DISCUSSION

THE PHOTOMICROGRAPHIC REPRODUCTION OF DOCUMENTS

THE usual procedure followed by scientists in gathering information upon a given subject is to make notes or abstracts of original papers upon filing cards or miscellaneous sheets of paper. These are classified and filed in the most convenient manner for future reference. Naturally in this way it is rarely possible to record more than a very brief account of the work. It is therefore necessary, whenever details of the research are required, to refer to the original paper, either by borrowing the journal from the library or going there to consult it.

In some cases it is possible to obtain from the author separates of papers published in journals, and these may be kept for reference. This can be done, however, in only a relatively few cases. What is greatly needed is a procedure by which copies of any paper, no matter where or when published, may be obtained and filed by the individual worker for use whenever desired. Since filing cards are so convenient and in such general use the ideal system would be one in which the copy of the original paper could be attached to the same filing card upon which was written the title, reference, abstract, notes or other points in regard to the subject.

The method which seems best adapted to this purpose is that of photographing the original paper upon strips of film and pasting these in a window in the filing card. For reading, a miniature table projecting apparatus would be used. The individual worker would then be able to have on a filing card not only his abstract or notes but the original paper itself and could make a collection of all pertinent articles upon a given subject, file them in a very small space and refer to them at any time most convenient to him.

Attention was called in a recent article on "Reforms in Chemical Publication (Documentation)"[1] to the movements under way having for their object the amelioration of the publication and distribution of papers describing chemical research. It was suggested that a process involving the photographing of printed pages upon motion picture film and the mounting of such strips of film in filing cards might contribute towards the solution of this problem. Subsequent inquiries in regard to available apparatus which could be adapted to this purpose have permitted the conclusion that such a process is not only practical but can probably be operated at a very moderate cost. On the basis of this information it is now possible to offer more detailed suggestions in regard to the organization of a service of photomicrographic reproduction of documents.

For the production of photomicrographic copies of printed papers upon motion picture film, there have been developed various forms of apparatus which could be adapted to making the strips suitable for inserting in filing cards. It is suggested that the process should consist first in photographing the pages of the original paper upon 35 mm film and mounting the strips corresponding to the several pages of a given paper in a rather large filing card; second, using the negatives thus prepared and mounted for the preparation of positives of about one half the size, which would in turn be mounted in smaller filing cards and distributed in response to requests for copies of papers; finally furnishing to each one making use of such miniature copies of original papers contained in filing cards a compact table projecting outfit adapted to receive the cards and magnify the copy to the degree desired by the individual.

For the first stage of the process there have been developed many more or less automatic machines. They consist of a table upon which is mounted a frame in which the book or any page to be copied is held firmly, by springs or otherwise, against the under side of a horizontal glass plate. An upright supports a roll film camera attached to a movable arm. Graduations on the upright permit fixing the focal distance at the points required for pages of different size. Finally lamps on the two sides illuminate the page to be photographed. Such apparatus has been perfected to the degree that after placing the copy a single movement actuates the remaining operations.

Since a service furnishing photographic copies of printed articles would undoubtedly be called upon to supply a large demand its efficient organization would be necessary. In order to fill the many orders which would be received daily it would first be necessary to assemble the books or periodicals containing the articles to be copied. Proximity to a library would be indispensable. Upon the filing card in which the film would subsequently be mounted would first be copied, by means of a typewriter, the title, author, reference and such classification data as may be necessary. This card would then be put at the page of the book where the article begins. When a sufficient number of such cards in their respective books had been prepared, the operator of the copying machine would have only to place one book after the other in the frame, make the exposure and turn

[1] SCIENCE, 80: 2064, 70–72, July 20, 1934.

the pages until each article has been completely photographed. When the roll of film is exhausted it would be developed by the usual process and dried. It would then be cut and the sections corresponding to the various articles mounted in the filing cards previously prepared. These cards then become the master negatives for preparing as many copies of each paper as may be subsequently ordered. Such cards would also be made for exchanging with centers of documentation in other countries.

The second stage of the process would consist in making positives from the master negatives. A simple reducing camera would be employed, and the entire film strip mounted in one card would be reduced to one half size and photographed as a positive in one operation. Thus the entire series of pages of a given article would be reproduced simultaneously and as many copies made as desired. If the master negatives upon 35 mm film were mounted in two strips in a window opening 70 mm in width, the reduction to one half size would permit the use of 35 mm film for the positives. In this way only standard 35 mm film would be used in the process and a developing machine of only one size be necessary.

The positives made in this way would be mounted, as in the case of the master negatives, in windows in filing cards. These, of course, would have previously copied upon them in typewriting the title of the paper, author, reference, etc., in accordance with such information given upon the master negative card.

Since the cards could not be larger than would fit the carriage of an ordinary typewriter it is suggested that the master cards containing the negative should be about 21 cm wide by 14 cm high. This size would be sufficient to leave ample space around an opening of 70×161 mm in which two strips of 35 mm film, each containing 7 photographed pages, could be inserted. The cards for the positives, although requiring window openings only one half this size, should probably be nearly as large as the master cards, in order to leave ample space for the individual user to write such notes and observations as he might desire. Articles of more than 14 pages would require two or more cards.

There have been developed a great variety of projecting machines for both rolls of films and slides of various shapes and sizes. They consist simply of a source of light, the heat of which is not allowed to damage the slide, a film or slide holder and a lens. The screen to receive the image may be of any convenient form, attached to or separate from the remainder of the apparatus. In the case of a projecting apparatus for films mounted in filing cards, the source of light need not be intense, since only a relatively small magnification would be necessary. The screen could be improvised as desired and consequently the outfit reduced to its simplest form.

From the above discussion it is evident that the suggested process requires only such apparatus and materials as are already at hand. All that is necessary is to assemble the several elements and organize the work in a systematic manner.

In the entire process the most expensive machine is that, together with its camera of highly specialized character, used to photograph semi-automatically the printed pages. Preliminary quotations indicate that the complete photographing machine and camera will not cost more than one thousand dollars.

The reducing camera required for making positives from 35 mm negatives would probably have to be made to order but would certainly be of very simple construction and should not cost more than a few hundred dollars.

The developing machines for standard motion picture film are of course highly perfected and not of an expensive character.

Projecting apparatus suitable for reading the film can be obtained in a great variety of forms, the simplest of which could undoubtedly be produced in quantity for not exceeding ten dollars each.

The other materials required for the process are motion picture film, filing cards and the usual miscellaneous office furniture, such as desks, tables, filing cases, etc. It is probable that everything required could be assembled for about two to three thousand dollars.

The actual cost of the film, filing cards, developer and such material as will be consumed in the process is certainly very low. On the basis of reliable estimates it is probable that 5 cents will be a very liberal maximum cost of materials required in making a card containing the photographic reproduction of 14 printed pages.

The uncertain feature is naturally the cost of the labor involved. This it is impossible to estimate until the process has been put into active operation and the number of journal articles which can be copied per day by one operator has been determined. The success of this undertaking will of course depend upon the moderate price at which the cards can be sold. To those who have access to libraries the cost will be of greater concern than to those who do not. In both cases, however, it is the service rendered which is of first consideration. If this should be as great as it is reasonable to expect, the cost should certainly not be a serious obstacle to the operation of the process.

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