series (thorium—energy, 4.20 MeV.; range, 2.60 cm. air) were found to be 15.4μ long. On the other hand, it is calculated from Gamow's equation that even in extremely unfavourable circumstances (assuming a decay constant $\lambda = 10^{-21} \text{ sec.}^{-1}$ and a nuclear radius 7×10^{-13} for the most highly charged among the nuclei under investigation, namely, bismuth-209) the α -ray energy would be only about 3.8 MeV., corresponding to a range in air of about 2.3 cm., and in the emulsion of about 13.6μ . The best-defined unidentified pleochroic halo has a range equivalent to 1.8 cm. air.

The relation between the half-life $\tau_{1/2}$ and the number of tracks N , counted in n (usually 1,000–2,000) fields of view under the microscope, each of volume v , after keeping the plate for a time t , is

$$\tau_{1/2} = \frac{nv\epsilon f A t \ln 2}{N},$$

if c is the concentration of the impregnating solution in gram-atoms/c.c. (usually about 5×10^{-5}), and A is Avogadro's number. The 'penetration factor' f is defined as the ratio of the concentrations in the dry emulsion and in the solution. Its value for each individual case is rather roughly estimated from a series of tests performed with α -emitters of known half-lives, where penetration can be derived directly from track counts. The following test substances were used: thorium B, giving tracks of thorium C or C'; radium in mixture with barium; uranium as uranyl salt, giving tracks of uranium I and II; samarium; thorium + radiothorium. The value of f depends on valency, nature of the anion, conditions of bathing, etc. The most potent influence, however, is that of pH, in the sense that much more material is taken up from neutral than from acid baths. Penetration factors of 2–4 were found to apply with solutions of pH 6 containing 1 per cent of salt—about the highest concentration compatible with good quality of the tracks. Finally, the volume v (about 10^{-6} c.c. for 100- μ plates) is obtained as the volume of the cylinder of emulsion constituting one field of view, minus the volumes of the upper and lower border zones, in which the true lengths of inclined tracks may remain unknown.

With most elements tested, including lead and bismuth, no unidentified tracks were obtained. In these cases, to give a figure for the limit, we put $N < 1$. In a very few cases, which are being further examined, there was a small number of tracks which we have not yet identified; in these cases we also put $N < 1$, but insert for n the average number of fields of view required to find one track of this kind. Some results are listed in the accompanying table.

Element	Salt used	Half-life (years) ($\times 10^{-15}$)
Mo	ammonium molybdate	> 9
Rb	rubidium chloride	> 17
Zr	zirconium oxynitrate	> 2
Cd	cadmium sulphate	> 6
Pb	lead nitrate	> 3
Bi	bismuth ammonium citrate	> 3
Sm (for comparison)	—	0.0010
Th (for comparison)	—	0.000914

From a search of non-impregnated plates, the conclusion is drawn that the half-lives of silver and bromine, which are present in very high concentrations, exceed 10^{18} years.

The investigation is being extended to other elements. In addition, the limits are being improved through various modifications of the procedure. A fuller account is in preparation.

We would like to thank Prof. Karl Przibram for his help and his interest in our work.

¹ Dempster, *Phys. Rev.*, **73**, 1125 (1948).

² See Schintlmeister, *Wiener Ber., A*, **173**, 250 (1939). Henderson, *Proc. Roy. Soc., A*, **173**, 250 (1939).

³ Glückauf and Paneth, *Proc. Roy. Soc., A*, **165**, 283 (1938).

⁴ Libby, *Phys. Rev.*, **44**, 512 (1933).

CINEMATOGRAPHY AND THE UNIVERSITY

By C. DENIS PEGGE

Cambridge University Educational Film Council

IN one or two universities, bodies have been instituted to foster the use of educational films; and to serve the interests of all British universities a national Universities Film Council was founded in October 1947. In the course of an article—which must necessarily repeat some things that might be said regarding school education—it is hoped to indicate how various are the ways in which a university may be concerned with films.

Education consists largely of literal and symbolic interpretations of reality, or of man's experience of it. One general function of visual aids is to supplement these interpretations with what as nearly as possible provides direct experience, where that experience cannot otherwise be provided, or cannot conveniently be provided. Also films supply matter for visual memory—which is more retentive than aural memory. Wherever there is movement or growth, films may illustrate it. Leaving aside the possibilities of stereoscopic film, relative movement between object and camera allows solidity to be shown—of use, for example, in a study of crystal forms. Often it may not be possible to provide university students with direct experience of a process or phenomenon—the manufacture of steel, the development of an embryo, or the failure of a bridge. In other cases the special devices of photography—allowing selection of viewpoint, lighting and time—can permit optimum presentation of a subject to a large class. Moreover,

cinematograph films provide the only means of presenting movement that is either too rapid or too slow to be perceived through normal vision.

In advanced teaching the provision of what have sometimes been called 'animated lantern slides', the mere provision of moving photographs, will probably remain of first importance. But, as everyone knows, the film can supply a visual language.

Apart from providing illustration in teaching, the film may be used for directing attention to a particular subject or problem, and for stimulating interest in it.

Shots are related to one another in a sequence; the effect of each shot is influenced by the effects of the shots which come before and after, and there is a sum-total of effect from all the shots. It is appropriate that the closeness of the illusion of reality allowed by moving photographs should have been exploited in the silent film of 20-30 years ago. 'Elements of reality' may be the syllables and words of the language of film. Whether from the rudimentary 'animated lantern slide' or from the developed montage film like Pudovkin's "Mechanics of the Brain", it is its quality of being able to provide direct experience that makes the widely various film medium mainly valuable in education. Also it is through sight that the film makes its unique contribution. In embodying speech, films supply what lectures and books can also supply. Nevertheless, the sound film and the talking film are in common use. The film has often been classed, therefore, as a visual-aural aid. Indeed, it is as an aural aid that it is of considerable value in the teaching of languages. For example, at one university recently a series of some six film sessions—each about two hours long—was arranged for students of the Russian language, a number of outstanding Russian talking films being shown, including "Ivan the Terrible", "General Suvurov", "Lone White Sail" and "My Universities".

Another important class of films in teaching are those embodying animated diagrams, and many other classes of films might be designated. But a great variety has been indicated.

In the presenting of these films in university teaching there may broadly be distinguished two main methods. The film may be used as an integral part of a lecture, illustrating the lecture directly and dominated by the lecturer's presence. This is the most usual and probably most valuable method. It is the one most frequently employed in schools. Partial black-out—and, if attainable, daylight projection—are desirable for this manner of presentation.

The other main method is to show films in a separate cinema period. This is suitable for the showing of what may be termed 'background' films, and for practical reasons may be a convenient way of showing films that illustrate current lectures. Although introductions may play a very valuable part, the introducer will not dominate as in the lecture method. The screen, generally speaking, is *allowed to take charge. It is important, therefore, when using this method that the black-out should be complete and the projection arrangements perfect. The films will be arranged to link as closely as possible with the subject-matter of lectures and laboratory work. But an important function that the provision of a cinema period may serve is to introduce 'fringe' subjects, that is, subjects which it may be desirable for the students of any branch of learning to consider, but which cannot conveniently be fitted into the lecture courses.*

A few instances of this manner of presenting films are known to be occurring at universities in Great Britain. The fourth-year medical class in public health and social medicine of one British university has a two-hour film session every week—these sessions to some extent taking the place of visits to institutions of public-health interest. Students in engineering at another British university have—for the past four years—an hour a week of their regular time-table reserved for the showing of films. At the same university films have been shown, by this method, in connexion with the teaching of economics.

Agriculture, anthropology, engineering, estate management, Colonial administration, geography, biology and medicine are all subjects for which—in addition to the lecture method—films can suitably be shown through a separate film session; also film sessions may be useful for languages and art subjects. Students at present have access to libraries for their reference and background reading. Facilities corresponding to these for the viewing of films do not exist.

Apart from the occasional provision of cinema periods by some university departments, the use of films as an aid in university teaching results from the initiative of individual lecturers. It is a use, therefore, which may be fostered by supplying information about films and by providing easy facilities for film projection, and for film-making, and for the viewing and assessing of films. Centralization for film apparatus, technicians and information seems to be the tendency at universities in Great Britain and America.

Universities are centres of research as well as of teaching. Cinematography provides a microscope in time. It may be an instrument of great importance in research work. It allows observations and measurements otherwise impossible. The cracking of glass may be studied, or the mechanism of flight of an insect, or the slow growth and movement of plants and microscopic cells. Films like "Spongilla" and "Cells in Tissue Culture" made by Dr. A. Hughes at the Strangeways Laboratory, Cambridge, are offshoots of research work, in which cinematography is an essential part of the technique used.

There are circumstances in which the impersonal camera must take the place of the human observer, and others in which it can most conveniently be employed. High-tension electrical phenomena may be safely photographed, and illumination outside the visible spectrum may be used. Cinematography may most accurately and conveniently record a number of measuring instruments at the same instant.

As well as providing a valuable tool for actual discovery and measurement in research work, cinematography may be employed to illustrate the phenomena and apparatus. A film may provide a valuable supplement to a written or read description of research work. A number of films that do this have already been made at universities.

There are other connexions in which a university may be concerned with films. Owing to their use in school education, a study of visual aids forms part of the course in the education departments at some universities. Like the longer established arts of literature and music, at some universities abroad film art provides an additional art subject.

A word may be added concerning the important subject of film-making. Nowadays at universities films are made—usually under very restricted conditions—on the initiative of individuals and depart-

ments. Valuable films have been made in this way. But it is possible that in the future universities may concern themselves more directly in this expensive and specialized matter of film production—providing a film unit, or a centre for apparatus and technicians. In many subjects films suitable for university teaching do not at present exist. Where teachers, research workers and apparatus are assembled, it is appropriate that films should be made, and appropriate institutions—like the university presses for the production of books—may eventually come into being.

DIRECTORIES OF PARASITES

THE Specialist Conference (August 1947), on Culture Collections of Micro-organisms, of the British Commonwealth Scientific Official Conference (1946), recommended that a "Directory" of the important culture collections in the Commonwealth should be prepared, and the first issue of a "Directory of Collections of Micro-organisms maintained in the United Kingdom and Crown Colonies" was published in May 1949. It has been compiled by the United Kingdom National Committee of the British Commonwealth Collections of Micro-organisms. This first issue states only the kinds of organisms maintained at each centre listed. It states, that is to say, whether the organisms are viruses, bacteria, protozoa, yeasts, and so on, but not, as yet, the genera and species. A supplementary list to be issued later will give the genera and species.

The lay-out of the "Directory" is not complicated. It allocates to each centre a code number and lists the centres in alphabetical order, commercial laboratories being listed by the name of the firm, non-commercial institutions, university departments and hospitals by the names of the towns in which they are and institutions in the London postal area by their names and not under London, unless their names begin with the word London. An index of the main types of organisms maintained, which includes such items as algae, bacteria, marine organisms, industrial fermentation, plant pathogens and so on, enables the reader to find, by means of the code numbers, which centres maintain each type of organism. There is also a list of the code numbers with page references. Information is thus easily obtained. The name of the director of each centre is given, together with the name of head of the department maintaining the organisms, the interests of the department, the types of the organisms (and, in most instances, the number of different kinds of them), and whether distribution of them is by personal favour or on request and whether a fee is or is not required.

The "Directory" is bound to be valuable to research workers, and criticism at this early stage in its life would be unfair. In future editions perhaps the use of the term 'director' could be more uniform. In this issue the names of the directors given are sometimes those of the heads of the departments maintaining the organisms and sometimes those of the heads of the centres themselves. The "Directory" is a valuable step in the right direction and all laboratory workers will be grateful for it. It can be obtained free from the Secretary, United Kingdom National Committee of the British Commonwealth Collections of Micro-organisms, 38 Old Queen Street, London, S.W.1, to whom additional information about items in this

first issue and also about collections not listed in it, should be addressed.

No less valuable than the "Directory" just discussed are the "Catalogues of Arthropods, Helminths, Molluscs and Protozoa of Interest to Medical and Veterinary Workers", issued on May 9, 1949, from the Laboratory Animals Bureau, Royal Veterinary College, Royal College Street, London, N.W.1. Prepared in collaboration with the organisers of the "Directory of Collections of Micro-organisms", these "Catalogues" are planned on similar lines and use the same code numbers for the centres listed. Fewer centres are given, but, as research workers send in further information, these "Catalogues" will soon grow into the complete directory planned by its organisers. They consist of two lists.

List 1 gives general information, classified by towns, about the parasitic animals and their intermediate hosts that are kept at the various centres listed, with the code number of each centre. Thus we learn from List 1, by looking up London, that Colonel H. E. Shortt, of the Department of Parasitology, London School of Hygiene, maintains five arthropods, eight helminths, eleven molluscs and fifteen protozoa. The number of protozoa maintained by him is by agreement also listed in the "Directory of Micro-organisms". To learn what parasitic animals are kept by Colonel Shortt we look up Colonel Shortt's code number in List 2 of the "Catalogues", which is divided into separate lists of arthropods, helminths, molluscs and protozoa, and gives in most instances their genera and species, the hosts in which they are maintained, the mode of their transmission in the laboratory, the history of the 'strain' kept (when this is known) and the code number of the centre.

The "Catalogues" thus give more information than the "Directory of Micro-organisms" does; but the forthcoming issue of a supplement to the "Directory" containing the species of micro-organisms listed in it will rectify this difference between them. Perhaps in the future it will be possible to combine both directories in one volume. The difficulty of obtaining accurate information of this kind and of keeping it up to date must be very considerable. No doubt this is the reason why the bindings used are not yet permanent, the "Directory" being in a stiff paper binding, the "Catalogues" duplicated. But everyone will be grateful to all those who have helped to produce these lists. It is up to all research workers to help to keep them accurate and up to date by sending to their organisers any information that they may have, not only about items published in these lists, but also about collections of organisms not yet included in them.

G. LAPAGE

FORTHCOMING EVENTS

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at King's College, Newcastle-upon-Tyne).—112th Annual Meeting (Wednesday, August 31—Wednesday, September 7).

Friday, September 2

At 8 p.m. at the Literary and Philosophical Society, Westgate Road.—Prof. Hans Pettersson: "Exploration of the Ocean Floor".

Saturday, September 3

At 7.30 p.m. (in the City Hall).—Division for Social and International Relations of Science Discussion on "World Food and World Population". (Speakers include: Sir John Russell, F.R.S., Lord Bledisloe, G.C.M.G., Lord Horder, K.C.V.O., Dr. Jaime Torres Bodet, Sir David Rivett, K.C.M.G., F.R.S., and Dr. P. O. Ripley).

Sunday, September 4

At 8 p.m. (at the Literary and Philosophical Society).—Prof. A. D. Ritchie: "The Science of the Living and the Lifeless".