

Library Association Pamphlet No. 17

MICRORECORDING IN LIBRARIES:

a review of present practice

By

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MICRORECORDING IN LIBRARIES

THE use of microphotography as a means of information storage and retrieval has had no great following among librarians and information officers in this country in spite of the larger-scale acceptance by librarians and scholars in America and on the continent of Europe. Out of the 441 libraries listed in volume 1 of B.U.C.O.P. (1955) only fifty undertake to provide microfilm facilities to enquirers. Twenty-one of these are special libraries, twenty-seven are university or college libraries, etc. Nevertheless, there is now a growing and active activity in its potentials, and a study of the characteristics and costs involved may be considered as a timely contribution to professional literature available for students and practising librarians.

1. THE HISTORY OF MICRORECORDS

It may be of interest at this stage to consider in what manner microphotography was first introduced and how its use developed. Like many other things, this form of reproduction first proved its value in time of war and received considerable impetus some time later through its continued and extensive use during the second world war.

Manchester has reason to be proud of the fact that John B. Dancer, an optician and instrument maker of that city, is to be considered as "the father of microphotography" (1). In 1840 he reduced a bill of twenty inches in length to one-eighth of an inch. Unfortunately, the opaque support for the photograph rendered viewing difficult. With the introduction of collodion emulsion in 1852, microphotography became quite a vogue. As an early example of extreme reduction we learn that in 1859 Dancer demonstrated a micro-example in which two pages of a book had been reduced to $1/1,600$ th part of an inch. At this rate the complete copy of 560 pages would have gone into a $\frac{3}{8}$ -in. square. A year earlier than this achievement, Thomas Sutton in his *Dictionary of photography* had dismissed microphotography as being useless and trivial!

The Frenchman Dagron probably saw some of Dancer's work and took a great interest in this form of photography. It was he who utilized his knowledge in 1870, during the Prussian siege of Paris, and, condensing certain vital information, contrived to have the microphotograph carried to the beleaguered city by pigeons, whereupon it was read by projection on to a wall.

Considerable ingenuity was shown during the war years 1917-18 by agents on both sides in the attempt to pass vital strategical information in highly reduced form. The value of microrecords and the medium of microphotography was so fully appreciated during the second world war in its use for making copies of documents and records in danger of destruction by enemy action, in addition to the regular carriage by air service for microfilmed letters from men and women in the Armed Forces overseas. The Rockefeller Foundation, in conjunction with the American Council of Learned Societies, sponsored one project in England which involved the copying of six million pages of early manuscript for deposition in the Library of Congress.

The scarcity of scientific journals from Germany and elsewhere in this country during the period of hostilities was overcome by Aslib,

who made a valuable contribution by microfilming over 1,000,000 pages (2). During the North African campaign, the Central Society of Medicine provided Fellows on active service with microfilm copies of material, setting up readers at key points along the North African coast. Later, the Central Medical Library Bureau was inaugurated, with the aid of a Rockefeller grant, for the defined purpose of preparing and distributing to war-damaged libraries in Europe and elsewhere microfilm copies of long runs of periodicals. The Bureau ceased operation when the task was completed.

The successful operation of such wide-scale activities in micro-reproduction had its roots in the slow but steady development witnessed in America during the years between the wars. Micro-recording was first put on a businesslike footing in 1928 when Eastman Kodak introduced its Recordak Division with the primary object of developing suitable apparatus for microcopying cheques. This was a culmination of experimental work on automatic photographic copying machines undertaken by commercial firms during 1922-26. Business establishments in the U.S.A. and, later, in this country, were quick to see the advantages which lay in the use of microphotography, particularly for reducing great volumes of records of limited information retrieval value to microform, for the purpose of saving storage space.

Acceptance of the microform by librarians and scholars in America came somewhat later, although as early as 1928 the Library of Congress, using a French camera, embarked on its Project "A" (at the cost of 450,000 dollars) involving the copying of material relating to American history which lay in European archives. Yale, Harvard and several other special libraries were using Leica and similar cameras up to 1934.

In 1933, after eight years of experience in industrial usage, Eastman Kodak decided to promote microcopying technique for libraries. The New York Public Library, co-operating with the Recordak Division, experimented with the reproduction of local newspapers and in May 1934 set up a microfilm reading room using prototype readers. The interest once shown encouraged the establishment of the Graphic Microfilm Corporation in 1936 and University Microfilms Inc. in 1938. The latter company now has an office in London.

Exploitation of microfilms in Great Britain came later. In 1936, after eighteen months of preliminary investigation, Kodak set up a Recordak Division for the promotion of 16 mm. usage by commercial establishments. The 35 mm. film was introduced in 1937 particularly for the microreproduction of *The Times*. Further encouragement came in 1938 when the Americans inaugurated a scheme for copying rare documents in English learned libraries.

In spite of the comparative ease with which microfilm could be projected and enlarged for viewing, certain disadvantages were apparent to librarians, and the idea of having a more durable microform, one which could be handled and filed easily, came with the introduction by Dr. Fremont Rider in 1944 of an opaque form of reproduction on convenient-sized cards suitable for library usage⁽³⁾. The considerable interest that was shown resulted soon after in the establishment in the U.S.A. of the Microcard Committee, a joint body of all library associations, under the chairmanship of Dr. Rider. Development of this medium of reproduction followed rapidly, resulting in the present availability of numerous valuable and out-of-print publications presented on cards, mostly of the size 3×5 in. More rapid acceptance of this form of publishing has been hampered by the difficulty of producing an ideal reader at an acceptable price.

The established use of microphotography for the reproduction of documents for storage purposes, where the most active period of reference had passed, has not been accepted by every organization engaged in this medium, however. The micro-opaque introduced in 1944 is being used as a medium for small editions of out-of-print and other documents for regular reference usage. In Europe and in the U.S.A. the microfilm has been removed from the role of space-saving only to that of active reference material. The popular transparent microfiche has become a rival to the microcard, whilst firms such as Remington-Rand provide the means of filing strips of roll film that can be used for active filing, e.g., the "Kard-a-film" system. The Eastman Kodak Minicard system, using a reduction ration of 60 : 1 on photographic film, will combine photographic images with digital information, thus linking high storage capability characteristics with the rapid information retrieval feature of punched cards. More than that, enlargements to either original size or Microprint are claimed.

Other systems have been introduced in America whereby strips of microfilm can be inserted in various types of punched cards to facilitate rapid selection of scientific and technical data. The Rapid Selector of the Massachusetts Institute of Technology and the U.S. Patent Office, searching at high speed, selects all abstracts (on microfilm) in the specified field of information⁽⁴⁾. A French system, Filmorex, uses sheets of microfilm divided into two; one side for the code and the other containing two pages of text. The selector scans at 600 per minute and the selected sheets can be read by using a microfilm reader or paper enlargement.

Each type of library and information organization, whether old established or of recent growth, may have one or more problems which might be resolved by using one or other of the forms of

microrecord available. It is essential, however, to understand the characteristics and limitations of microphotography and microforms and then to survey adequately each problem, to decide whether it is a change of procedure that is needed or that microrecording is the only answer. It may be found that justification in capital expenditure exists, particularly when more than one problem can be solved by using the same apparatus. The various factors that may have to be considered are:

- Preservation of unique material;
- Saving of storage space;
- Saving of binding cost;
- Publication of limited editions, including out-of-print material;
- Prevention of wear and tear in inter-library loans;
- More rapid dissemination of scientific and technical data;
- Saving cataloguing costs;
- More rapid retrieval of scientific and technical information;
- Miscellaneous uses.

2. FORM OF MICRORECORD

Reduced-size photographic reproduction may be divided into two groups: one of transparencies which are read by transmitting light through the film, and the other consisting of opaque records which can be read only by means of reflected light⁽⁵⁾. (Figure 1.)

2.1. TRANSPARENCIES

The material for copying is photographed on to microfilm, using either a camera specially constructed for speedy operation or a good-quality miniature camera. The size of film that can be used ranges from 228×152 mm. (9×6 in.) sheet film to 16 mm. roll film ($\frac{1}{2}$ in.).

There is some loss of definition with photographic reduction, therefore the maximum reduction factor desirable depends on the type and size of lettering, the fineness of detail in a drawing, the shape of page and the use to which the negative is to be put. Experts recommend that newspapers, where the type size is on the average 7 point, should have a maximum reduction factor of 17-18, whilst with books printed in 12-point type the reduction could be down to 30. As far as usage is concerned, if it is only intended to view the film with a suitable reader, then a greater reduction is permissible than in the case where enlarged prints are required.

2.1.1. *Sheet film*

Many users of microfilm in Europe favour presentation in the form of flat films or microfiches. These are sometimes referred to as "microcards" and they should not be confused with the American opaque type of microcards. There is no present standardization in sizes, but the most-used ones are 228×152 mm. (9×6 in.), 75×125 mm. (3×5 in.) and 9×12 cm. ($3\frac{1}{2} \times 4\frac{3}{4}$ in.). The latter sizes, which are used in the system of the Netherlands firm, Nederlandse Document Reproductie, can be filed more easily by using the catalogue heading or class mark which is superimposed in readable-sized type at the top of each sheet, a feature characteristic of all microfiches. The maximum size of the original that can be made on one exposure of 9×12 cm. film is 85×120 cm. ($32\frac{1}{2} \times 47\frac{1}{2}$ in.). Subjects of a larger size are photographed in sections. One sheet can take from thirty-six to seventy-two pages of a book or periodical, depending on the size of the original, or eight pages of a newspaper such as the *New York Times* (Figure 2). In France, Germany and the Netherlands, small inexpensive portable readers have been developed for this microform.

2.1.2. *70 mm. film ($2\frac{3}{4}$ in.)*

Fine detail such as one finds in machine drawings, graphs and newspapers, etc., should have as small a reduction as possible. This size of film is therefore particularly suitable for the microreproduction of large originals of this nature.

2.1.3. *35 mm. and 16 mm. film (in 100 ft. rolls)*

This form of microfilm is the most widely used in the United States of America and in Great Britain, and has dictated the design and development of apparatus and methods of usage. Arrangement of the subject depends on the size of original and type. With an average-sized book (6×9 in.) two pages can be photographed on one frame (or exposure), the image taking up 18×24 mm. of a 35 mm. film with the lines of type running at right angles to the length of film. A newspaper of the size 12×18 in. can be photographed to take up the same area of the film, but the lines of type will run parallel to the length of the film. A large newspaper 18×24 in. will be reduced to 24×36 mm. and the lines of type will run at right angles to the length of the film. Use of film in large rolls is at a disadvantage for quick-reference purposes and, to overcome this, the film can be cut into short strips and filed in envelopes or mounted in special cards. The general practice in

France is to use 35 mm. film in ten-page strips. Remington Rand, in the "Kard-a-film" system, provides slotted cards with translucent protectors which can be used for either 16 mm. or 35 mm. film. Specimen sizes of card available:

	Price per 1,000
16 mm., 5 × 3 in. (houses 2 strips)	£32 10s.
16 mm., 6 × 4 in. (houses 3 strips)	£40
35 mm., 8 × 5 in. (houses 2 strips)	£37 10s.

(The last is suitable for ten page reproductions.)

(Other sizes can be made to order.)

This system has been well received in the U.S.A. by business organizations, because further data on film can be added progressively to the card so that records are filed in sequence, either by subject or in some other desirable order. The special protection provided overcomes the criticism of microcard adherents that microfilm scratches and marks easily (Figure 3).

2.1.4. *Microfilm for rapid information retrieval*

The Film "N" File Corporation system in America permits microfilm frames to be inserted into I.B.M. punched cards with the punched coding along the card's edges. The Filmsort system provides the means for inserting film into cards or in attached pockets for use with any type of punched card installation (6).

In France, Filmorex uses sheet film 45 × 72 mm. ($1\frac{3}{4} \times 2\frac{3}{4}$ in.). One million records occupy one cubic metre of space and a special machine is available which selects at 600 per minute. Sheets which carry both code and textual information can be read with the aid of a viewer; facilities for enlargement are also provided (4).

In the U.S.A., Eastman Kodak is developing the Minicard system, which combines the advantages of microfilm with those of rapid selectors and it is claimed that the cost will compare favourably with conventional forms of punched card and microfilm (7). Small pieces of film are used, 16 × 32 mm. ($\frac{5}{8} \times 1\frac{1}{4}$ in.), which carry digital information in the form of clear or opaque dots arranged in code patterns together with photographic images from original documents at 60 : 1 reduction (Figure 4). A Minicard can accommodate up to twelve pages of text, based on the original size of $8\frac{1}{2} \times 14$ in. Ten million such cards would take up ten square feet of floor space. The system's mechanical and electrical components will make it possible to sort Minicards at a rate of 1,800 per minute and, in the same way, facilitate rapid interpolation. It will be possible to read the selected

cards on a desk-type viewer and it is claimed that enlargement to full size or on to microprint will be possible (in spite of the extreme reduction). The prototype equipment was demonstrated in June 1955 and consisted of a number of units classified by the U.D.C. whose ultimate destination in 1956 was the U.S. Air Force. At the time observers considered the system was likely to be a major advance in making the best use of recorded information but that further development was first necessary on the scanner for greater flexibility of sorting.

2.2. OPAQUES

An opaque microrecord is, in effect, a positive print made from a photographic negative, and it can only be read by means of a magnifying lens or by using reflected light through an optical system. Apart from miniature facsimiles the original is photographed on to 16 mm. film, reproduction then being made in print or by photographic means. This medium was developed as an economical method for publishing a small number of copies of materials with a limited demand.

2.2.1. *Miniature facsimiles*

In Europe, facsimiles with reductions varying from 3 : 1 to 6 : 1 are made which can be read, sometimes with the naked eye, but generally by means of an inexpensive magnifying glass. The German firm Mikrobuch und Film Gesellschaft in Düsseldorf publishes micro-editions of books at a reduction of 3 : 1. As an example, an octavo volume of 785 pages is reduced to eighty-eight pages. The overall cost is greater than microfilm, but printing by offset-litho method reduces cost. It is understood that University Microfilms Incorporated are experimenting at the moment with this process and discussions are in progress with the U.S. Atomic Energy Commission on the possibility of printing reports in miniature.

2.2.2. *Microcard* ⁽⁸⁾

A contact print on to 3 × 5 in. cards is made from strips of 16 mm. film. Pages are arranged in three or four rows, average accommodation being forty-eight pages of a normal-sized document (Figure 5a). Headings in readable-sized type are added for self-indexing. Reproduction on microcard is considered to be a practical process for microcopies greater than fifteen. A scheme for the microcard production of single journal articles, however, is advocated by Bishop ⁽⁸⁾.

2.2.3. *Microtape and microstrip*

Images are photographed from 16 mm. film on to narrow lengths of adhesive photographic paper in 100 ft. rolls, which can then be cut into desired lengths for application to any-sized filing card. New material can be added to the card at any time to maintain a current record. The cost is estimated to come to less than a half-cent for an average-sized page.

2.2.4. *Microprint* ⁽⁹⁾

The microfilm images are transferred to photosensitized master plates, and with the offset-litho printing process, using permanent colour-fast ink, reproduction is made on to rolls of good-quality paper. 6 × 9 in. cards are formed which carry 100 pages of text arranged in ten rows of ten pages to enable quick location of a specific page. Readex Microprints are not published in editions of less than fifty and the cost works out less than for microfilm or microcard. It is claimed that tone pictures are within the range of this medium. Sets of cards are stored in shelf boxes (Figure 5b).

2.2.5. *Microlex*

Documents are photographed page by page on to sheets of $6\frac{1}{2} \times 8\frac{1}{2}$ in. film (200 pages to one negative). The images are then printed on to an $8\frac{1}{2}$ in. roll of photographic paper by continuous process. The prints are laminated back to back to form a card containing 400 consecutive pages with large readable type at the head of each card for cataloguing or classification purposes (Figure 6).

3. APPARATUS FOR MICRORECORDS

There is a wide range of microfilm cameras and readers marketed in Europe and in America. There are fewer micro-opaque readers, however, to choose from, and the range has been predominantly American, although several English firms are now showing a practical interest. Both the Unesco Report and the F.I.D. "Manual on document reproduction and selection" ^(10,11) give very full lists of manufacturers and the characteristics of their apparatus, including cameras, processing equipment, readers and enlargers. Apparatus is continually being modified, new machines are being introduced periodically and the models described below are a selection from those currently available.

The need is constantly being expressed for a multi-purpose reader on economical grounds that will make it possible for many more libraries and other users to introduce the various microforms as part of their information and research service. Whilst it is possible to use certain microfilm readers for all varieties of the transparent medium and some of the microcard readers for viewing transparencies (using a white card underneath the film), there is no one satisfactory piece of apparatus to cover the whole range. A universal-type reader, the Waterworth, has been made in Australia and is being marketed in this country by Micro Methods Ltd.

3.1. MICROFILM APPARATUS

3.1.1. *Portable readers*

Probably the most satisfactory reader in this category, from the point of view of handling, finished workmanship and projection, is the V.C. Portable Microfilm Reader of Micro Methods Ltd. (Figure 7). It is, however, more expensive than the other readers listed. It is contained in a carrying case which is an integral part of the apparatus and is very easily erected. The image is projected down on to the desk or table in the natural reader position, thus eliminating any troublesome glare or eye-strain that is sometimes apparent when using a translucent screen. When in use the reader takes up little more room than a typewriter. It will accommodate 35 mm. and 16 mm. film and it can also be adapted for the transparent microfiche.

The standard hand-operated model (35 mm.), weighing 35 lb., costs £85. Another model is available with automatic press-button control, facilitating speedy winding. This reader weighs 45 lb. and costs £118.

A. West & Partners Ltd. have two readers available, both less expensive than the V.C. reader. The Kangaroo microprojector is a simple machine designed to sell at a modest price (£40). It can be used at a desk, where the image is magnified about ten times, or for large-scale wall projections. It is not a highly finished product and the lens is not of the same high quality as obtained in the more expensive reader. Consequently, it does not give an even reproduction over the whole reading area. It is a reasonable machine, however, for the type of work for which it was designed. The weight is only 8 lb.

The other reader is the Leech "Rochester" and its assembly is similar to the ordinary photographic enlarger, the projected image being directly beneath the lamp-house and lens unit (Figure 8). It can be used for 35 mm. and 16 mm. film and the movement of the

lamp-house up the internal column allows a variation of magnification from $\times 8$ to $\times 13\frac{1}{2}$. The prefocus projection lamp 300-watt/230 volt gives effective illumination. The price without carrying case is £60.

Another very simple and inexpensive table reader is the Microvist I, marketed by Nederlandse Document Reproductie of The Hague in the Netherlands (Figure 9). Although primarily intended for 9×12 cm. transparent microfiche, it can be used with 35 mm. roll film by use of an adaptor. The height of the reflecting mirror is adjustable so that the enlarged image can be increased from 10 : 1 to 25 : 1. Wall projection is also possible and it is claimed that paper enlargements can be made. This company also markets the "Leeuwenhoek" and the "Huygens-I," both table readers similar to the Microvist but more suitable to read in daylight.

The Grimscombe Corporation of America have a portable reader built into a carrying case weighing 17 lb. Interchangeability of lenses enables the projection of 16 mm. and 35 mm. film. Excluding import duty the price is about £65.*

3.1.2. *Standard readers*

The most widely used standard models in this country are made by Kodak, although readers are available from Burroughs and Remington Rand. A number of libraries use Edison Swan readers, but these are no longer on the market.

The Kodak Recordak Library Reader AH.3 is a precision-made machine for standard library usage. It has a translucent screen 18 in. square, inclined about 10 degrees from the vertical, permitting a number of persons to read the projected image at the same time. The reader is designed to take 35 mm. roll films and it can be fitted with both a 1 in. and 2 in. lens giving twenty-four times and twelve times magnification respectively. Illumination is provided by a 200-watt lamp and, together with a specially designed lens, presents an effective image on the screen. The reader costs £185. The "Commercial" reader can be used for the 16 or 35 mm. roll film and is fitted with two lenses giving forty and twenty-four times magnification. The machine stands on a table to enable the user to make notes. Projection is downwards on to a matt-finish screen, 18 in. square, which is protected from normal light by its siting within the body of the reader. The price is the same as for the AH.3 model. In both models there are glass flats which hold the film to give sharp focus at all times. The "Microfilmer" desk model acts as a combined 16 mm.

* New portable Microfiche/Microfilm readers:
Iota Service Ltd. Standard reader 1, with roll film attachment—£53.
Microfilm Systems Ltd. Dagmar reader—about £40.

camera and viewer and its primary use is for business establishments. It will copy loose-leaf documents up to 12×14 in. and small bound volumes at a reduction of $26 : 1$. Push-button control enables commercial work to be copied at an output up to 1,500 exposures an hour. The price of this dual-purpose apparatus is £425. Although not recommended for regular practice, paper enlargements can be made on the latter two readers.

Remington Rand have recently produced a reader designed for use in conjunction with their "Kard-a-film" system. It has a translucent viewing screen slightly inclined from the vertical. The projection of the image and the illumination is quite satisfactory. It has a special card holder to take their filing cards and, presumably, can be adapted for use with microfiche and film strips. Photographic enlargements can be made. It is priced at about £150.

Photostat Ltd. manufacture a "Statfile" film-viewing desk for use with their system of "Statfile" reductions from plans, drawings, etc. It is not really in the microfilm range, magnification being of the order of either times two or times five, the latter being made possible by using a supplementary scanning lens mounted on a universal arm. Nevertheless it comes within the scope of apparatus for reduced reproductions.

3.1.3. *Microfilm cameras*

The Kodak "Commercial" Camera, which can be rented at £120 per annum, does not really come within the range of library equipment. The most popular model, however, for document copying is the Micro-file All camera, capable of taking sizes up to $17 \times 25\frac{1}{2}$ in. With a special holder, it can accommodate books up to $17 \times 23\frac{1}{2}$ in. It is relatively simple to operate, the movement of the camera up and down the height column is coupled with mechanism which automatically adjusts the lens. The specially corrected 2 in. Dallmeyer lens allows a reduction range of from $8 : 1$ to $18 : 1$. The price is £385. An "Industrial" model costing £450 extends the range to sizes up to 20×30 in.

Photostat Ltd. have recently introduced a 70 mm. camera which can be used for projection on to photographic sensitized materials for enlargements, as well as for making reductions up to a ratio of $17 : 1$. The makers claim enlargements have a very high-quality definition. 70 mm. negatives are made from originals up to 40×60 in. Another model permits usage with 34×55 in. material. These models are intended primarily for the mass recording of large numbers of drawings and would only be of value to large manufacturing concerns or research organizations.

The Goebel camera of the Netherlands firm Nederlandse Document Reproductie has been designed for making 9×12 cm. sheet films (microfiche). A 3.5/50 mm. Schneider Kemat lens permits reductions of from 8 : 1 to 24 : 1. A reduction diagram enables a document to be laid upon it for the immediate determination of the reduction factor, as well as indicating which of two special racks has to be attached to the camera. One of the racks decides which number of exposures per line is desirable and the other one determines the number of lines per sheet. In operation, a buzzing sound acts as a warning to indicate that the end of the line has been reached. At the same time, the camera stops until it is returned to the starting position, automatically moving up one line. Accessories include a title camera and book clamps. This particular equipment has much to recommend it and it is interesting to note that it has been purchased for one Government department in this country handling a great volume of statistical information, and at least one private research organization is using the camera. It is understood that Micro Methods Ltd. have one available for making microfiche on a commercial basis.

3.2. MICROCARD READERS

3.2.1. *Pocket-size readers*

The relatively high cost of microcard readers prohibits a large number from being distributed to all the focal reference points in a large information department, a factor which probably detracts from the value to be gained from using the opaque form of microrecord. Two American manufacturers have, however, put on the market small hand-held readers which enable cards to be read at the desk, in the laboratory and at home. They are cheap enough to permit issue with the loan of each microcard. Microrecord can be read either in daylight or with battery illumination, and the lens system enables a whole regular book page to be seen without eye movement. Microfilm can also be viewed provided that a white backing card is used. These small readers are obviously not intended for extended reading, but they are likely to be most useful for scanning, consulting indexes, bibliographies and for use when comparing the information on one card with another when one of the cards is already in a standard-sized reader. The model made by the Microcard Foundation, weighing 7 oz. (without battery) (Figure 10(b)) operates with battery or on mains (110 volts), giving a $\times 12$ magnification, and is priced at 25 dollars. In this country the Ultra Lens Company market a very well-made illuminated hand-held reader with a thirty-six-area magnification. Although designed for textile

inspection and similar work, it is suitable for microrecord scanning (Figure 10(a)).

3.2.2. *Standard microcard readers*

The design of an ideal reader for projecting micro-images on opaque cards has presented difficulties. The following factors have had to be taken into consideration: maximum illumination yet avoidance of hot spots and final glare; prevention of overheating with continued use; sharp focusing of the reflected image without distortion on the outer edges of the projected page, a screen made of the right material to allow the best diffusion of light and of the most suitable colour tint to minimize eye-strain with prolonged reading, a card-holder that facilitates quick location of pages. Each of the readers available endeavours to satisfy these requirements in one way or another.

A short time ago we were dependent entirely on importing readers from America, but at least one English firm is now in production.

Micro Methods Ltd. are marketing their V.C. Microcard reader at a price of about £95. It is illuminated with a prefocus 100-volt/200-watt lamp and has a built-in transformer. The translucent screen is $8\frac{1}{2} \times 10$ in. and is made of a tinted plastic material. Normal magnification is times twenty but interchangeable lenses are available for other magnifications. No special card-holder has been provided, so that the apparatus can be used for any available size of microcard, in addition to the transparent microfiche with white backing. This model compares favourably with those available in America and the great advantage is that, being British, the components are easily interchangeable (Figure 11). The makers claim that a paper enlargement can be made on the reader.

Kodak are investigating the possibilities of making a simplified version of the Eastman Kodak Microprint Reader at a price suitable for the English (and European) market.

Elite Optics Ltd. have produced a prototype reader especially designed for the library of a public authority, but further development was abandoned in favour of an attachment to a standard Elite eptdiascope or 2×2 in. slide projector. The composite instrument costs just over £80 (Figure 13).

The Microcard Foundation market four models (5, 5B, 6, 6B) varying from 215 to 275 dollars, which can be supplied with or without a card-moving mechanism. The translucent screen, $9\frac{1}{2} \times 10\frac{1}{8}$ in., is illuminated by a prefocused 110-volt/150-watt projection lamp and a magnification of times twenty-three is provided (Figure 4).*

* Iota Services Ltd. are planning to produce an inexpensive microcard reader.

The Microcard 6B Special offers improved viewing with the introduction of a Fresnel screen and by the use of a 300 watt bulb instead of 150 watt—335 dollars.

3.2.3. Microprint readers

The Readex reader, with a times twenty magnification, has a screen of $8\frac{3}{4} \times 11\frac{1}{2}$ in. and can be used for microprint, microcard, positive microfilm sheets and microfilm strips. There is a brilliance control and two detachable screens, one of which has a finer grain particularly suited to screen illuminations of varying brightness, whilst the other screen is grainless and eliminates glitter and hot spot. A "Newspaper" model from the same American firm has a screen 16×18 in. projecting an image of slightly over half of a page from the *New York Times*. The standard model is 325 dollars, whilst the "Newspaper" model costs 400 dollars.

The Microlex Model B reader is also adaptable in its use and costs only 168 dollars. It has a blue-tinted screen which is restful to the eyes but is smaller in size than others described, and it is not possible to view the whole page of a standard microcard at one time. The definition of the image is good. The screen page is well set back in the cabinet and it is essential that the viewer has the apparatus adjusted at the right height for correct effect.

The Eastman Kodak Kodagraph Microprint reader Model "A" is probably the best reader available but it costs about £120. The green screen makes viewing easier on the eyes. The complete $8\frac{3}{4} \times 10\frac{1}{2}$ in. page of any microtext can be seen at once and there is no apparent distortion. The card-holder is particularly novel. It consists of a roller in which the card is gripped along the whole of its edge. This takes all sizes from 3×5 in. to $8\frac{1}{2} \times 14$ in. and offers smooth, quick movement for selecting pages. The lens has had to be specially designed to work from the curved surface of the card (Figure 12).

The American Optical Company of New York have marketed a reader, the "Magnavisa," which, they claim, enables enlarged photographic copies to be made (Figure 15).

4. MICROPHOTOGRAPHIC SERVICE ^(12 13)

Several firms in this country undertake to microfilm specific documents for the customer who has considered that it is uneconomical to purchase the necessary photographic equipment and to employ a member of the staff for the job. The charge varies according to the amount of preparatory work and handling that is involved. The customer has to submit a statement that either he is the owner of the copyright of the documents or that he has obtained the permission of the owner before copies can be made. This protects the firm from any claim for infringement of copyright.*

* Microfiche. Iora Services Ltd. will provide microfiche reproductions at approximately 1.4d. a page. Microcards can also be obtained.

KODAK'S CHARGES

16 mm. loose-leaf sheets up to
10½ in. wide and up to 18 in.
long

Minimum charge, 7s. 6d.

Over 100 exposures, 7s. 6d. per
100, with proportional reduction
for quantities over 100.

Minimum charge Over 100 exposures

35 mm. Ordinary commercial
work up to 18 × 24 in.

(1 exposure per page) ..

15s.

15s. per 100

Newspapers up to 18 × 24 in. ..

20s.

20s. per 100

Library work (maximum 18 ×
24 in.)

30s.

30s. per 100

Paper enlargements are made at the following cost:

Minimum charge per job—5s.

Minimum charge per print up to 8 × 10 in. 1s.

“ “ “ 8 × 13 in. 15.33d.

“ “ “ 10 × 12 in. 17.5d.

A. WEST AND PARTNERS' CHARGES

35 mm. (originals up to 16 ×
20 in.)

From 1 to 100 frames, 3d. per frame.
100 to 500 frames, 22s. 6d. per 100.

Larger originals:

Each

¼-plate original up to 22 × 15 in. 2s. 6d.

½-plate “ “ “ 40 × 30 in. 3s. 6d.

whole plate “ “ “ 50 × 40 in. 5s. 9d.

Enlargements are made at the following cost:

Each

8 × 6 in. first copy 1s. 9d.; additional copies 1s. 5d.

13 × 9 in. first copy 2s. 6d.; additional copies 2s.

(The firm undertakes to return records within a few days)

Another organization, University Microfilms Inc. (Great Britain) Ltd., maintains a microfilm camera in the British Museum photographic studio to meet the demands from scholars and libraries for copies from books and manuscript. In addition, they have portable equipment for outside work and facilities for microfilming at the London office.*

* Microcard. Kodak operates a microcard service, price varying from 0.69d. to 0.37d. a page according to number of copies.
Microfilm enlargements. Using Xerography (Rank Organisation), cost at about 6d. per running foot of paper (uncut).

5. PUBLISHING FACILITIES

The publishing firm of I. R. Maxwell & Co. Ltd. has issued a catalogue of over 3,000 titles of medical and scientific journals, dissertations, newspapers, manuscripts, as well as back issues of current periodicals, published in microfilm or microcard and undertake to supply microfilms, microcards or photostats from publications in their stock. Unfortunately certain details are omitted, such as the sources of supply, whether or not the purchaser has to be already a subscriber to the paper edition, if the reproduction is on film or card and whether or not copyright restrictions deny supply to other countries. It is understood that this firm have negotiated for the supply of microfilm copies of books and periodicals published in the U.S.S.R.

5.1. MICROFILM⁽¹⁴⁾

Positive microfilm copies of a wide range of current periodicals, dissertations, etc., are published by University Microfilms Inc., many of which may be imported through their London office provided that the purchaser is a subscriber to the paper edition. The 7th edition of *The problem of periodical storage in libraries* lists nearly 800 titles available. Mr. Ardern⁽¹⁵⁾ considers that the firm's statement that the cost of a microfilm edition is little more than the cost of binding is not generally borne out for English purchasers with the exception of a few titles. A number of back files are also available which result in a saving over second-hand price of paper copies.

As far as national newspapers are concerned, *The Times* from 1785 and the "Official Index" from 1906 are available on 35 mm. film and the *Manchester Guardian* from 1821 to 1952, reproduced by the Manchester City Library, is obtainable at commercial rates. This Library is now engaged in microfilming the *Manchester Mercury* from 1752.

Further microfilm facilities provided by large national bibliographical and research organizations are discussed later.

Catalogues of microfiche editions of periodicals and books have been issued in France by Masson et Cie and Microthèque-France.

5.2. MICROCARD

The Microcard Foundation, which is now located at Madison, Wisconsin, where it is affiliated with the University of Wisconsin Press, have a very extensive range of micro-reproduced publications

from the fields of Science, Engineering, History, Geography, English Literature, etc. Typical examples are complete runs of such well-known series as: *Annalen der Physik* 1790-1944, Beilstein's *Handbuch der Organische Chemie*, *Chemisches Zentralblatt* 1830-1945, *Proceedings of the Royal Society* from 1800, certain Soviet scientific journals, *Comptes Rendus*, various law report series, U.S. Patent Office Official Gazette from 1950, etc.

The Foundation lists all titles currently available on microcard in an occasional publication entitled the *Microcard Bulletin*. Apart from scientific and technical journals, certain valuable literary series are included, to list a few: The Chaucer Society publications, the Shakespeare Society publications, the Rolls Series, the Annual Register. Volumes 1-131 of the last named series are contained on nearly 2,000 cards and cost about £96.

One very large undertaking is the publication of all unclassified reports of the U.S. Atomic Energy Commission. It was originally intended to supply subscribers with any subject grouping they desired but the work involved has dictated a change of plan. It is now necessary to order either the complete release each year or specific reports. The Microcard Foundation issue a list entitled "Unclassified Atomic Energy Commission Reports." The plan for publishing the complete series of the reports of the National Aeronautical Council of America has been dropped through lack of support.

Comparative edition costs:

	Bookform	Microcard		Microfilm		Annual
		Vols.	Price (Approx.)	Vols.	Price	
<i>American Journal of Physiology</i> ..		1-25	£33	1-159	£166	£3 12s.
<i>Bell System Technical Journal</i> ..		1-5	£5 4s.	1-27	£32	£2
<i>Isis</i>		1-7	£7 6s.	1-6	£7 4s.	13s.
<i>Liebig's Annalen der Chemie</i> ..	£1800 (Approx.) (Reprint Edition 1920-39. £370)	1-554	£400	1-557	£404	

	<i>Bookform</i>		<i>Microcard</i>		<i>Microfilm</i>	
			<i>Vols.</i>	<i>Price</i>	<i>Vols.</i>	<i>Price</i>
(Approx.)						
<i>Journal Biological Chemistry</i>	Reprint	V. 1-45		£70		
		V. 1-25.				
		£140				
<i>Library Journal</i>		1-50		£53	1-73	£126
<i>Zeitschrift für Physikalische Chemie</i>	..	£1,000	(1-193)	£283	(1-193)	£324
			(1-35B)		(1-35B)	
<i>Monatshefte für Chemie</i>	..		1-74	£70	1-74	£124

A microcard copying service is now operating in this country under the Kodak Recordak Division for reproducing archival volumes. The size 3 × 5 in. is followed.

5.3. MICROPRINT (9)

The Readex Company since 1941 have undertaken a number of significant Microprint projects among which are the publication of:

The House of Commons *Sessional Papers*, 1731-1800; 1801-1900, comprising over 6,000 volumes containing over 80,000 documents.

The *New York Times*, at £30 per annum (microfilm edition £56).

Cumulative subject catalogue of the Library of Congress, 1950-54, (over 500,000 entries) at £50 (£10 for current year).

All current and past publications of the United Nations at 250 dollars per annum.

U.S. Surgeon-General's Office of the Army Medical Library Index-Catalogue, 1880-1948, at £30.

A large project in active preparation is the production of all scientific and technical articles which have been abstracted in *Nuclear Science Abstracts*.

5.4. MICROLEX

This type of opaque card has been used only for the reproduction of American and Canadian law reports.

6. USES OF MICROPHOTOGRAPHY

The use of microrecords may be a means of solving one or more problems that face archives, registries, libraries, business establishments, research organizations and other places where a large number of paper records are handled. Librarians may wish to consider the medium of microphotography as a possible factor in reducing costs under such headings as: the acquisition programme, binding, storage, cataloguing, charging ^(16, 3).

6.1. SECURITY

Some of the uses to which microphotography can be put give rise to controversy, but its application for the security of unique documents is not likely to be debated. By this means, the text of valuable manuscripts and books can be brought to a larger number of scholars, who would never have had the facility otherwise. The Rockefeller Project, for instance, not only ensured that copies of unique material among our national treasures were made safe from destruction, but also made them available to scholars in the United States. Other schemes have made it possible for anyone to purchase microform editions of priceless material of historical and sociological interest, e.g., the House of Commons *Sessional Papers* and the Rolls Series. Where the reference factor is likely to be low, particularly for documents with a large number of pages, the most widely-used medium, especially in this country, is microform in roll form. Microfilm is also the medium for an organization wishing to make a single microcopy (or several copies) of its own papers, either in the form of roll film or sheet film. The latter, which is very suitable where the reference factor is high, is popular in Europe.

A scheme for the preservation of contemporary foreign newspapers was started in 1938 by the Harvard University Library and in the period up to 1955 a total of sixty-two papers were filmed. On January 1, 1956, the Association of Research Libraries in America took over the entire back files of the University Library, consisting of 375,000 feet of master negative film containing over 2,600,000 pages, when it initiated its Foreign Newspaper Microfilm Project. Sufficient participants to the new scheme assured financial success. One hundred papers are reproduced on negative film, a positive copy of which is made for loan purposes to any of the subscribers ⁽¹⁷⁾.

6.2. STORAGE

Unless they are very fortunate to have adequate stack facilities, well-established libraries are likely to have to face the ever-increasing problem of finding document storage space. Where land is cheap and readily available, relatively inexpensive buildings for this purpose may solve the problem for a period in the development of the system. New information services may consider that this is not one of their problems, but, in time, it may well become one, for technical, scientific and commercial data grow at a great rate.

In most industrial, commercial and scientific establishments, different sections compete over the smallest amount of spare space and difficulty arises as to who has the most pressing claim. It can be argued that the library and information side of an organization must have first consideration. An alternative attitude to this question may have to be adopted through pressure from the management. Drawing boards, calculating machines, laboratory equipment, machine tools, office equipment and personnel cannot be condensed—records can.

Old established or of recent growth, organizations whose responsibility it is to collect, store and disseminate information sooner or later will have to face this question of where to find additional space for storage. In some cases, greater selectivity of stock, together with a well-devised scheme for discard, may be the solution. Such a policy can be pursued successfully provided that reliance is placed upon other libraries having the not-in-stock information. Acceptance of this philosophy creates a number of other problems, however, a subject which will be considered later.

All forms of paper records can be reproduced by microphotography if so desired: newspapers⁽¹⁸⁾, periodicals, books, reports, trade literature, patent specifications, typescript papers, correspondence, statistics, personnel records, borrowers' registers, plans and drawings. Before deciding on the form of microrecord to be adopted, it will be essential to consider certain factors that affect the final determination of whether or not to use microform. These factors are the actual saving of space achieved and the cost of storing originals compared with the cost of microform storage.

In a pamphlet published by Records Engineering Inc. in February 1954 entitled *Survey of government microfilm operations*, cost comparisons are included which attempt to refute the general acceptance that microfilm is a low-cost substitute for storage and binding. It is shown that records which are kept for two years in active office space and then removed to a records centre where they are stored under

specialized warehouse conditions could be maintained from twenty to over sixty years before equalling the cost of microfilming.

It is difficult to make a decision, therefore, on the position of microforms in one's future policy when experienced writers, backed by statistical studies, conflict with each other. The answer lies in a thorough appreciation of the characteristics of each specific organization and the urgency for space-saving measures. There are factors other than storage which have to be considered when the use of microphotography is under consideration.

Advocates for microforms give varying estimates for the saving of space. Mr. Verry of the Organization and Methods Division of H.M. Treasury, who has made a detailed study of the subject, gives the following figures in dealing with paper records ⁽¹⁹⁾.

2,000 sheets (8 × 13 in.) will occupy 1 linear foot of shelving when filed in three foolscap boxes.

Volume of space . . . = 2,065 cu. in.

2,000 microfilm (35 mm.) exposures on roll film, with two pages on each frame, will go into 2½ reels (contained in three cartons)

= 79 cu. in.

The same number of pages on 16 mm. film. . . = 28 cu. in.

Mr. Verry goes on to estimate comparative costs of storage and then reports on an investigation made for a Government department on the storage of 100 million single-sided sheets of foolscap size (or less).

Storage space for originals . . . = 6,400 ft. wall space

Storage space for films (35 mm.) . . = 200 ft. wall space

Storage space for films (16 mm.) . . = 100 ft. wall space

Cost of microfilming at ¾d. . . = £56,250

The cost was based on the relative ease with which the sheets could be handled by a continuous-flow camera, thus giving a high output. More difficult material requiring initial preparation and special handling would have to be photographed with a different camera, resulting in slower output and increased cost.

Using 3½ × 4¾ in. sheet film (microfiche), a 256-page book (6 × 8½ in.) can be reproduced on five sheets. The full set of *Zeitschrift für Physikalische Chemie* in 258 volumes occupies 30 ft. of shelving, whereas the same set on sheet film takes up only 30 in. in a card cabinet drawer, i.e., about 1/36th of the original space. The same set of volumes reproduced on 35 mm. film would take forty-three reels (assuming one reel of 100 feet would accommodate from between 1,500 to 1,600 pages at two pages per exposure). Stored in cardboard cartons, the space occupied = 1,120 cu. in., i.e., about 1/16th of the original.

For practical purposes, the microfilm cartons are stored in specially designed cabinets. For instance, the Roneo cabinet, 28 in. high and 20 in. wide, is intended to be used as a stand for a reader and has four drawers each having four compartments, either $24\frac{1}{2}$ in. or $28\frac{1}{2}$ in. deep. There is total storage space for 256 reels in the latter size representing over 409,000 pages. Other-type cabinets can be made with more economy in space utilization.

Newspapers, graphs, machine drawings and other information on large sheets are difficult to file and occupy even more space than periodicals and books, in addition to the high cost of special furniture to house them. 70 mm. film is suitable for this kind of material, enabling originals up to 40×60 in. to be reproduced. Quarter-plate, half-plate and whole-plate sized reproductions are also being used in industry for sizes of the original varying from 16×20 in. to 40×50 in.

Savings in space similar to that for sheet film are made by using micro-opaque records. The 3×5 in. microcard can contain forty-eight pages or more of a normal-sized report, whilst a microsheet (e.g., Microlex $6\frac{1}{2} \times 8\frac{1}{2}$ in.) edition of a series of American law reports in 418 volumes, originally occupying $73\frac{1}{2}$ linear ft., occupy only $3\frac{1}{2}$ ft., the sheets being filed in seventeen shelf boxes.

6.3. BINDING PERIODICALS (20, 21, 22)

The biggest consumers of space in the technical and reference library are the files of periodicals upon which so much reliance is placed for information on a great variety of specific topics. For permanency and neatness, the general practice is to bind each volume, but there are disadvantages in this routine, particularly where loans are permitted. In a large organization, an enquirer for an article of a few pages may find that his name has been added to a long waiting list for a volume containing many other references in addition to his own. Bound volumes of periodicals are usually cumbersome, both to handle for reference and to send through the post. Some libraries separate the articles in a journal to get over this difficulty.

An alternative practice is to either file the loose copies of journals on shelves or racks, or in specially designed loose-leaf binders (e.g., "Easibind" or "Quickbinde") for a period of no longer than five years, a period estimated to be the most active one in the life of most periodicals. In the meantime, microfilm or microcard editions can be purchased to take the place of the original sets when they are eventually discarded. There will, of course, be exceptions to this rule for serials having a high reference factor going beyond this period, as well as

titles with a much shorter practical existence. Each library will have to determine its own discard periods according to its users' requirements.

American producers of microfilm editions of periodicals state that the cost is little more than the cost of binding the paper edition, but a study of the prices charged for microfilms does not substantiate this claim as far as binding costs in this country are concerned, with the exception of a few titles. The price of binding is only one consideration, however, in determining whether or not to discard eventually in favour of microreproductions.

6.4. STORAGE SPACE AND INTER-LIBRARY CO-OPERATION

The problem of storage can be solved by means other than replacing original material by micro-reproductions. A system of discard, related to an inter-library scheme for a centralized stack of little-used series, on a regional basis, can work quite well, provided that the lines of communication are kept running smoothly. Even so, the efficiency of such a system is hampered by the factor of time lag and those of cost and labour introduced in the handling of material for transit in both directions. Where no regional scheme operates, libraries may discard anyway, placing reliance on national libraries for loan or photocopy. The burden on organizations granting such facilities is becoming increasingly great, as is the wear and tear on the volumes loaned. The growing reliance that is being placed on the larger libraries is likely to result in longer waiting lists. Often, when the desired reference finally arrives, the originator of the request has passed on to another facet of his research and has no further interest in the context of the original article or report. It is possible that the larger national libraries and other libraries within the regions, all of whom have retained long back runs of periodicals, may eventually decide that loan facilities can no longer be permitted because of deterioration and that their services must be limited to the provision of photocopies or microcopies only.

Information centres in remote areas, such as ones which exist in countries like Australia, the United States, etc., may best be served by micro-editions of essential reference works. This may be particularly relevant when a new service is being started and funds do not permit large-scale purchase of expensive reference sets. It is of interest to note that the United States Army have provided a basic microcard reference library for the Judge Advocate's Division.

The question of inter-library co-operation has been considered in the United States, where inter-library depository centres have been set up. It was thought by some that micro-editions of serials and other

printed material would eliminate the need for such book storage centres, but both Esterquest⁽²³⁾ and Tate⁽²⁴⁾ argue that microrecords and the storage library are complementary and that the depository centres are likely to become the heaviest purchasers of microform reproductions. Esterquest has attempted to analyse the costs of whether or not to store at a centre.

6.5. MICRORECORDING IN UNIVERSITY AND OTHER LIBRARIES OF THE BRITISH ISLES

A questionnaire requesting information on various aspects of microfilming was sent to thirty-one large library systems, including twenty-three universities and university colleges, the National Libraries of Scotland and Wales, Manchester College of Technology, the British Museum, the Public Record Office, the Patent Office, Liverpool and Manchester Public Libraries. Limited details were already contained in the F.I.D. Directory, volume 1 of B.U.C.O.P. and in the Aslib Index to theses.

Only nine of these libraries, those of the smaller universities and the Patent Office, do not provide any kind of facilities for the copying of library material. Generally speaking, requests for microfilm copies should be reasonable ones, and, of course, all reproductions are subject to copyright. Only four university libraries do not microfilm unpublished theses, and, where facilities are available, permission to copy has to be given by the author and, in some cases, by the head of the department as well. In all cases requests should be made through the university librarian. The value of thesis literature is not generally appreciated in this country and it is to the credit of Aslib that the first national bibliography of this type of research material has commenced publication⁽²⁵⁾. Theses are arranged in subject order with a letter indicating university of origin. In the introduction, a summary is given of the attitude of each university to requests from outside enquirers for access to its theses holdings.

Internal usage of microrecords is limited to the copying of rare manuscripts and other material for security purposes, the copying of newspapers and the filling of gaps in periodical runs. The problem of storage does not appear to have arisen. Manchester University Library, however, has built up a large stock of microtext editions, and Mr. Arden, of the Manchester College of Science and Technology, reports that his library has purchased 1,000 volumes on microcards over the last four or five years with the saving of about £1,500. Manchester and Liverpool Public Libraries have entered into an active period of stock-building in microtext.

From the point of view of equipment, twelve university libraries have microfilm cameras, eight doing their own processing. In some cases the work is carried out by a separate photographic department. Four libraries delegate the copying to commercial undertakings. In addition, both the National Libraries and the public libraries of Liverpool and Manchester have cameras, the Public Record Office has eight, the British Museum has five, the latter two doing their own processing. Most of the equipment is Kodak Micro-file but the following are also used: Williamson, Leica, Practiflex and the portable American Graflex. The average cost for an exposure of two pages is 3d.; a minimum charge of from 2s. 6d. to 5s. is usually made—in some instances a reduction is made for quantity orders. A number of the libraries have facilities for enlargement, the charge for a 10 × 8 in. print varying widely from 10d. to 3s. 9d.

Every university library with a few exceptions has one or more types of microreader. The majority use either Kodak Recordak or Ediswan, a few possess portable readers such as the Pilgrim, the French Kangaroo, the American Spencer and the Griscombe, and the Dutch Microvist. Out of the whole number only eight microcard readers are installed and include the West, Kodak Microprint, Readex model B and the Microcard 6B. It is interesting to observe that the problem of greater exploitation of microfilm stock by allowing borrowers to take away a reader with the film borrowed is being tackled by Queen's University, who have purchased twelve additional portable Kangaroo readers.

6.6. INFORMATION RETRIEVAL

The chief objective of any library or information service is to disseminate information in the quickest possible way, prolonged delay resulting in loss of confidence in the efficiency of the organization.

Current information is brought to the attention of the service's potential users by means of bulletins summarizing the contents of recently received periodicals and by circulation. The latter is the least satisfactory method because of the delays that inevitably result. The other two mediums often result in an embarrassing list of requests for the loan of a periodical, pamphlet or report, a demand that may not be easily satisfied quickly. Thus, in the effort to disseminate information rapidly, the ends are defeated by the means.

Large bibliographical centres in various countries attempt to provide a service to cater for this initial demand. In France, the Documentation Centre, following the publication of its *Bulletin analytique*, undertakes to supply on 35 mm. film in 21 cm. strips, within

three to four days, reproductions from any document listed from a coverage of about 5,000 journals. 1952 figures show that over 1,000,000 pages in microfilm were dispatched over the year⁽²⁶⁾.

The American Chemical Society offers a somewhat similar service to its members and subscribers of *Chemical Abstracts* for the provision of photoprint or microfilm copy of any chemical paper appearing in the *Abstracts*. The service is centred in Washington, where library facilities are especially good, and the copying and distribution is carried out by the U.S. Department of Agriculture. (On going to press it is learnt that this service has now ceased but alternative arrangements are under consideration.)

One research association in this country upon request from its members undertakes to microfilm articles and pre-prints of up to sixteen pages and to make enlargements to a standard size for dispatch. This standardization enables large-sized pages from journals such as *Engineering* to be reproduced in a format more easily handled and filed. The capital outlay for the complete equipment was under £600, with consequent running costs and cost of materials relatively low. Apart from giving an enlargement of good definition, the master film copy is much easier to file than negatives made by photocopying processes. The Royal Society of Medicine also does all of its documentary reproduction initially on microfilm, making thin paper print enlargements for Fellows not having micro-reading facilities.

In the United States, the Office of Navy Research and the Navy Research Section of the Library of Congress changed its policy of loaning research reports in original format to issuing them on microcard. Apparently most subscribers and one-time borrowers have shown satisfaction with this medium, which enables a greater number of research workers to receive reports at the same time. The same method of microcard distribution has been in use by the Atomic Energy Commission for the rapid dissemination of scientific information to A.E.C. sites and co-operating laboratories.

The Technical Information and Document Unit of the Department of Scientific and Industrial Research provides a very useful service to industry by sending lists of unpublished reports from many sources, according to the subject interests of each particular firm. Any of the reports can be borrowed, but, in addition, microfilm copies (at 3d. per frame) or photocopies (at 1s. 3d. per page) can be supplied for retention. Other Government Departments in this country who supply information to outside bodies in the form of research reports, etc., are very much hampered in their loans service by having only a few copies which they can circulate at any one time. This is particularly true of foreign material. Responsible officers are quite aware of this failing

but are prevented from using microphotography because of Treasury restrictions on governmental spending.

In large organizations with a number of outlying information focal points, it is possible to supply duplicate sets of microcard of all the essential working reference material to as many centres as necessary. Apart from libraries, the same principle could be applied to systems with large centralized filing systems, such as registries. In all instances, it is possible to reduce the time spent in finding, carrying, fetching and refiling records needed for immediate attention. To justify duplication, the cost of reproduction will have to be considered in its relationship to the real need for speedy delivery of information.

A scheme has been described by Bishop⁽⁸⁾ for the microcard production of single journal articles. The cost of single copies of articles either in the form of reprints or photocopies is relatively high, particularly when one or more requests are received later and another negative has to be made. He argues that microreproduction by his method cuts reproduction costs under these circumstances. He makes no comparison with the method which uses autopositive paper masters in conjunction with dyeline positives. We have mentioned above libraries which use microfilm as a medium for copying articles. Mr. Bishop considers the roll of film is not convenient to store. Exposures are taken on 16 mm. film and the negative is cut into strips in sufficient numbers for a 3×5 in. card. These are mounted inside a cellulose acetate jacket with a suitable adhesive. Whenever a copy is required, a piece of microcard is slipped into the jacket, an exposure is made and the card is processed. The jacket with the strips in place can then be filed for future use. A system of coding for identification is then described.

Microviewing may be (or become) an accepted medium for reading by most library users, but there is likely to exist for a long time those research workers who will insist on having the full-sized document⁽²⁷⁾. Public librarians and the librarians of technical colleges and universities can do much in training the student to become accustomed to reading microrecords, but an obligation presumably exists in having to cater for the unconverted, particularly if reproduction cost is not a problem. Manufacturers of microreaders have acknowledged this need, and in some cases they have designed their apparatus so that paper enlargements can be made. The various microfilm reproductions permit enlargement, either by using an attachment to the reader or by using a photographic enlarger. The opaque card, on the other hand, is not easy to enlarge. Micro Methods Ltd. claim that enlargements will be possible on their V.C. reader and Microlex have recently introduced a modification to permit this form of copying.

Direct single-stage enlargements are also possible using a photomicrographic camera, or a 35 mm. negative could be made for subsequent enlargement, but loss of quality is likely. Much depends on the standard of the original document copied. The cost of making full-size copies, however, may prove prohibitive. The Nederlandse Document Reproductie of the Netherlands undertake to make microcard enlargements for research and Government establishments, executed white on black, at a cost of about 1s. 10d. per sheet.

6.7. CATALOGUING BY MICROPHOTOGRAPHY

Sheet film and all opaque forms of microrecord have readable-sized headings added to the top of each card. The systems which provide cards or special holders for strips of microfilm also enable suitable headings to be typed on. In all cases a scheme of filing is possible using either drawers or, for microsheet, boxes. This disposes of the need for a separate card catalogue, if such an economy is desired. It can be argued that items removed from file for reference are subject to loss of record, but this may be overcome by the simple expedient of inserting a temporary card of the same size as the microrecord, using it as a location record.

Organizations already using a microfilm camera can find an added use for their equipment in the duplicating of catalogue card records. Mason, of the U.S. Department of Navy, describes a method which gives an estimated saving of 40 per cent. in processing time over typed carbon copies. Where possible, the actual document being catalogued can be used for the inclusion of an abstract or introduction. Other details are typed on an overlay sheet and the composite whole filmed. The desired number of copies is then run off on a continuous-strip printer⁽²⁸⁾.

Apart from its use in duplicating single cards, microphotography could be used in the publication of lists of additions, bibliographies and the duplication of complete catalogues where new reference points are to be established. The record cards (or sheaf-catalogue sheets) overlapping each other, with suitable headings interposed, would be photographed on to microfilm. Paper enlargements could then be made with the conventional equipment if a continuous printer is not available.

6.8. OTHER USES

A number of public libraries in this country have recently adopted the use of microphotography for speeding up the discharge of loans. Photocharging was introduced in America some years ago, the method being described in Greer's *Charging methods*. Wandsworth was

the first library to experiment with it⁽²⁹⁾, and once its success was assured other libraries followed suit: Hull, Finsbury, Hampstead, Brentford, Croydon, Norwich, Coatbridge, Woolwich, Hove. Mr. Corbett of Wandsworth has written a book on photocharging which will be published later this year.

7. POLICY

Having considered the various factors associated with the use of microrecords, a further aspect has to be taken into account before the final decision is made to go ahead with a definite plan. The users' reactions to a new reading medium might well nullify the advantages gained⁽¹¹⁾.

Some readers may be averse to gadgetry, preferring to browse among the crowded shelves, a long-developed habit. For some time to come, preference is likely to be shown for full-sized copy, yet it is feasible that with the growing adherence to televiewing, microviewing might be readily accepted as a normal medium for reading within the near future.

Not everyone will necessarily agree with Tate that a modicum of physical discomfort for patrons is not entirely undesirable and that it may even be conducive to more effective and retentive reading⁽²¹⁾.

Pascal⁽³⁰⁾ has stated that when the need to know is strong, a visual task even under adverse conditions of lighting will produce less fatigue and less difficulty than slight motivation under superior conditions. In spite of these arguments, some American libraries have observed a reader resistance. Others say that books are preferred, but if it is a question of microform or nothing, then readers usually accept the situation.

It is not anticipated that the student and the less senior research workers will register objections to microreading, particularly when they appreciate the advantages to be gained and the problems that have been resolved.

Apart from the psychological resistance to microform, the main objection is likely to be the inconvenience of having to travel to a reference point to use the reader. A solution lies in providing a genuinely portable reader, one cheap enough to duplicate in sufficient numbers for use beyond the library.

There are also physiological objections to be considered, those of eyestrain, uneven illumination and glare, but, with the constant research that is being carried out, readers are being improved to eliminate these

imperfections. The use of reflected light makes the opaque-microrecord reader particularly subject to them.

Once the need for microphotography has been established, the question of budgeting and capital expenditure has to be considered and related to the work awaiting immediate attention and to future programmes, including other uses to which apparatus can be put, if purchased.

Apart from the choice of process, the following alternatives have to be considered:

- (1) Microphotography on the site, either with one's own apparatus or through an agency;
- (2) Originals to be sent away for copying; only a reader to be purchased;
- (3) The combination of microrecords with an existing punched-card system;
- (4) The introduction of both microrecords and a punched-card system.

7.1. CHOICE OF PROCESS (5. 31, 32)

There is no one best method. Each form of microrecord has its own unique characteristics. Microfilm cannot be replaced by microcard or Microprint when it is used by individual organizations desirous of reducing their own particular bulk records. Microfilm copying is more economical than photocopying provided that a viewer is used. A study of *U.S. Government Research Reports*, a periodical which gives the price for purchasing copies of any of the items listed, either from the Library of Congress or from the Department of Commerce in Washington, shows that a report of around eight pages costs 14s. for both microfilm and photostat. After a reproduction of forty pages, the difference between the two methods becomes marked. At thirty-five to forty pages a photocopy costs twice as much as a microfilm, whilst at 160 pages the cost of a microfilm is about £3 2s. and of photocopying over £10.

Microfilm is used for small numbers of copies and it is generally considered to be uneconomical as a publishing medium for fifteen copies or more. The following estimated comparative costs are from an American source:

Microfilm positive—original $8\frac{1}{2} \times 11$ in. (from existing negative)	approx. $1\frac{1}{4}$ cents
Microfilm positive (including making a negative)	approx. 5 cents
Microcard minimum edition (about forty-eight pages)	30 cents
One page of microcard	under 1 cent

Nevertheless, University Microfilms Inc. offer a large range of microfilmed publications, in a few cases at prices at little higher than the same publications on microcard.

Notwithstanding the possible disadvantages, micro-opaque reproductions are almost certain to come within the scope of the accessions programme of university, public reference and special libraries sooner or later ⁽⁶⁾. Libraries engaged in the field of nuclear engineering will most certainly. Depository libraries for the reports of the U.S. Atomic Energy Commission, such as Sheffield, are now receiving many of the reports on microcard. Borrowing libraries will have to buy readers, of course, to exploit these reports.

The microcard range of complete runs of many kinds of serials, especially in the fields of science and technology, is large and increasing in variety. In many cases, quite a number of back runs are unobtainable in the original form, even if space could be found to shelve them. The cost of such long runs is often prohibitive, especially in its relation to the frequency of use value.

The titles reproduced in Microprint and Microlex are of value to libraries, particularly when one considers such projects as the reproduction of the complete set of the House of Commons *Sessional Papers* from 1731 to 1900, amounting to over 6,000 volumes in the original publication, an impossible acquisition for libraries in the normal way.

Use of this medium in addition to stocking microcard will necessitate separate filing because of the different sizes. Acceptance only of 3×5 in. cards means that existing furniture can be used.

In considering the process to be adopted, provision may have to be made for full-sized enlargements, especially for organizations that send information to scattered groups distant from the main location, particularly where it is uneconomical to provide sufficient numbers of readers. The same factor applies to institutions and research associations who undertake to make copies for members, some of whom may not have a viewer available.

Except for security purposes and for records having very low reference value, there is much to recommend microreproduction on sheet film, because of the ease with which the sheets can be filed and retrieved, economy in filing space and the ability to accommodate a large number of pages on one sheet and the facility for enlargement to full size if required.

16 mm. and 35 mm. roll film is widely used in this country, however, and one may be committed to these sizes for the future, in any case, by the purchase of microfilm editions of periodicals, or of copies of research reports. Moreover, those establishments who have considered

it uneconomical to purchase cameras and have engaged a specialist firm to carry out the work will also be committed to this form of microfilm. There is no need for this medium to remain an obstacle to rapid information retrieval, however. Equipment is available which not only transforms strips of roll film into self-indexing card records but also protects the film from damage, one of the weaknesses when compared with microcard.

The combination of microfilm records with punched cards is a system likely to interest only a small number of establishments at the moment. Nevertheless, when the rapid retrieval of technical and scientific data by means of punched cards is further developed and becomes more widely accepted by information organizations, it might be profitable to consider the system when future policy is being planned.

7.2. CHOICE OF READER ⁽¹¹⁾

Once the librarian commits his records to some form of microfilm and, possibly, his purchases to include micro-opaque editions, he will then consider the best methods for the exploitation of these reproductions, relating them to the particular characteristics of the organization which he serves and to the habits of his potential users.

Compact establishments may need only one or two readers at their central reference points whilst others will need to provide a larger number. Facilities may have to be provided for full-sized enlargements as and when necessary; once again this is dependent on the nature of library users.

Where microfilm is the only medium used for reduction, there is a good range of suitable readers to select from. Standard-sized models are available for permanent siting and there are less expensive portable readers, most of which claim to produce paper enlargements, if required. The choice of the right type of reader depends on the form of microfilm, the location of the reading reference point and desk space available. Most of those manufactured in this country are designed for use with 16 mm. and/or 35 mm. roll film. Where combined use of roll film and sheet film is contemplated, a most useful reader is the N.D.R. Microvist. It is very light in weight and allows projection downwards on to the table, or, alternatively, on to a wall. It is cheap enough to allow duplicate models to be supplied to a number of different reference points. Where transparent and opaque forms of microrecord are to be used, on the grounds of economy, it may be desirable to have only a general-purpose type of reader. Whilst microcard readers can be used for viewing sheet film (backed with white card), microfilm apparatus cannot be used other than for

transparencies. A general-purpose machine has, however, been made in Australia but little is known about it yet. Most micro-opaque readers cannot, at the moment, be used for making enlargements, although this facility is claimed by Microlex and Micro Methods Ltd.

The Microcard reader and the Micro Methods V.C. reader present a reasonable illuminated reproduction. The latter has a tinted screen to lessen glare. The Microlex Model B, primarily intended for microsheet, provides a sharp definition of image and it also has a tinted screen. One objection is that in using microcard the bottom few lines of each page cannot be seen whilst viewing the remainder of the card. All three readers are quite portable.

The Eastman Kodak Microprint A reader is a very good instrument but more expensive than those above. Since a British model is now available to librarians, it may no longer be possible to get an import licence for American apparatus.

On financial grounds, it may not be possible to purchase more than one reader, in which case there will be occasions when more than one person will require its use at the same time. Under the circumstances hand-held enlargers, such as those marketed by the Microcard Foundation and the British firm Ultra Lens Ltd., might be considered. Although they are not recommended for prolonged reading, they can be useful on many occasions. Their low cost would permit sufficient duplication to enable one to be issued with each card or sheet loaned.

For the future, the reluctance to think in terms of microform will determine the rate of progress that is likely to be made in the provision of microtext services and the development of economically-priced readers. We have shown that a number of problems can be solved by its adoption, but it is not necessarily advocated for every type of library service.

It is difficult to see, however, that some benefit will not be gained by most kinds of library. All forms of literary output have been reproduced on microfilm, microcard or microprint, many filling gaps in series that have been long required. The provision of better reference library facilities over the whole country on a regional basis to cater for the increasing demand for scientific and technological information may well be encouraged by the availability of inexpensive microform editions of books, periodicals, reports, etc.

The cost of material and of apparatus can only be reduced when larger numbers are manufactured. Consequently, the success of microphotography in its library applications and future development is dependent on our present interest and adoption.

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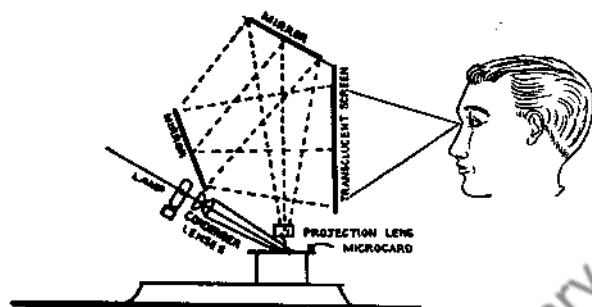
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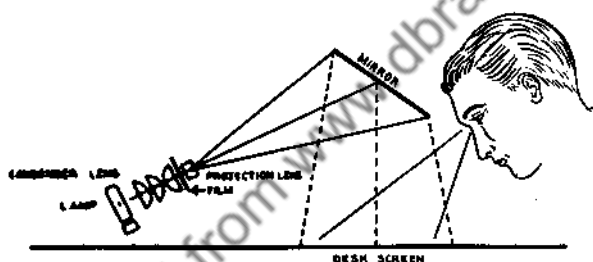
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—— DIRECT LIGHT
 REFLECTED LIGHT



MICROCARD READER USING REAR PROJECTION SCREEN



MICROFILM READER USING OPAQUE SCREEN

[Micro Methods Ltd.]

FIG. 1. PRINCIPLES OF THE MICROFILM AND MICROCARD READER

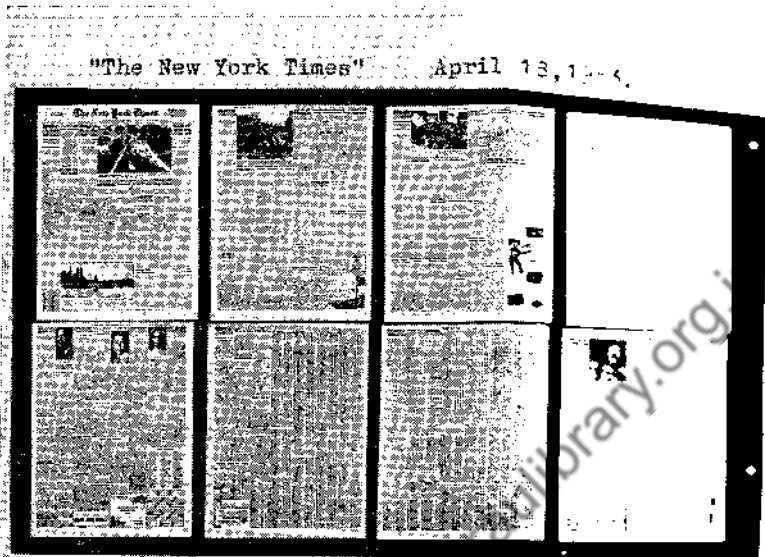


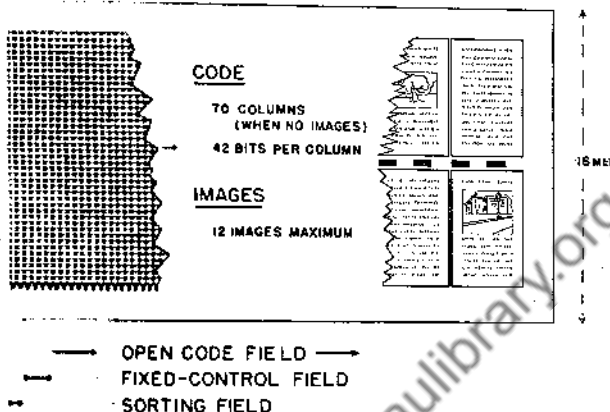
Fig. 2. TRANSPARENT MICROFILM



[Remington Rand, New York]

Fig. 3. "KARD-A-FILM" SYSTEM

32 MM



[Eastman Kodak Co]

Fig. 4. THE KODAK MINICARD SYSTEM

The New York Times.

1949 July 5 p. 1-10



[New York Times]

Fig. 5(a). SPECIMEN MICROCARD

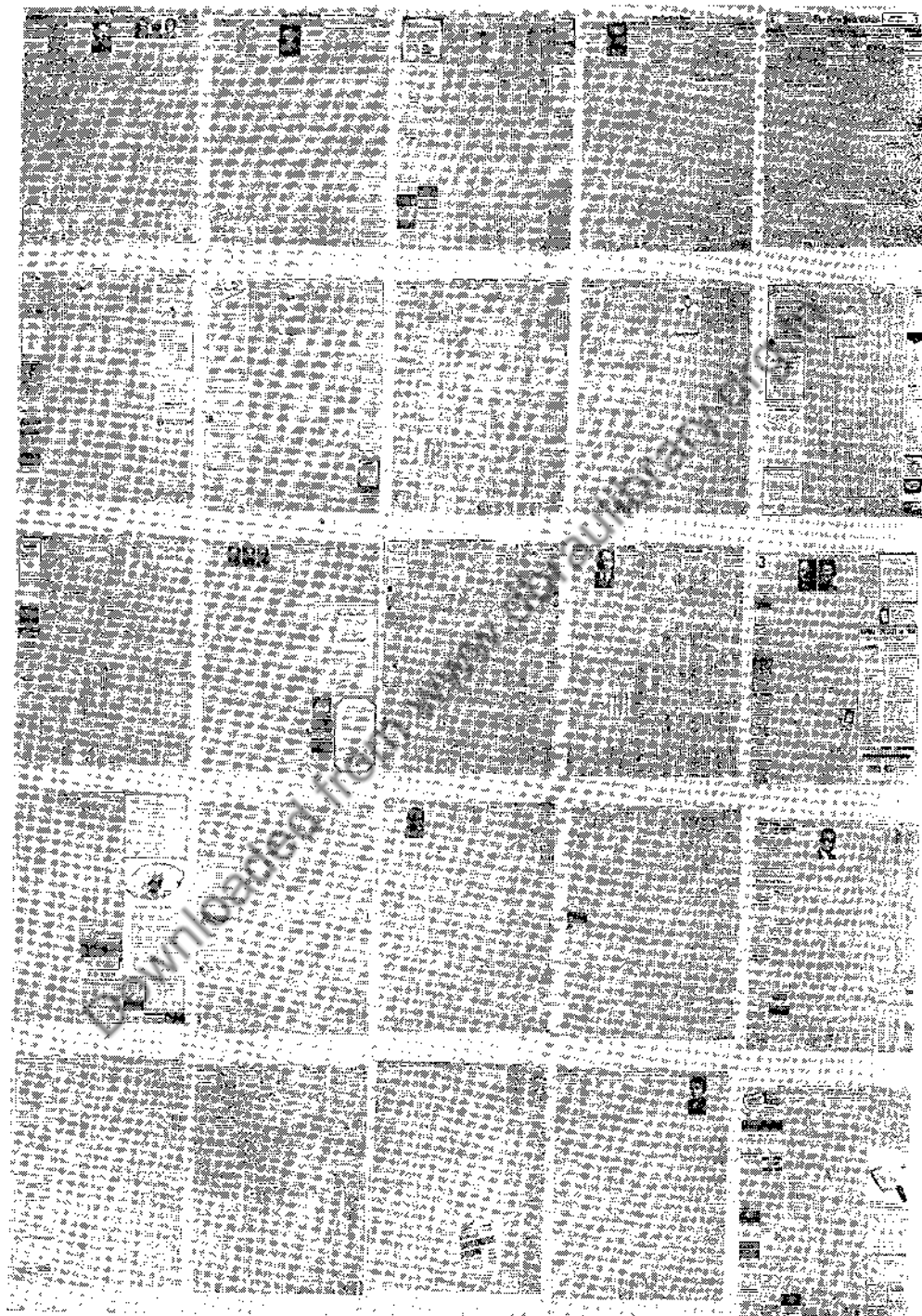
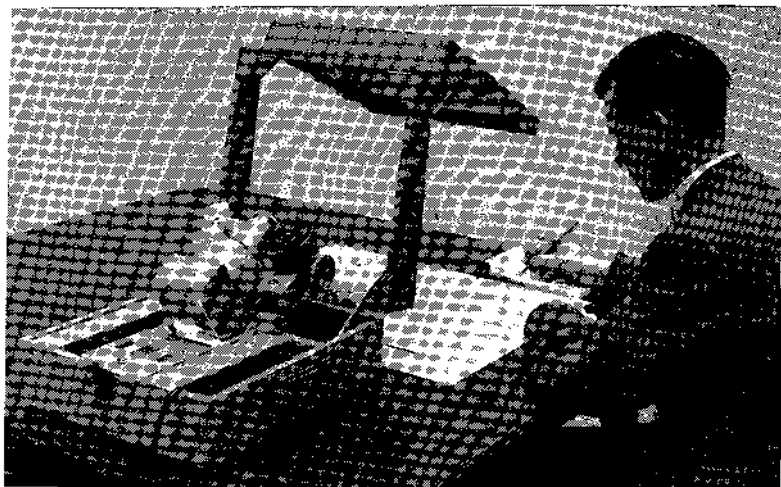


Fig. 5(b), SPECIMEN READX MICROPRINT



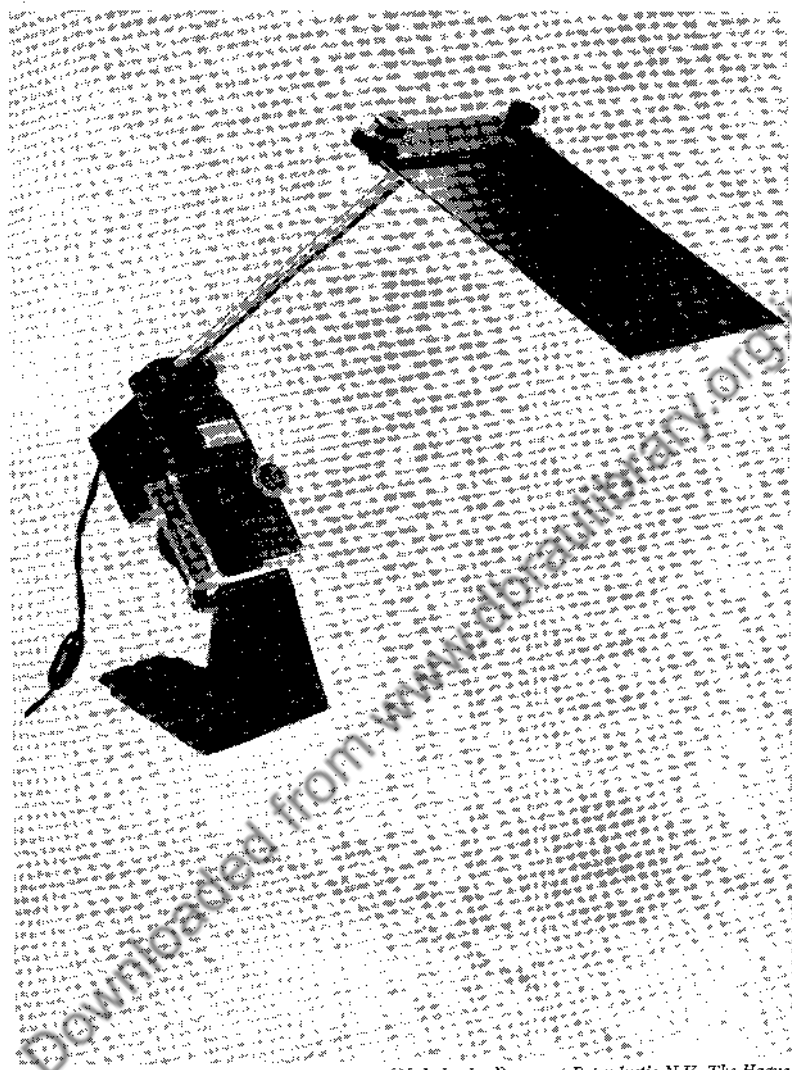
[Micro Methods, Ltd., 17 Denbigh St., London, S.W.1

Fig. 7. THE V.C. PORTABLE MICROFILM READER
(Manual Operation)



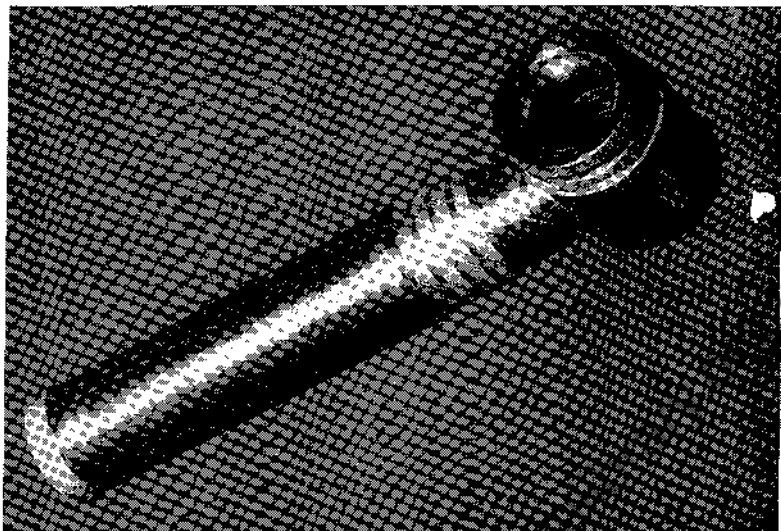
[A. West & Partners Ltd., 4 Abbey Orchard St., London, S.W.1

Fig. 8. LEECH "ROCHESTER" PORTABLE
MICROFILM READER



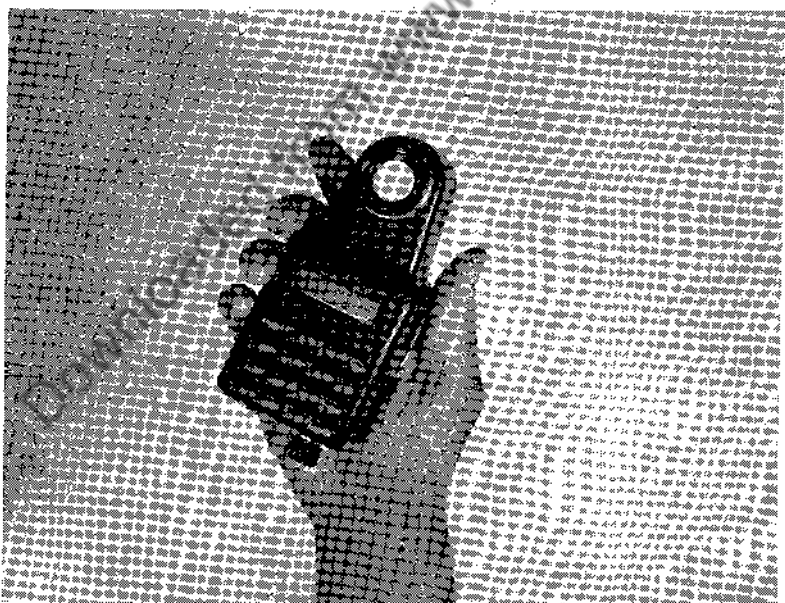
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Fig. 9. N.D.R. MICROVIST READER



[Ultra Lens Co., 17 Oxendon St., London, S.W.1

Fig. 10(a). ULTRA LENS POCKET READER



[Microcard Foundation, Madison 5, Wisconsin

Fig. 10(b). MICROCARD FOUNDATION POCKET READER

[American Optical Co., Southbridge, Mass.]

Fig. 13. THE "MAGNAVISA" MICROPRINT READER