the carrying out of the project; the estimated cost; and the scientific and physical qualifications of the applicant to undertake the project. The scholarship will be awarded for a term of two years. If at the expiration of the term it is desired to extend the time, the incumbent shall make application a sufficient time in advance, accompanied by a statement as to the necessity for such extension. All collections, photographs, records and equipment become the property of the institution. The incumbent shall not engage in work for remuneration or receive salary from other sources than the institution or its branches during the period of occupancy of the scholarship.

DR. L. O. HOWARD, formerly chief entomologist in charge of the Bureau of Entomology, U. S. Department of Agriculture, writes: "Government officials of Denmark paid last autumn a very good and well-deserved compliment to the work done in the United States in a certain branch of science. They invited Dr. Adam G. Böving, who for twenty-two years has been working in the U. S. National Museum and in the Bureau of Entomology of the Department of Agriculture, to cross the Atlantic and to give two short courses of lectures in Denmark. One of these courses, given at the Royal Museum of Zoology, of the University of Copenhagen, related to the classification of the larvae of the Coleoptera. This is a subject that in the last century was studied by the famous Danish workers, Schiödte and Meinert. Böving worked with Meinert and, fortunately for us, fate brought him to the United States and to Washington, a generation ago. These lectures were well attended by Danish students and workers and by some men from adjoining countries. The book by Böving and Craighead published in 1931, entitled 'Illustrated Synopsis of Larval Forms of Coleoptera' and which has been termed 'epoch-making' by certain Europeans, incited this course. The second course was delivered before the Royal Veterinary and Agricultural College and aroused much interest. The agricultural journals and the daily press paid much attention to these lectures. They related to applied entomology in the United States and especially described our organization and methods of work. Both courses were given in September."

IN SCIENCE for January 4 on page 24 the address for Dr. Gustav Zechel should have been University of Illinois instead of University of Chicago.

DISCUSSION

FILM-STRIP COPIES OF SCIENTIFIC PUBLICATIONS

ATTENTION was called some months ago[1] to the efforts being made to reorganize the production and distribution of scientific publications. Special emphasis was laid on the need of making published results of research more easily accessible to those who use them. It was pointed out that the apparatus and materials required for making film-strip copies of printed pages exist at present and all that is needed is to assemble them and systematically organize the service. A plan of such an organization was suggested, and a preliminary estimate given of the cost of the equipment required.

At the time the articles referred to above were written, the most highly developed machine for photographing pages of books upon moving picture film, of which I had learned, was one of German manufacture, for which the quoted price, in marks, corresponded to about $1,000.

Since then, through the courtesy of Dr. Robert C. Binkley, chairman of the Joint Committee on Materials for Research, I have had the privilege of reading the advance sheets of chapters IX and X of his revised "Manual of Methods of Reproducing Research Materials." These chapters give a comprehensive critical survey of the factors involved in applying film-copying processes to the reproduction of printed or other documents. The contributions of a large number of workers are reviewed and it is apparent that greater progress has been made than is generally realized. Some 12 film-copying cameras are described and their relative merits discussed. Of these, the camera invented and built by Mr. Lloyd B. Kennedy, of Warren, Ohio, is considered to be the most ingenious so far developed.

Of the several cameras at present on the market, the most widely used is the Leica. This camera, however, is designed particularly for the use of individuals who wish to make their own copies of documents. Its limited film capacity restricts the usefulness of this camera for the large scale production under which a highly organized library copying service would be called upon to operate.

On November 5 last Mr. Watson Davis, of Science Service, invited to a luncheon at the Cosmos Club of Washington about 15 persons known by him to be interested in the subject of film copying of documents. Among those present was Dr. R. H. Draeger, of the Medical Department of the U. S. Navy. Dr. Draeger

[1] SCIENCE, 80: 70–72, July 20, 1934; pages 184–5, August 24, 1934. See also address on the Berthelot Centenary, SCIENCE, 67: 497–99, May 18, 1928.

told of a camera he had built and exhibited film-roll copies of books made with it. He was led to build his camera by the desire to provide himself with a conveniently transportable film library of scientific publications, for consultation and study while on shipboard or at distant naval posts. The camera was completed shortly after he was detailed for a special course of study at the Naval Medical School of Washington. While here, the director of the school recognized the utility of the camera for copying rare volumes needed to complete files upon naval hygiene being assembled at the school. Upon his recommendation, Dr. Draeger was provided with facilities for constructing a second and more highly perfected camera, which is expected to be completed shortly.

As a result of this information communicated at the luncheon, Miss Claribel R. Barnett, librarian of the Department of Agriculture, who was also present, has arranged at my suggestion for Dr. Draeger to install his camera in her library and make experiments upon copying articles in bound volumes of journals, the loan of which in large numbers is requested by out-of-town governmental and private research institutions. This experimental service has been in operation for over two months and the most varied lot of articles have been copied and sent out.

The experiment has conclusively shown that this first stage of a film-copying service has been satisfactorily achieved. The only other improvements will be in the direction of increasing the automatic character of the apparatus. The next step is the designing and manufacture of film-strip magnifiers and projectors which will permit one to comfortably read the printed matter photographed on the film.

The many film projectors at present on the market have been designed for other purposes and can not be conveniently used for reading film strips without more or less modification. In general, they are equipped with holders for film rolls and not short strips. Furthermore, the lens focus is usually too long to permit the screen to be placed conveniently near the projector. This latter disadvantage can in some cases be overcome by projecting into a box provided with a mirror which reflects the image upon a ground glass.

In view of the need of reading equipment especially designed for film-strip copies of printed pages, attention has been turned first to constructing a simple magnifier. This consists of a short cylinder, to one end of which is fixed a holder to receive the film, beyond which is a ground glass, and to the other a lens capable of being focused to sharp definition of the image.

The film strip is inserted, the apparatus is held towards a source of light, the focus adjusted and the brightly illuminated text, which is magnified about 10 times, read without difficulty. A film-strip magnifier of this kind, provided with a satisfactory lens, a handle and a screen to shade the eye not used, has been constructed at a cost which would permit it to be sold for not more than five dollars.

Experiments with such a magnifier have shown that it can also be used for projecting the film copy upon an improvised screen or a reflecting mirror and ground glass mounted in a box. All that is required is an efficient source of light. This may conveniently be composed of a lamp, condenser lenses and a reflector mounted in a small metal box. A clamp bracket permits the light source and film magnifier to be held in line and directed towards any improvised screen or into a reading box provided with a mirror and ground glass. Of the three elements composing the apparatus, film strips may be read directly, using the magnifier alone, or by projection on an improvised screen with the aid of the magnifier and light source, or by projection on a ground glass by a combination of the three elements. As mentioned above, the film-strip magnifier with a lens suitable for reading the printed matter directly should cost not more than five dollars. Provided with a better lens, needed for projecting to a larger scale, the price would probably be within $10. The other two elements of the apparatus can no doubt be furnished for another $10.

In the previous communications upon the organization of a film-strip documentation service it was suggested that the film strips should be mounted in windows in filing cards and sent out in this form. The object of this was to facilitate filing and permit the title and reference to be typewritten on the card and thus the subject-matter identified without resorting to magnification or projection of the film copy. The high cost of equipping projectors with holding devices for cards as large as would be necessary makes this plan impractical. It is now suggested that the film strips be filed in envelopes with the necessary indications written on the outside. For reading, the film strips could then be removed and inserted in the ordinary sized slots provided on magnifiers and projectors.

In order to facilitate the identification of the subject-matter of a given film strip it is contemplated that the title page of the volume in which appears the article copied shall be photographed in the first frame of the strip, together with the abbreviation of the journal title, volume, page and year, copied from a legend sufficiently large to be read on the film strip with the naked eye. Thus the film copy will be so perfectly identified that the possibility of its being misplaced from its proper envelope need not be a cause of concern.

The film-copying service would at first consist simply of photographing the pages of articles in journals and sending the negative film strip to those desiring them. The cost would be very low. Acetate

film sells for $20 per 1,000 feet, and since two pages are photographed upon each 1½ inches of film there would be 16 pages per foot. Allowing for the title page, identification reference and a short blank space at each end, the film for a 10-page article would cost about 2 cents. The developing and labor would probably not amount to more than 8 cents per 10-page article, hence it is likely that the service could be rendered by a library, without loss, at 10 cents per article of 10 pages or less and 5 cents for each additional 10 pages. This, however, is only a preliminary estimate and may be subject to revision on the basis of experience gained during an experimental period of operation.

When one considers the complex and expensive organization required for keeping track of borrowed books, the wear and tear to which they are subjected, and the messenger or other service required to deliver them, the saving effected by reducing the number which would leave the library would certainly be an important item. It is even possible that film-copying service rendered free might be a saving over the present system of lending library books. It is therefore not unreasonable to expect that even at the low price mentioned, the adoption of film-copying by libraries would lead to a considerable economy of operation.

With this end in view and also in consideration of the great service that film copies may be expected to render research workers, Miss Barnett has arranged to have made, at the prices mentioned above, with the equipment of Dr. Draeger, film-strip copies of articles contained in publications on file in the library of the Department of Agriculture.

Those desiring to avail themselves of this service should send their orders to the "Biblio Film Service," care of Library, U. S. Department of Agriculture, Washington. It is expected that within a short time film-strip magnifying and projecting apparatus, such as described above, will be available.

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ORIGIN OF PETROLEUM

THE notes on this subject by J. M. Macfarlane and E. Berl recently published in SCIENCE are worthy of some comment. Macfarlane appears to favor the old theory of the decomposition of fish oil, or lime soaps of fish oil, by heat. Berl believes there is evidence that the source material of both coal and oil was "carbohydrates and carbohydrate-humic acids."

The writer has pointed out in two recent papers[1] that the older theories of petroleum origin were proposed almost entirely without consideration of the chemical character of petroleum and with little reference to or knowledge of the conditions of its geological occurrence. It was also pointed out that there is abundant factual evidence, of both chemical and geological nature, that petroleum has had a low temperature history, of the order of 100° F. There is also abundant evidence against the early, but still widely prevalent, idea that petroleum is nevertheless the result of heat decomposition of fatty oils or other organic material, these decompositions being assumed to take place at low temperatures by virtue of the great periods of time available, in the case of the older strata, for such change. The evidence is much too abundant to summarize adequately in this brief note.

Berl evidently accepts the evidence of low temperature history. It is a pity that theories of "distillation" and heat decomposition, set up years ago on the simple experiments of Warren and Storer (1867) and of Engler, which do much violence to the many chemical and geological facts that we now know, should continue to clutter up our scientific literature. Surely we owe it to youth, seeking to learn, to clear some of our scientific debris.

The chemical history of petroleum is still bristling with unsolved questions, but how to produce petroleum by cooking fish is not one of them.

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ARE FISHES THE PRINCIPAL SOURCE OF PETROLEUM?

DR. MACFARLANE'S recent communication in SCIENCE[1] calls to mind his theory that fishes are the principal source of material from which natural petroleum has been derived.[2] Even admitting that petroleum may have been derived from fish oil in the rocks by natural processes, he has failed to present convincing evidence of fish remains in sufficient quantity to account for the enormous quantities of petroleum in some formations, having attempted to account for the large quantities in other formations by assuming, without proof, migration from far distant sources, and ignored all other as likely sources. In his interesting book he assumed, for example, that fish remains are very abundant in the Green River oil shales. As I have elsewhere stated, such remains are confined almost entirely to a thin series of strata in a very small area of that thick, wide-spread formation.[3] Even in the limited region where the beautiful fish skeletons are

[1] *Bull. Am. Ass'n. Petr. Geol.*, 15: 611, 1931; *Jour. Inst. Petr. Technol.*, 20: 177, 1934.

[1] SCIENCE, November 23, 1934.
[2] Macfarlane, "Fishes the Source of Petroleum," The Macmillan Company, 1923.
[3] Henderson, *Proc. California Acad. Sci.*, 4th series, Vol. XV, pp. 269–278, 1926.