in a final report.²⁹ Felix Reichmann and Josephine M. Tharpe were charged with investigating effective systems of bibliographic control of microforms. Their findings appear as an interim report.³⁰ Reichmann and Tharpe, who are continuing their work for another year, are expected to present their final report by June 1971.

Holmes provides authoritative information on microform reading areas and work rooms, on microform carrels, and on storage and handling. He also includes a chapter on "Teaching the Use of Microforms and Related Equipment." In one appendix Holmes provides a glossary listing the most important technical terms, and in other appendixes he gives information on types of microforms, characteristics of films, as well as desirable characteristics of readers and reader-printers. Since bibliographic matters are outside the scope of this study I shall only briefly mention that in their broadly conceived investigation Reichmann and Tharpe deal with the various levels of bibliographic control—local, national and international.

Ralph W. Lewis undertook a study of users' reactions to microfiche in a research laboratory library.³¹ He deemed such a study important since more and more research-oriented government agencies distribute their reports in microfiche only. It was surprising to discover that the majority of the researchers had a negative attitude toward the use of fiche, an attitude comparable to that held by early users of microfilm. This attitude prevailed even though the data were available in microform only. Lewis stresses that a considerable effort must be made to help scientists overcome this coolness, or at times even antipathy, toward microform use.

A study was conducted by James P. Kottenstette,³² with the aid of a group of college students, to discover whether the reading skills of the students would be preserved if they used microforms rather than hard copy as the information carriers. Since ultra-microfiche is coming into its own he used not only the conventional microfiche which he defined as reduced 40x or less but also ultra-microfiche which he defined as fiche at reduction ratios ranging from 40x to 150x.

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(Earlier I noted that the line of demarcation between conventional and ultra-microfiche is usually set at 60x.) The readers at the disposal of the students had magnification ratios corresponding to the reduction ratios of the microforms. For instance, an ultra-microfiche with a reduction ratio of 115x was read with a reader having a magnification ratio of 115x.

It should be mentioned that all materials which were in microform also were available in hard copy so that valid comparisons could be made by having the participants in the study use both hard copy and the corresponding microform. The study revealed that in the case of substantive reading materials (such as required reading) the reading ratio and comprehension level were not in any essential way affected by the kind of information carrier. Stated in a different way, in this experiment information transfer by means of microform, even ultra-microfiche, was essentially as effective as information transfer by means of a hard copy.

The American Association of Junior Colleges (AAJC) has set in motion a most ambitious project called the AAJC Microform Project.³³ It is divided into four phases and is expected to extend over a five-year period. Louise Giles was the principal investigator during Phase I (1969-70). Since July 1970 Dale Gaddy has been serving as the project director. The study is to determine under what conditions junior college students will select microforms and to assess the effectiveness of microforms in learning. The project provides, among other things, that bibliographies will be prepared for those courses which are nearly universally attended by junior college students; a research design will be developed; colleges for the pilot study will be chosen; materials used in courses will be filmed; colleges for a two-year field test will be selected; the necessary hardware will be procured; and finally, the data will be analyzed and reported.

While this study is projected against a junior college background, the breadth of its design assures that it will have at least partial applications to other levels of higher and even secondary education.

STANDARDIZATION

Many efforts have been made to bring about a higher degree of standardization than now prevails. As Peter Scott observed, it is not practical to have as many different formats of microforms as of books, because in the case of microforms a device—a reading machine—must be interposed between medium and user.³⁴

The microfilm norms formulated by the ALA³⁵ are intended to bring about uniformity without stifling ingenuity. These norms are largely concerned with 35 mm. microfilm. They do not deal with 16 mm. microfilm, microfiche, nor readers and reader-printers. However limited the scope of these norms may be, they set a pattern for attaining a higher degree of uniformity than prevails now.

Of greater significance are the detailed technical standards which have been set by the USA Standards Institute, a voluntary organization of film users and manufacturers. The standards relating to films are in the institute's PH series.

Also pertinent are the federal microfiche standards by COSATI³⁶ and the specifications for Library of Congress filming by Stephen R. Salmon.³⁷ Scott's comment that all of these standards are voluntary and need not be followed would seem especially important.

So far no comprehensive guide for the evaluation of microfilm has been available. Though concise, Allen Veaner's series of articles that appeared in *Choice*³⁸ offer some guidance. Of considerable help should be a forthcoming publication by the same author. It was originally intended as a manual for microform reviewers for the magazine *Choice*. In its expanded form it is expected to serve generally persons who are responsible for the acquisition and evaluation of micro-publications.³⁹

EXPERIMENTATION

The experimental computer-based technical library project which was established at the Massachusetts Institute of Technology in 1965 should have a great potential for effective and increased microform utilization. The project is known as Intrex, an acronym derived from information transfer experiments.

The prototype system which is now in operation contains a literature base composed of an "augmented" catalog and of approximately 12,000 complete microfilm texts. The augmented catalog, which is stored in the computer memory, contains not only the conventional catalog information for each article but also other data such as subject indexing terms, abstracts, tables of content and reviews. In all, the augmented catalog gives information relating to each article in approximately fifty different field codes. The separate text base which contains about 12,000 complete articles on microfilm is being increased at the rate of 400 items per month.

From various locations within the library building the user may

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interrogate the computer and command the display of the desired data—catalog information or full text. The information is displayed on a cathode ray tube. It is also possible to obtain hard copies of the displayed item at a reproduction station.

The full range of the research and development activities and the status of the model library are well described and evaluated in the latest semi-annual report of Project Intrex. This report also lists the Project Intrex staff, and the current and past publications relating to the project.⁴⁰

THE FUTURE

Microforms will have an ever brighter future if predictions made by G. B. Bernstein in the report entitled *A Fifteen-Year Forecast of Information Processing Technology*⁴¹ come true. The section of this report which deals with microforms and related equipment has been reproduced in the magazine *Microdoc* under the title "Things Ahead?"⁴² Forty-two categories which are expected to undergo changes are listed. It is predicted that some of the changes will occur very soon and others considerably later, but all within a fifteen-year period. Bernstein notes for each event the span of time within which he expects it to occur together with the likely year of occurrence.

Lack of space does not allow me to present this optimistic outlook in full but I shall note here at least a few of the events with their "likely" year of happening.

Availability of a "universal" viewer for a wide variety of optical format microfilm (1972).

Increase in use of microforms and associated equipment by a factor of ten (1978).

Marriage of microforms with other information processing equipment; this will enhance the utility of microforms as dynamic elements in active current information systems (1975).

Conversion of one form into another (e.g., film to fiche) will be inexpensive and will increase; it will help to standardize film formats (1974).

Substantial improvement in quality of microfilm and microfilm equipment. Substantial improvement in light sources for making and using film (1980).

Capability of microfilm viewers for displaying images in color (1970), and of printers to print in color (1974).

Availability of compact, less expensive viewers as a result of breakthroughs in optic design (1973).

Radical change in policy and methods of publication, now hampered by present copyright laws (1974).

Decrease in use of conventional printed materials and corresponding increase in high density media and soft display (1980).

Availability of a microfilm reading device which will be as easy or easier to use than a book. This device will be so light and adaptable that in the author's words "you should be able to take it to bed with you if you like" (1975).

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