microphotography in the library

by Alfred Günther

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MICROPHOTOGRAPHY
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INTRODUCTION

Microphotographs are photographs which are reduced to a minute or even microscopic size. They have many applications in science and industry, the most extensive being the microphotographic reproduction of documents. The advantages of the use of photographic reduction in recording documents are so obvious that it is not surprising that the first microphotograph was made shortly after the invention of photography [1-4].

Micro-writing and micro-printing were known centuries ago; indeed, the earliest specimens of micro-script have come down to us from the ancient Assyrians [5]. The first photographic process was invented by J. N. Niepce in 1826. Niepce etched a metal plate on which there was a light-sensitive protective asphalt layer, but this method did not show great detail. In 1839 L. J. M. Daguerre was successful in producing the first photograph on an iodized silver plate developed with mercury vapour. This ‘Daguerrotype’ gave excellent quality, and when he heard of this new process J. B. Dancer, in the same year, made the first microphotographs on Daguerrotype plates with a reduction of 160:1. In 1852, J. B. Dancer used the new collodion process to obtain the first transparent microphotograph.

In 1853 Sir John Herschel suggested ‘the publication of concentrated microscopic editions of works of reference—maps, atlases, logarithmic tables, or the concentration for pocket use of private notes and manuscripts [6], and R. Dagron was the first to use microphotography in quantity for his pigeon post during the siege of Paris in 1870 [7].

After the discovery, in 1871, by R. L. Maddox, of the ‘dry plate’ with its silver bromide gelatine emulsion, modern photographic techniques could develop. In 1887 H. Goodwin produced the first photographic film on celluloid base, and in 1889 T. A. Edison developed the 35 mm. cine film as it is still used today.

Towards the end of the nineteenth century some libraries had already established photographic laboratories for full size copying work, but microfilm only came into use thirty years later. In 1924, the Leica camera came on the market, and it was essentially this camera which made it possible for the scholar to take his own microphotographs, and which stimulated microfilm activities. Nowadays, microphotographs are used in many libraries and, increasingly, libraries maintain their own photographic laboratories. The applications of microphotography to problems in documentation have been discussed in many papers [8-16].

1. The figures in brackets refer to the bibliography on p. 24.
After a brief survey of microforms and their possible uses in the library, this paper will deal with practical aspects of handling microphotographs; the installation of a photographic laboratory in the library; and the production of microphotographs.

**Characteristics and Forms of Microphotographs**

A photographer who wishes to take a black-and-white photograph of a certain subject (e.g., a portrait or a landscape) normally uses in his camera a film which will give a negative. From this master negative he may produce paper prints at any time he desires. He may also decide to print this negative on transparent material (film or plate). When projected on a screen this transparent positive (slide) gives an excellent image. Although more light is needed for the projection, by reflection, of a paper print by means of an episcope, the image is less bright and lower in contrast and shows less detail than the image produced by a slide.

A microphotographic negative as used in documentary reproduction is produced on special material. Consecutive pages of a document may be photographed either in linear array on roll microfilm, taking one or two pages of the document placed on one frame (Fig. 1) or placed in a two-dimensional array on sheet microfilm (Fig. 2, photographic section). A first sequence of exposures constitutes the first line, the second sequence of an equal number of exposures makes up the second line, etc. This can be achieved either by cutting microfilm into strips and mounting these strips one below the other [17], or by means of an automatic step-and-repeat camera, which works rather like a typewriter. The first line is taken by consecutive exposures, the sheet film carrier moving step-by-step in the direction of this line. When the first line is complete, the film carrier moves back into the position of the first exposure and at the same time one step down vertically. Now the film carrier is in position for the first exposure of the second line.

![Arrangement of pages on microfilm: a, single pages on full frames (e.g. 24 x 36 mm.); b, single pages on half frames (e.g. 18 x 24 mm.); c, pairs of pages on full frames; d, pairs of pages on half frames.](image-url)
When copies of a microphotographic negative are required, contact prints may be made either on transparent material or on paper. As in the case of pictorial photography, the projected image of the transparent copy may be expected to be brighter and of higher contrast, and it will, therefore, show more detail than the opaque copy on paper. On the other hand, paper is much cheaper than film, and micro-opaque prints are, therefore, of special interest for publication in microform. Micro-opaque cards have another advantage in that they do not need a protective envelope and may be readily filed. However, they need much more light for projection and, therefore, a more complicated and more expensive reader, which must be equipped with a blower for cooling. Furthermore, the quality of the projected image is not as good as that of a transparent microphotograph, and there are certain difficulties involved when enlarged prints are required.

Although it is possible to produce good microphotographs of very high reduction, a fundamental limitation of the reduction ratio for library applications arises from the mechanical tolerances of the microfilm equipment and from the difficulties of keeping the film flat enough. Very high reductions can only be obtained with microscope objectives on photographic plates of high resolution (e.g. Kodak Maximum Resolution Plates) using special focusing aids. This process would, however, be far too complicated and impractical for routine reproduction of documents, and similar difficulties would arise in connexion with reading equipment.

Practical limitations of the reduction ratio in microphotography of documents are imposed by the following considerations: (a) the quality of the original does not always allow for higher reductions (newspapers and the products of some office duplication processes are examples of low-quality documents); (b) the resolving power of the lenses of microfilm cameras and the microfilm material does not usually exceed 150-200 lines per millimetre over the whole field; (c) variations in exposure time and variations in processing conditions may occur in routine work, and have an effect on the quality of copying; (d) microphotographs used in libraries and documentation centres have often to serve as masters for further reproduction, and as each copying step involves a loss of detail a certain 'reserve of resolution' should be kept in hand.

When suitable equipment and material are used, when exposure times are fairly accurate, and when processing is done with care, microphotographs may be obtained in routine work which show a resolving power of 120-150 lines per millimetre. As the limit of visual resolution of a pattern in reading distance (about 30 cm. or 12 in.) lies between 5 and 10 lines per millimetre, reduction ratios of the order of magnitude of 15-30 diameters should give good microphotographs. In fact, most microphotographs for libraries are the result of a reduction of 10-25 times.

**Microphotographs in linear array**

**Microfilm** (roll microfilm) is the basic form of microphotographs in linear array. Standard film widths are 16 mm, 35 mm, 70 mm and 105 mm. The film may be either unperforated or perforated along one or both edges. 35 mm film which is perforated along both edges is known as standard cine film. It can be used in any 35 mm camera, whereas unperforated film can only be used in special cameras which have no sprocket wheels in their film transport mechanism.

35 mm film is preferred in the library as it is economical and at the same time easier to handle than 16 mm film. The standard sizes of frames on perforated film are $24 \times 36$ mm. and $24 \times 18$ mm. On unperforated film different sizes of frames are used.
Each microfilm frame may take either one single page or a pair of pages of the opened book. The arrangement of pages is shown in Fig. 1. The film may be of any length, but is normally stored on standard reels which take up to 30 metres (100 ft.) of microfilm, containing about 800 frames of size 24×36 mm., i.e., 1,600 pages when two pages are taken per frame. Reels which can take up to 10 metres (about 30 ft.) are also used.

Microfilms of great length can be most economically processed, duplicated and enlarged, since all these operations can be carried out by machines. For reading, however, they are not very convenient because of their length.

Microfilm strips are strips of 35 mm. microfilm containing six frames. The first frame usually shows the title of the document in type which can be read by the naked eye. The five frames following may each contain two pages of the document, thus giving ten pages per strip. Although microfilm strips are not suitable for continuous copying, they are much more convenient for reading than roll microfilm. They are easier to handle and a given page can quickly be found. A system whereby a microfilm negative is kept on reels in a master file for possible future copying and positive microfilm strips copied from the negative master are kept near the microfilm reader offers the best advantages. Microfilm strips are widely used in Europe.

Copies may be obtained from microfilm negatives, by contact, on ribbons of photographic paper. Such micro-opaque copies are commercially available from various firms in America [18, 19].

Microstrip is the trade name for a micro-opaque ribbon printed from 16 mm. or 35 mm. microfilm supplied by Hall and McChesney Inc., Syracuse, N.Y. Microstrips have an adhesive coating on the under side. When moistened these strips may be stuck on cards of any size. This system is quite flexible and allows for easy amendment of the cards at a later date.

Microtape is a trade name for a paper ribbon printed from 16 mm. or 35 mm. microfilm by the Microcard Corporation, West Salem, Wisconsin and by the American Microfilming Service Company, New Haven, Connecticut (under licence from the Microcard Corporation). Microtape is backed with pressure-sensitive tape. When the protective layer on the tape is stripped off, Microtape may be mounted on any card by simply pressing it on to the surface.

Microtak, another type of micro-opaque positive print on paper ribbon with a backing of pressure-sensitive tape, is sold by Microdealers Inc., Waltham, Massachusetts.

Microphotographs in two-dimensional array

For most applications in the library, microphotographs in two-dimensional array are more practical than microfilm and microfilm strip. Because of their convenient size they can be easily handled and filed, and they may be mailed in ordinary envelopes. They can also carry many more pages of a document than a microfilm strip. The title of the document can easily be indicated photographically on top of the sheet in such a way that it is readable without any optical aid.

Sheet microfilm is a rectangular sheet of film carrying a set of microphotographs in two-dimensional array.

Microfiche is a sheet microfilm of smaller size. Different sizes of microfiche are used but sizes 75×125 mm., 90×120 mm. and 105×148 mm. are generally preferred. The 75×125 mm. has the advantage of being the international standard size of library cards, so that standard library filing equipment can be used for microfiches of this size.

As early as 1906 R. Goldschmidt and P. Otlett [20] proposed the 75×125 mm. microfiche at the Congrès International de la Documentation Photographique de Marseille, but practical use of this suggestion was not made
until much later. At the Fourteenth Conference of the International Federation for Documentation in 1938, at Oxford, G. van Iterson [21] reported on the micro-reproduction of 18 pages on a 13 x 18 cm. photographic plate. Using a reduction ratio of 1:6 he placed on one plate three horizontal rows of three 40 x 57.5 mm. frames. With a simple step camera he took 18 pages on a plate every 10 minutes. A binocular low-power microscope with a magnification of about 6 x allowed him to read paper prints or the negative plates on a specially made light box.

In January 1939, C. H. Kleukens and J. Goebel [22] established the Mikrokopie-Verlag in Mainz with the intention of publishing small editions of rare books (e.g. ancient manuscripts, xylographic books, incunabula) on microfiche. J. Goebel constructed a step-and-repeat camera for the production of microfiches, and he already envisaged the production of coloured microfiches. After the war the microfiche was further developed in Europe, especially in the Netherlands and in France. Today more and more institutions use the microfiche, and printed catalogues of microfiches are available from some publishers [18, 19].

Micro-opaque cards contain a set of microphotographs in two-dimensional array printed on photographic cardboard. L. Bendikson [23] and G. van Iterson [21] were the first to produce micro-opaque cards and F. Rider [24] developed the idea of the Microcard (see below). He suggested the use of micro-opaque cards of international library card size (75 x 125 mm.) with the full catalogue entry printed in normal size on the reverse. These microcards were considered as a form of publication. Nowadays, the catalogue entry is usually indicated in a condensed form and reproduced at the top of the card above the microreproduction. In the United States of America especially, micro-opaque cards are used mainly for reprints but sometimes for primary publication as well; there is thus already an urgent need for bibliographical control of these publications. E. M. Tilton [25] has compiled a union list, which contains references to some 3,200 publications on micro-opaque cards up to the end of 1958.

Some manufacturers of micro-opaque cards have developed their own systems carrying trade names:

**Microcard** is the trade name for a micro-opaque card, size 75 x 125 mm., produced by the Microcard Corporation, West Salem, Wisconsin. These Microcards are printed on photographic paper from strips of 16 mm. microfilm mounted on the glass plate of the automatic printer [17]. Two Microcards may be laminated back to back, to give a two-sided Microcard. Microcards are distributed by several publishers, among them the Microcard Foundation, Washington, D.C., a non-profit-making institution. The Microcard Foundation has also published annually since 1959 a cumulative *Catalog of Microcard publications* [26], which lists all the Foundation's publications available on Microcards and most of the items issued by other Microcard publishers.

**Microlex** is a micro-opaque card, size 6 1/2 x 8 1/2 in., produced by the Microlex Corporation, Rochester, N.Y. Up to 200 pages are photographed page by page with a step-and-repeat camera on 6 1/2 x 8 1/2 in. film. These negatives are printed on photographic paper by an automatic printer. Two cards may be laminated back to back, thus giving a card containing 400 pages.

**Microprint** is the trade name of a micro-opaque card produced by the Readex Microprint Corporation, New York. First a 16 mm. microfilm is made of the original text. This film is cut into strips, mounted and reproduced by a photolithographic process on 6 x 9 in. card. Each card can carry 100 pages (10 x 10). The firm claims a life for their cards of more than 300 years. Microprint cards are especially suitable for large editions of long texts. They are sold in strong boxes, size 6 1/2 x 10 in., of the same shape as a book and thus readily shelved.
Other forms of microphotographs

35 mm. transparencies for projection (slides) may be considered as microphotographs because of their scale of reduction. The size of the image of these transparencies is usually 24x36 mm. They may be put under 50x50 mm. (2 x 2 in.) cover glasses, or they may simply be framed in cardboard mounts. Compared with larger size slides such as 83x100 mm. (3 1/4 x 4 in.) and 83x83 mm. (3 1/4 x 3 1/4 in.) they offer the advantage of being much less bulky, and they can be projected with cheaper portable projectors.

Although for high-quality projection transparencies under cover glasses are preferred because of their flatness and because of the better protection given, transparencies in cardboard mounts have some other advantages. They are cheaper and less heavy; they can be easily produced in sets for distribution; and they may be mailed without any danger of breakage.

A variant of the 35 mm. transparency is the 35 mm. filmstrip, which carries a sequence of pictures to be projected. The size of the frames on the strip is usually 18x24 mm. Filmstrips are mainly used for teaching purposes [27].

Microphotographs and information retrieval systems may be combined in such a way that the automatically selected information contains a microphotographic reproduction of the relevant document or abstract [28].

Microcards may be laminated on punched cards. When IBM cards are used 60 of the 80 columns will be covered by the Microcard, thus leaving 20 columns available for coding [29]. The coding capacity of marginal punched cards will normally not be affected by the Microcard.

‘Aperture cards’ are punched cards with a window into which individual frames of 16 mm. or 35 mm. microfilm can be mounted. They are available both for manual and automatic selection. Cards, mounters and reading devices are sold by several firms.

Microcite is a system developed by the National Bureau of Standards in Washington for literature retrieval in conjunction with superimposable cards (called ‘peek-a-boo’ cards in the United States) using optical coincidence of holes in a set of subject cards. In each subject card any document relevant to this subject is marked by a hole punched in a position which characterizes this document by its co-ordinates. When literature relevant to several subjects is searched for, the corresponding subject cards are superimposed together on a transparent matrix card which carries highly reduced microphotographs of abstracts of all documents in their characteristic positions. When in a certain position there is optical coincidence of the holes of all cards, the transmitted light prints the corresponding abstract of the matrix on photographic material. Thus a bibliography is obtained which contains abstracts of the relevant literature in microform.

The Filmorex system [30, 31] uses 35x60 mm. microfiches. Half the surface of each microfiche carries digital information (light and dark spots); the other half carries a microphotographic image. A special camera reproduces the document and the code pattern simultaneously on unperforated 35 mm. microfilm which is cut into microfiches after processing. In an automatic selector the code patterns are scanned by photo-electric cells at a rate of 600 microfiches per minute. The text of selected microfiches may either be read directly in a microfilm reader or be enlarged on photographic paper in an automatic ‘photolisting’ machine. The equipment for this system is commercially available from the Filmorex company, Paris.

The Minicard system developed by Eastman Kodak [32] is based on the same principles using 16x32 mm. microfiches.
Microphotography can solve a number of problems in the library. Microphotographs need much less filing space than the original publications. When carefully prepared, microrecords have a higher degree of permanence than most modern papers. They are easily and quickly produced at low cost. For these reasons, microphotographs of manuscripts, printed books, periodicals, pamphlets, etc., can be used instead of the original documents, and rarely used documents may even be published in microform.

Admittedly, the reader will always prefer the original publication to the microcopy, and wherever possible libraries should provide the originals. Microrecords can never be a substitute for original documents, but they may well supplement them. The reader will be quite satisfied if he can get a microcopy of a document which is not obtainable otherwise. In principle, enlarged prints can be made from microphotographs, but this method is justified only for documents which have constantly to be referred to or which have to be compared.

A number of possible applications of microphotographs to library routine will be discussed below.

Inter-library loan

The enormous increase of literature, the increase of the number of library users and the trend towards specialization are the main factors leading to an expansion of inter-library loan. Not only does the number of borrowed items increase continuously, but there is also an urgent demand for a quicker service in inter-library loan.

The use of microphotographs instead of original publications in inter-library loan has the following advantages. The original stays in the library; it remains accessible, is not in danger of being lost in transit and suffers no wear and tear. Microfilm strips and microfiches can be mailed in simple envelopes at low postage rates which allow of airmail transmission. Finally, microphotographs need not be returned, and therefore they do not involve checking loan files.

A cost comparison shows that in many cases the production and mailing of a microcopy is decidedly less expensive than sending and returning the originals. This is especially true for short articles from bulky volumes of periodicals.

The use of the teleprinter has been recommended for ordering microcopies of publications and libraries are using the telex system in inter-library loan more and more [33, 36]. As even the quickest ordering and mailing system is inefficient if the location of a publication is not known, the participation of the big union catalogues in this system is of special importance.

Fortunately, periodical literature can be located more easily thanks to the existence of printed union catalogues of periodicals. Some abstracting periodicals also render a very valuable service in supplying, on request, microcopies of any original article abstracted by them. Thus in 1956 the French Centre National de la Recherche Scientifique (CNRS), which publishes the Bulletin signalétique, produced more than 2.3 million pages on microfilm strips [37].

The preservation of unique and rare documents

In 1904, a terrible fire which destroyed more than half the manuscripts of the National Library of Turin [38], focused attention on the problem of the preservation of unique and rare material. At the Congrès International pour la Reproduction des Manuscrits, des Monnaies et des Sceaux, held at Liège in 1905 [39], these problems were discussed and the establishment of photographic laboratories in all libraries was recommended.
Today, large collections of manuscripts and other valuable documents are being microfilmed to preserve them from loss and destruction and to make microcopies available to other libraries [40, 41]. Thus the handling of manuscripts in inter-library loan is avoided and microcopies can be sent instead.

In 1956, Unesco set up a special mobile microfilm unit which visits many countries to microfilm the books, documents and other cultural material in danger of destruction or which is irreplaceable, to train technicians of the country in the handling of microfilm, and demonstrate to the authorities the advantages of having a national microfilm office to carry out the country’s international cultural exchanges [42, 43].

The availability of microcopies of manuscripts is of special value to research workers. They can study manuscripts in the form of microfilms without having to travel all over the world to consult the originals [44].

The full beauty of illuminated manuscripts and incunabula cannot be shown on black-and-white microfilm but for this purpose 35 mm. colour film can be successfully used. Some libraries, such as the Bibliothèque Nationale in Paris and the Bodleian Library, Oxford, provide copies of some of their manuscripts on 35 mm. colour film [45].

The preservation of deteriorating documents

The rapid deterioration of modern printing paper presents a grave problem for librarians. Not only does the cheap wood-pulp paper of the type used for newspapers disintegrate rapidly, but even paper which is considered to be of good quality soon loses its strength and may deteriorate within a few decades [46].

Books and periodicals which have become unusable or unbindable owing to the deterioration of the paper can often be replaced by a photographic reproduction.

The problem of periodicals

One of the most rapidly growing sections in most libraries is the collection of periodicals, and this involves high storage costs every year. But older volumes of periodicals are infrequently used, and the binding of some periodicals, and especially newspapers, is excessively expensive. The question arises, then, how far the binding and storage of periodicals on shelves in the library is justified.

Studies of this question have been made, particularly in the United States [47, 48]. They show that some types of serials, in particular newspapers, should not be bound at all but, when they are consulted only infrequently, replaced by microcopies after a few years. Some publishers of microforms specialize in the distribution of microcopies of periodicals and newspapers [19].

Publications in microform

Microphotographs are a convenient medium for publication and for re-publication in small editions [49]. Microphotographs of out-of-print books and back numbers of periodicals can be of great use, particularly to young libraries, in building up resources which would otherwise be unobtainable or too expensive [50].

Very specialized research reports and similar items which are likely to have only a limited number of subscribers are sometimes published exclusively in microform, as a full-size edition would be too expensive or too bulky. The World Meteorological Organization, for instance, published the meteorological data of the International Geophysical Year on microcards [51].
In 1959 the American Institute of Biological Sciences, Washington, D.C., with the aid of grants from the Council on Library Resources and the National Science Foundation, started an experiment in the publication of a scientific periodical in microform. *Wildlife disease*, the official publication of the Wildlife Disease Association, is being published quarterly on Microcards during a test period of three years [52, 53].

The large number of publications already available in microform urgently calls for a bibliographical control of this new form of publication [54].

Use in library operations

Microphotography can be used in routine clerical work in the library [55]. The microfilming of title pages and re-enlargement on catalogue cards has been proposed as an aid to quick cataloguing of large amounts of material [56]. Bibliographical cards may be produced photographically by combining author, title and abstract of scientific papers on photographic cardboard [57].

Regional union catalogues can be compiled by interfiling photographic copies of the catalogue cards of all libraries of the region. The catalogue cards are microfilmed and re-enlarged on photographic cardboard [58].

Preferred microforms

Not all microforms are equally suitable for every purpose in the library. In principle, for the reproduction of documents of short and medium length, the microfiche is the ideal form for use in the library as a fair number of pages can be reproduced on each fiche and it is easy to handle. A less useful alternative is the microfilm strip, the capacity of which is limited to 10 pages.

Archival material is usually recorded for preference on roll microfilm because of its lower cost, facility of retrieval not being an important consideration in such cases. Roll microfilm is also the most suitable form for master negative files kept for further reproduction; the 24 x 36 mm. negative is preferred for high quality reproduction such as is required for the microfilming of manuscripts.

Micro-opaque cards have no advantage over microfiche except the lower price of the paper, and this is appreciable only where it is a case of mass production. For small scale production micro-opaque cards are not recommended.

THE HANDLING OF MICROPHOTOGRAPHS

As all forms of microphotographs may reach the modern library, the system for handling them must be as flexible as possible. None the less, certain basic principles must be applied.

Ordering and accessioning

The ordering and accessioning is the first and one of the most important steps in the acquisition of microphotographic records. When acquiring microforms already in existence the choice of variant is limited. Where a choice exists the library should concentrate on one form and try to acquire as much as possible in that form.

When commissioning microphotographs, either in a laboratory attached to the library or with an outside contractor, the best possible original must be provided. It should always be accompanied by a carefully typed or printed title for reproduction at the beginning of the microcopy.

On receipt, microphotographs should be checked for quality, and libraries
should not hesitate to return any poor copy. Today, practically all microfilms are on safety film, but great care should be taken to exclude films on inflammable nitrate cellulose base from library collections. Microfilms on reels should have trailers, and should be wound so that the text is readable when looking at the inner side of the film. If the supply reel has a round spindle hole, this should be on the side away from the observer as the film unwinds in a downward direction to the right. This checking and preparation could best be done in the photographic laboratory of the library, and positive copies needed for loan should be made at this stage.

To assign location marks, microphotographs should be grouped according to their form: roll microfilm, microfilm strip, microfiche and micro-opaque card. It is advisable to separate short microfilms of lengths below 3 metres (10 ft.), which are kept in small round boxes, from long microfilms kept on reels. Reels in common use for microfilm hold either 10 metres (30 ft.) or 30 metres (100 ft.). If possible the library should adopt one of these sizes as a standard in order to reduce the number of groups of microforms. In big libraries, it may be necessary to separate different sizes of microfiches, but in smaller collections the preferred sizes 75 x 125 mm. and 9 x 12 cm. may be filed in one sequence when envelopes for size 90 x 125 mm. are used.

As access to microphotographs is possible only via the catalogue, there is no need for a breakdown by subject within each group, but a separation of serial from non-serial publications is advisable to allow for continuations (see also [59]).

After this broad classification has been completed the microcopies can be numbered in accession order within each group. The microrecord of a volume of a serial publication is identified by the class symbol, the accession number of the series and the number of the volume.

These location marks should be indicated on the microphotographs and on boxes, jackets or envelopes in which they are kept. They may either be written with ink on special pressure-sensitive labels which are affixed to the microcopies or they may be written directly on the film with a special ink for use on plastic material. This is the most suitable point at which to affix ownership marks; for micro-opaque cards or on the labels, a normal rubber stamp; for film material, if desired, a special perforating punch.

**Cataloguing**

The catalogue entry of a publication in microform should be identical with that of the original.

The first supplementary note should indicate the microform and whether it is a positive or negative copy, e.g. ‘Microfiche of typewritten manuscript. Positive’. For positive copies the location of the negative should be indicated, if known. On the catalogue card of microphotographs of rare material such as manuscripts, incunabula, etc., reference should be made to the original and its location [60].

**Filing systems**

Microfilms on reels are best kept in standard cardboard boxes which are filed upright in suitable drawers (Fig. 3, photographic section). Short lengths of microfilm up to 3 metres (10 ft.) can be kept in round boxes of plastic material (Fig. 3).

Microfilm strips should be inserted in transparent jackets to protect them against dust and finger prints. Clear transparent jackets have the advantage

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1. Inks based on pigments or dyes dispersed in acetone.
Microphotography in the Library

025 Microcards Z 665
Rider, Fremont. 1885- (Card 1—p. i-xiii. p. 1-64)
The scholar and the future of the research library, a problem and its solution... New York city, Hadham press. 1944. (xiii p., 1 l. 236 p. 2 facsim., diagr. 24cm.) Proposes microcards as the solution for research library growth.

Fig. 2 Lay-out of microcards and microfiches. [Photo: CERN, Geneva]

Fig. 3 Storage of microfilm strips and roll microfilm; short lengths in plastic boxes and reels in cardboard boxes. (Steel cabinets manufactured by Flambo, Paris.) [Photo: CERN, Geneva]
FIG. 4 The filing of slides.
[Photo: CERN, Geneva]

FIG. 5 Leica with focusing stage set up for reproduction of microcards using a Leitz Summar lens of 24 mm. focal length. For illumination a microscope projector and a light-box are used (mixed illumination).
[Photo: CERN, Geneva]

FIG. 6 The Durst-Micromat automatic enlarger with copying cassette for microfilm of 10 metres length. Illumination by two fluorescent tubes.
[Photo: CERN, Geneva]
FIG. 7 Lay-out of a small photographic laboratory.
A, microfilm camera; B, table or shelf for documents; C, table, with drying machine and paper trimmer, for finishing paper prints; D, table, with light-box and microfilm reader for checking microfilm; E, cupboards for photographic materials, etc.; F, table for handling microfilm; G, processing tanks for microfilm; H, trays for developing paper prints; J, cascade washer; K, light-trapped hatch for passing out processed paper prints from the darkroom; L, microfilm enlarger; M, microfilm contact printer.

FIG. 8 Lay-out of a medium-size photographic laboratory.
A, microfilm camera; B, table or shelf for documents; C, table, with drying machine and paper trimmer, for finishing paper prints; D, table, with light-box and microfilm reader for checking microfilm; E, cupboards for photographic materials, etc.; F, table for handling microfilm; G, processing tanks for microfilm; H, trays for developing paper prints; J, cascade washer; K, light-trapped hatch for passing out processed paper prints from the darkroom; L, microfilm enlarger; M, microfilm contact printer.
FIG. 10  A microfiche (75×125 mm.) copied from a negative microfilm strip.

[Photo: CERN Geneva]

FIG. 11  A microcard-copier which makes full-size positive copies directly from opaque micro-copy.

[Photo: Microcard Reader Corporation, Wisconsin, USA]
that the filmstrips need not be removed for reading. But these jackets should not be of hygroscopic material as this can cause rapid deterioration of the microphotographs. To facilitate filing and retrieval of microfilm strips the top of the jacket should carry a guide strip on which the location mark, author and title of the publication are indicated. The best method of storage is in drawers as illustrated in Fig. 3.

Microfiches are usually kept in paper envelopes which are open at the top so that author and title can be seen without removing the fiche. These envelopes can be filed in drawers of the kind used for catalogue cards of international standard size (75 x 125 mm.).

Microcards need no envelope; they are simply filed in standard catalogue drawers.

It may seem complicated to have to keep different files for different microforms, but there are filing cabinets with interchangeable drawers for all forms of roll microfilm and microfilm strips (Fig. 3), and these can be combined with filing cabinets for microfiches and microcards. As each drawer is labelled, it is as easy to find any publication in microform as to find any card in a card file.

Storage and preservation

Microphotographs should always be stored in steel cabinets. Those intended for public use should be kept as near as possible to the reading room. The filing cabinets should not be exposed to the direct rays of the sun or any heat source. The room temperature need not be maintained within close limits, but the relative humidity should be kept between 40 and 60 per cent [61].

Microphotographs intended for archival purposes should be stored in a special air-conditioned room; temperature should be in the range of 16-27° C. (60-80°F.), preferably near 21° C. (70°F.), and relative humidity between 40 and 50 per cent [61]. The air should be filtered and kept free from injurious gases (especially hydrogen sulphide and sulphur dioxide). The air should be circulated under slight pressure, and the steel cabinets in which the microphotographs are stored must provide free access of air.

Microphotographs which are not used regularly have to be inspected at least once every five years, and copies should then be made of any photograph which has suffered damage.

Reading apparatus

Microphotographs are usually borrowed by readers on conditions similar to those for borrowing full-size publications. As special equipment is needed for reading microphotographs, the user will generally read micro-copies in the reading room, and he expects suitable equipment to be at his disposal.

There are two essentially different types of reading apparatus, one for transparent microphotographs and one for micro-opaque cards.

In a microfilm reader the light transmitted by the film produces an enlarged image of the microphotograph either on the back of a translucent screen (e.g. ground glass) or on an opaque screen (e.g. white cardboard). An advantage of the first system is that the reader may be used in plain daylight if no direct light falls on the screen. But there is a rapid decrease of light intensity towards the periphery of the image if the reader is not equipped with a Fresnel lens. The second system is simpler and less expensive, but it needs a slight darkening of the room. It has the further advantage that the reader can be easily used as an enlarger for occasional production of enlarged prints, while a translucent screen has to be replaced by a support for photographic paper.

There are many models of microfilm readers on the market [8, 9, 62, 63].
A reader which can be used for all variants of 35 mm. microfilm as well as for microfiches is naturally preferred for use in the library.

A reader for micro-opaque cards uses the light reflected from the card to produce an enlarged image on the back of a translucent screen. A reader for micro-opaque cards can also be used as an auxiliary reader for transparent microphotographs when these are backed with white cardboard. Many models of these readers are available, mainly in the United States [8, 9, 62, 63].

Every library that has to handle microphotographs should have at its disposal at least one microfilm reader for all types of 35 mm. film and for microfiches, and one reading apparatus for micro-opaque cards if these are also handled in the library. These pieces of apparatus may be located in the reading room or better still in a cubicle attached to the reading room. This cubicle should be slightly darkened.

Some microfilm readers have special accessories for the occasional production of enlarged prints. Either a dry process such as 'Thermofax' is used or a semi-dry process such as diffusion printing (e.g. 'Copy-rapid') or stabilization techniques. These quick duplication processes, which are currently used in office copying work, can also be applied to any other reading apparatus, especially to microfilm readers which project the image on an opaque screen.

It is obvious that all reading apparatus must be used with great care. The mirrors of high-quality readers are silvered on the front surface and must therefore not be touched. From time to time the dust should be removed from mirrors and lenses with a very soft brush. When necessary they may be cleaned with a soft clean linen pad slightly moistened with chemically-pure benzine. The optical parts must not be cleaned too frequently. A few dust particles do not affect the quality of the image, but excessive polishing of mirrors and lenses may result in scratching.

For scanning of microphotographs pocket-size magnifiers are useful, both for the library staff in cataloguing and classification and for the clients for rapid identification.

**Handling of slides**

35 mm. transparencies will normally be numbered in accession order. The cataloguing has to be adapted to the special character of the collection. The captions of slides may be typed on library catalogue cards and filed in catalogue drawers. Cross-references may be made by means of added entries.

It is preferable, however, to use a copy of the slide itself in the catalogue. This can be achieved when the slides in cardboard mounts are systematically arranged in special frames taking up to ten slides (2 × 5) each.¹ Short captions and the number of the slide can be written directly on the cardboard mounts. A card catalogue may supplement the subject catalogue.

For extensive slide collections which need many added entries in the catalogue, aperture cards can be used. A film copy of each slide is mounted in the window of the card, and the caption and the number of the slide are entered. After coding, this data is then punched on to the card.

A stock of slides may be kept in special drawers with suitable compartments to take size 5 × 5 cm. (2 × 2 in.) (Fig. 4, photographic section). The filing of negatives is described below (see 'The production of microphotographs', p. 19).

**The photographic laboratory**

The question whether a library should have its own photographic laboratory has been discussed by several authors [64, 65]. It is certainly true that a small-

¹ Available from V-Dia-Verlag, Heidelberg, Germany, for instance.
size photographic laboratory with its modest equipment cannot work as efficiently as a commercial firm specializing in this field. However, other aspects must be considered besides the costs involved.

The whole advantage of the use of microphotographs to replace inter-library loan breaks down if the publications have first to be sent to a commercial firm, which usually cannot deliver the work in less than 2 days. Furthermore, once an item leaves the library it suffers wear in transit and there is always the risk of loss. Obviously the safety of rare or unique material can best be ensured in a laboratory under the direct control of the library. These intangible advantages, which are hard to express in terms of money, may well introduce real savings which more than compensate the lower commercial price of the mass-produced article.

Many libraries consider photographic reproduction as an inconvenient obligation to produce copies at special request. On the other hand those libraries which wish to take full advantage of all the creative possibilities of microphotography are advised to install their own photographic laboratory.

Location and installation of the laboratory

The photographic laboratory should not be relegated to an empty corner in some distant basement. It should be functionally integrated into the plan of the library, as near as possible to the lending department and the stacks from which the documents will be drawn. Water, electricity and waste drainage must of course be provided.

The size of the laboratory depends on the size of the library, but still more on the amount of photographic work to be done. It may well be the case that a small library needs a bigger photographic laboratory than another library of medium size.

In principle, the laboratory will comprise at least two rooms, one for work in daylight and a darkroom. The walls and especially the floor of each room should be resistant to water and acids. The walls should be either white or cream in colour.

Furniture may be of wood or steel. Tables should have a coating of plastic material. The sinks should preferably be constructed in wood, coated with plastic material (polyvinyl chloride). The water supply should be controlled by a thermostat which can be regulated between 18 and 40°C (65 and 100°F). The electricity supply must have a special line connected with the ground, and all electrical apparatus must be earthed. There should be a central safe-light in each darkroom, and each place of work should be provided with an additional separate safe-light fixed on the wall.

The laboratory, especially the darkrooms, must be well ventilated and should preferably be air-conditioned. The room temperature should be maintained at around 19°C (66°F).

The equipment

A good selected guide to the wide range of equipment and suppliers in many countries is provided by the following authors: International Federation for Documentation (FID) [8], Lewis and Offenhauser [9] and Ballon [63].

In principle, for the production of microfilms any good miniature camera that can be focused on objects at distances down to about eight times the focal length can be used. Examples of such cameras are the Leica with focusing stage (Fig. 5, photographic section) and reflex-type miniature cameras.

For microfilm laboratories miniature cameras have certain disadvantages; their shutter and film transport mechanisms are not designed to be used intermittently all day and they have to be continually re-charged with film.
Therefore, a suitable microfilm camera is essential for working on this scale. For the production of roll microfilm there are planetary or flat bed cameras which photograph the originals frame by frame, and there are rotary cameras in which separate original pages and the film move synchronously.

In libraries planetary cameras for 35 mm. film are commonly used. Rotary cameras for 16 mm. film have some applications, for example in microfilming library catalogues [58]. For the production of microfiches a step-and-repeat camera is preferred.

Laboratories that produce only a moderate quantity of microfilm and can therefore hardly justify expense of a microfilm camera may choose an enlarger which can be used as a microfilm camera in conjunction with a copying cassette taking 10 metres (30 ft.) or 30 metres (100 ft.) of 35 mm. film (Fig. 6, photographic section). When installed in a darkroom this apparatus can thus serve both for photography and enlarging.

Some commercially available book holders apply too strong a pressure on the back of the book and should therefore not be used. R. R. Shaw [66] has constructed a very simple and effective book holder which uses three layers of foam rubber, each 10 mm. (2 1/2 in.) thick.

The processing of large quantities of microfilm is best done in an automatic developing machine. This has the advantage of saving manpower and keeping processing conditions constant. Small quantities of microfilm can be processed manually with processing units consisting of a processing reel taking 10 metres (30 ft.) or 30 metres (100 ft.) of film, a spooling device, a set of circular processing tanks and a dryer.

For making positive microfilm from the negative a contact printer is necessary, and for the production of enlarged prints an enlarger is needed.

Small laboratories

The lay-out of a small laboratory occupying two rooms of about 15 square metres (150 sq. ft.) each is shown in Fig. 7 (photographic section). This laboratory will normally be operated by one photographer. Although it would be possible for two photographers to work in this laboratory, one taking and processing microfilms and the other making copies and enlargements, this is not recommended as a permanent arrangement because of the interference between these two different jobs. When two photographers have to be employed it is better to establish a special darkroom of a minimum area of 10 square metres (100 sq. ft.) for the development of films. Thus the smallest expandable laboratory should comprise three rooms (Fig. 8, photographic section). (See also [67]).

Medium-size laboratories

A medium-size laboratory may operate in at least three rooms: one daylight room, one darkroom for the development of films and one darkroom for making prints. An additional small room for storage of chemicals and preparation of processing baths is recommended to avoid contamination from chemicals in the darkrooms. There is room in this type of laboratory for up to four photographers.

Large laboratories

Large laboratories are normally concerned with various processes of document reproduction, depending on the special requirements of the library. Apart from the production of microphotographs they may use special types of machines for mass production of copies as continuously working enlargers and
the Xerox Copyflo machines [68, 69], and they may also have to use photo-offset reproduction. These laboratories have therefore to be specially adapted to their various tasks.

Staff requirements

The first photographer should, in principle, be a skilled professional reproduction photographer. He is responsible for the smooth running of the laboratory and for the maintenance of a high standard of reproduction. He distributes the jobs and does the final checking. He should be supervised by a senior librarian who can decide policy questions and maintain good library standards in microrecording.

As junior photographers semi-skilled personnel may be appointed. Junior photographers may also be trained in the laboratory itself. The laboratory staff should have a feeling for accurate and clean work.

The management of the laboratory

The management of document reproduction services has been quite fully discussed in an excellent article by F. Donker Duyvis [35].

THE PRODUCTION OF MICROPHOTOGRAPHS

Good quality is an essential requirement in microphotography. Poor quality of reproduction has been the cause of much prejudice and of misunderstanding of the place of microphotography in libraries. In a well organized photographic laboratory good quality reproduction does not present any difficulty when the quality of the original is reasonable. In order to maintain a high standard of readability as well as for purposes of later reproduction, the quality of microphotographs must be closely watched.

\[ \gamma = \tan \alpha \]

**FIG. 9** Characteristic curve of a photographic emulsion.
The control of quality

The quality of a microphotograph depends largely on the quality of the original. The microcopy of a printed page of a book may be expected to be of better quality than the reproduction of a typewritten page or of a pencil drawing. To some extent, the quality can be controlled by exposure time and in the course of processing the film. In order to explain this the properties of photographic emulsions will have to be briefly discussed.

The speed of an emulsion, i.e., its sensitivity to light, is of much less importance in documentary reproduction than in pictorial photography. In microphotography there is usually enough light available to work with exposure times of the order of magnitude of a second with slow emulsions. But the contrast, i.e., the rate of change of density of the negative with increasing exposure, directly affects tone reproduction and the sharpness of the image. The contrast can be evaluated by giving the emulsion a graduated series of exposures (e.g. by exposing it behind a step-wedge). When the densities produced by these exposures are plotted against the logarithms of the exposures, the 'characteristic curve' is obtained (Fig. 9). If the slope of the tangent to this curve (the 'gamma') is smaller than unity, the contrast of the photographic image will be lower than that of the original; if the gamma is greater than unity, the contrast will be greater.

A high value of gamma is desirable in photographic reproduction of lines, as in the pages of a printed book. However, a great increase in contrast of non-uniformly black lines, as they occur in manuscripts, typed pages and pencil drawings, would lead to an accentuation of these irregularities, and cause a loss of detail. Therefore, the control of contrast is very important for good quality reproduction.

The gamma of an emulsion depends on the composition and temperature of the developer. It would be very inconvenient to change either of these factors in the processing of a microfilm of a document which contains pages of varying character. However, the slope of the tangent to the characteristic curve is flatter at points corresponding to shorter exposure times (see Fig. 9). Therefore, handwriting, typed pages, pencil drawings and also pages containing photographs should be given shorter exposure times than documents with uniformly black line-patterns.

In judging the quality of a microfilm, spot checks should be made by inspection of several frames with an 8 x or 10 x magnifier. Special attention should be paid to the reproduction of fine lines and to the legibility of the smallest characters in the text. In microphotographs of poor quality the loops of the letters a and e may be filled or, much worse, characters like a, e and o, or l, t and f may easily be confused so that they are recognizable only from context. Microphotographs for which high quality is of special importance (e.g. microfilms of manuscripts) should be carefully checked frame by frame in a reader. All other microphotographs should at least be quickly inspected frame by frame for continuity of pagination and general quality.

The production of microfilms and microfilm strips

A large range of microfilm material is available in standard widths of 16 mm., 35 mm., 70 mm. and 105 mm. There are orthochromatic emulsions (e.g. Agfa-Agepe-Film, Ferrania Microfilm Ortho, Gevaert Duplo-Ortho) which are sensitive to all colours of the visible spectrum except red, and there are panchromatic emulsions (e.g. Agfa-Agepan-Film, Ferrania Microfilm Pan, Gevaert Duplo-Pan, Ilford Micro-Neg Pan and Kodak Microfile) which are sensitive to red light also. Panchromatic emulsions have a higher speed rating for tungsten light and are therefore preferred in continuously working rotary
microfilm cameras. They are also preferred for the reproduction of originals containing red colours. In the darkroom, only dark green light is permitted for panchromatic material. Orthochromatic material, however, may be handled in fairly bright red light, which gives a far better visibility.

In order to obtain uniform results it is advisable always to use the same film material and the same developer and to keep processing conditions constant. Exhausted processing baths should not be used. To achieve a high degree of permanence of microphotographs, two consecutive fixing baths should be employed, the second being fresh or almost fresh, and the films should be well washed in an efficient washing bath.

For films which are needed for archives, special precautions during processing are necessary in order to achieve high permanence of the photographic image [61].

If the camera is not equipped with an automatic focusing device (e.g. when a miniature camera is used) focusing should be done with great care. The original must be kept flat. If no special copy holder is used, a clean glass plate may help to flatten the original, and cushions of foam rubber can be used to compensate for differences of height underneath the cover of a book [66]. Undue pressure must be avoided so as to prevent damage to the binding of bound volumes.

To avoid undesirable reflections and to obtain uniform illumination the light sources should be placed so that light rays are incident at an angle of 45°.

The exposure time for a new type of film has first to be found experimentally, and subsequently need be varied only slightly depending on the nature and colour of the original. The operator soon acquires enough experience to estimate the correct exposure time, but measurement of the light reflected from the original to the camera by means of a light meter held near the camera lens may be helpful. The light of incandescent lamps can easily be controlled with a transformer regulating the voltage, and it may be adapted in such a way that the pointer of the light meter is kept at a fixed point.

Roll microfilms should have an unexposed trailer for winding on to the second reel. It is advisable to start each roll of microfilm with the title reproduced on the first frame at a reduction which is readable without optical aid. It is good practice for the document to be catalogued before microfilming so that the title is identical with the catalogue entry. The position of pages on the microfilm is indicated in Fig. 1.

Microfilm strips may simply be cut from a microfilm which has been prepared with the first frame of a strip carrying the title of the document and the following five frames carrying ten consecutive pages.

The production of microfiches

If no step-and-repeat camera for the production of microfiche negatives is available, these may be assembled by montage of strips of 16 mm. or 35 mm. microfilm [17]. The negative of the title may be made with a process camera or any other camera which takes negatives of the corresponding size. It may even be printed by contact when the title is typed in small characters ('Elite') on good thin paper. The negative of the title is then assembled with the strips of 16 mm. or 35 mm. film. The strips, emulsion side up, are mounted with Scotch tape on transparent film base with the margins and the parts between the strips blackened. Contact prints may be made on sheet microfilm or diapositive material to obtain a positive microfiche. Copying on some other transparent material 1 also gives good results. This material is much cheaper than film.

1. For instance, the new 'Agfastat' transparent material.
Microfiches (size 75×125 mm.) as shown in Fig. 10 (photographic section) can easily be obtained from negative microfilm strips by the following method. The microfilm strip need not be cut. A mask is used in which there are three windows, each for one frame (24×36 mm.) of the microfilm strip. At a distance of about 2-3 mm, from these windows double-faced pressure-sensitive tape is fixed on this mask along both edges of the series of windows. This tape holds the microfilm strip in position when the first line of three frames is printed on the sheet microfilm. Then the strip is taken off, and the negatives for the second line are brought into position on the windows. Registration marks on the mask assure correct positioning of the sheet film in this contact printing process.

The enlargement of microphotographs

Enlargements of microfilm or microfiche negatives on photographic paper may be made with any enlarger suitable for the size of the negative. Although automatic focusing is preferred in routine copying work, it is not absolutely necessary when only occasional enlargements are made. Special photographic paper is available for the enlargement of microfilm (e.g. Agfa-Agape-Papier, Gevaert Document-Amplex, Ilford Document Paper, Kodagraph Fast-Projection Paper). This paper is specially adapted for reproduction work and is cheaper than ordinary photographic paper.

It is not always necessary to enlarge up to the size of the original. Usually it is quite enough to print two pages of the original on photographic paper of approximately the size of one page of the original, thus obtaining a 50 per cent saving of paper. Several copies of the same microphotograph can be produced most economically in the following way. The enlargement is made on transparent material (e.g. Agfa Agfastat-Transparent, Gevaert Diaflex-Rapid) which is then used as a master copy in diazo-printing or even in a positive photo-offset process. It is advisable to put the microfilm negative in the enlarger with the emulsion facing the condenser in order to obtain an enlarged image with reversed sides. This method allows for direct contact of the emulsion of the transparent copy with the sensitive layer of the diazo-paper or the offset plate. Thus light diffusion in contact printing is eliminated.

When enlargements are made from long microfilms the gathering of pages which have been mixed up on their way through the processing baths is a time-consuming job. This is avoided by the use of a continuously working automatic enlarger, in which film and paper move synchronously during exposure [68]. This paper is processed from the roll in a special machine and cut only after drying.

If a high degree of permanence of the enlargements is not required, stabilized prints may be made. In this process the unexposed and undeveloped silver halide is converted into compounds which are no longer sensitive to light. These compounds may stay in the emulsion. Therefore, no washing is necessary and development and stabilization may be carried out in a quick ‘semi-dry’ process using a simple machine which transports the paper through the developer and the stabilizer within about 15 seconds. These copies, which are only slightly humid, dry within a few minutes. The drying process may be accelerated by use of a small drying cabinet, in which warm air is circulated by a ventilator.

The stabilization process has the following advantages: no running water is needed and therefore a very simple darkroom is quite sufficient; prints can be made quickly by unskilled staff; and the assembling of prints does not cause any trouble as they are not mixed up during processing. Under normal

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1. Equipment and material are available from various firms, among them Mimosa G.m.b.H., Kiel.
conditions stabilized prints can have a life of several years. They may however stain normally processed photographs when they come into contact with them. Therefore, stabilized prints should not be kept in files which contain photographic records which have a longer lifetime, and it is advisable to mark them with a warning stamp.

Dye-line prints may be made directly from microfilm positives by means of enlargers which are equipped with special light sources (e.g. mercury-vapour discharge tubes). This process does not seem to be much used for the enlargement of microfilms.

In recent years great progress has been made in electrostatic printing. The most advanced of these processes at present is xerography. An electric charge is applied in the dark to the semiconductor layer of a plate. When a photographic image is projected on this plate the electric charge will disappear where the plate is exposed to light, thus forming an electrostatic image of the original. A special powder applied to this plate will be attracted by the electrostatic image. The powder-developed image can be transferred to any sheet of paper put into contact with the plate. Fixing is done by fusing the powder to the paper.

Xerography is a specially suitable and economic process for large-scale production of enlargements from long rolls of positive microfilm which do not contain half-tone reproductions. For this purpose the Xerox Copyflo is used—a machine in which the film moves synchronously with a drum carrying the semiconductor layer, the image being printed on a roll of paper [69].

The photographic enlargement of micro-opaque cards constitutes a special problem. In this connexion it might be noted that the Microcard Corporation, at request, produces enlarged prints of their negatives [70]. However, the enlargements are frequently needed on the spot. In principle, a film negative can be made by contact printing from one-sided micro-opaque cards, but the structure of the paper presents difficulties in the reproduction of detail. Enlarged reproduction, frame by frame, on 35 mm. microfilm gives better results. Focusing is rather critical, and a precision camera with focusing screen should therefore be used (see Fig. 5). If only reflected light is used for illumination, the contrast is often too low. Best results are usually obtained by a combination of reflected and transmitted light.1

Microphotographs of manuscripts

Special care is necessary when mediaeval manuscripts or other unique or rare documents are to be photographed. If the temperature in the stack rooms is much lower than in the photographic laboratory, the documents should be brought near the laboratory and should be kept unopened for conditioning for about 24 hours before the photographs are to be taken.

Bound volumes should not be kept under pressure during reproduction, and special precaution is necessary in the choice of light sources [71]. During long exposures infra-red and ultra-violet light may affect colours as well as parchment and paper. Incandescent lamps emit much infra-red light and full intensity should therefore be used only during exposure time. Focusing can be done either with feeble illumination or by using a dummy in place of the document. The light of modern fluorescent tubes is practically free of infra-red and ultra-violet radiation, but it is not suitable for colour reproduction. There seems to be no objection to the use of electronic flash light.

2. In summer 1961 the Microcard Reader Corporation, West Salem, Wisconsin, brought out a Microcard Copier which provides enlarged copies directly from micro-opaque cards, using a diffusion transfer process (see Fig. 11, photographic section).
Good colour reproduction of manuscripts and other coloured documents is a difficult task and should be left to the specialist. However, it is possible to obtain colour reproductions of reasonable quality on 35 mm. reversal colour film. The exposure must be accurately timed with a good exposure meter, and only light of the appropriate colour temperature should be used.

Palimpsests may be examined by luminescence analysis. When exposed to ultra-violet light parchment emits an intense bluish light, whereas writing on it, even if erased, emits light of another colour or no light at all. Thus the effaced writing can be made visible in a darkroom and may be recorded on microfilm [72]. The contrast of colours may be improved by the use of colour filters in front of the lens.

The production of slides

35 mm. transparencies for projection may be either printed by contact from 24 x 36 mm. negatives or photographed with a miniature or microfilm camera from large size negatives (e.g. 9 x 12 cm. or 4 x 5 in.), using transmitted light. The second method is preferred if large size negatives are already available or if the negatives have to be used frequently. In either case the negatives can be filed in envelopes in accession number order. It is advisable to number not only the envelope but also the negative itself. This can be done by affixing pressure-sensitive labels to the negatives.

If further requests for the same slide are expected, it is quicker and cheaper to make a few more copies immediately than to have to produce them at each request. These additional transparencies may be kept in strips together with the negatives and need only be mounted when they are requested. Sometimes it is useful to keep a small stock of slides of special interest already mounted.

Simple cardboard frames of size 5 x 5 cm. (2 x 2 in.) with an aperture of 24 x 36 mm. may be used for 35 mm. transparencies. The name and address of the library or documentation centre and the number of the negative should be indicated on the slide. This number is the key to the negative if further slides or enlarged prints for publication are needed at some future date.

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