that the helium nuclei are bound together with much weaker forces than the H-components of the helium nucleus itself. If the structure of the complex nucleus, say, of oxygen is such that the α -particle may communicate a considerable fraction of its momentum and energy to a single component, we should expect such disintegration to occur. It is also possible that charged particles of mass about 2 or 3 may exist as secondary building units of the complex nuclei of some elements, but so far no definite evidence of their liberation has been obtained.

I have so far confined my remarks to the disintegrating effects of swift α -rays, but it is important to consider whether the swift β -rays or energetic γ -rays from radium are able to produce any effect. We have found that neither β - nor γ -rays appear to have the power of giving sufficient energy to a free H-atom in ordinary hydrogen to detect it by the scintillation method, and consequently still less should we expect these rays to liberate a swift H-atom from a complex nucleus. It is possible, however, that these agencies, and particularly γ -rays of very short wave-length, may be able to liberate an electron and lead in this way to a change of its atomic number. Unless, however, the resulting atom is unstable and breaks up with the emission of a swift particle of the α -ray type, it will be difficult to be certain of such transformations. It should be noted that Slater has shown that α -rays are able to excite some very penetrating rays in their passage through ordinary matter. There is some evidence that such high-frequency radiation can only arise from the nuclei of atoms. If this be the case, it may be possible that the α -rays in some cases lead to a liberation of a β -particle from the nucleus and a consequent transformation. This effect, however, must be on a very small scale.

Many attempts have been made in the past to test whether the ordinary atoms can be disintegrated by special agencies. The late Sir William Ramsay, with the characteristic instinct for choosing the best line of attack, made a number of experiments on the effect of the α -rays of radium on matter and concluded that

he had obtained evidence of the production of neon from water and the liberation of lithium from copper. These conclusions have not been confirmed by subsequent investigators, and in the light of the experiments described in this lecture it seems very doubtful whether the amount of transformation, even if it occurred, would be sufficient to be detected by ordinary chemical methods such as were employed.

Many instances have been recorded of the appearance of helium in discharge tubes, and it has been suggested that helium is a product of the transformation of the electrodes by the action of the intense electric discharges. The most notable experiments in this direction have been made by Prof. Collie, but the subsequent detailed investigations by Strutt did not confirm his conclusions. It is exceedingly difficult to prove that the appearance of helium is not due to its occlusion in the electrodes and liberation by the intense heating of the discharge. Similarly, many observations have been made of the steady liberation of hydrogen from electrodes. Winchester, who examined this effect in detail with thin aluminium electrodes, found that hydrogen was released until the electrodes were entirely dissipated. It is very difficult to believe that this hydrogen is a product of the transformation of aluminium when we remember the great energy of the α -particle required to effect it. As in the case of helium, it seems more probable that the hydrogen was originally absorbed in the electrodes.

While it is unsafe to be dogmatic on these points, the general evidence indicates that the atoms as a rule are such stable structures and the nuclei are held together by such powerful forces that only a most concentrated source of energy, such as the α -particle, is likely to be effective in an attack on such well-protected structures. Even when disintegration takes place, it is on an exceedingly minute scale, and only a few α -particles in a million are effective. If we had charged atoms available of ten times the energy of the α -particle from radium, we could probably penetrate the nuclear structure of all atoms and occasionally effect their disintegration.

Organisation for Visual Instruction.

By DR. C. W. KIMMINS, Chairman of the Cinema Education Committee.

A BULLETIN on the subject of visual instruction recently received from the University of Wisconsin is of great value as showing the remarkable results which have been obtained by the collection and distribution on an elaborate scale of material for the development of this method of teaching. The fact that in Wisconsin "the circuit plan of distribution" has been in operation for six years "with increasingly gratifying results," enables the authorities to speak with great weight on the subject. The Bulletin deals not only in considerable detail with every department of the organisation, but also gives valuable suggestions for overcoming difficulties such as the transport, storage, and repairing of films and lantern slides. An idea of the great importance attached to visual instruction by the University may be obtained from the fact that a room in the University extension building has been fitted up and equipped with stereopticons, motion-

picture machines, and projection apparatus of many of the leading makes. Teachers and committees are invited to visit Madison at any time to inspect these machines side by side and compare their respective merits with one another. It is also possible at the same time to become better acquainted with the visual instruction plans and purposes of the university extension division as well as with the stock of material.

In the British Isles the useful part which visual instruction can play in educational methods has long been recognised, as is evidenced by the action of the more important local education authorities in providing the schools with lanterns, lantern slides, pictures, maps, diagrams, botanical and other specimens, and a variety of other material for this purpose. The Lantern Slide Committee of the London County Council has done valuable work for many years in the preparation of a magnificent collection of lantern slides suitable

for the illustration of lessons in various subjects. The catalogue of slides is frequently revised and ample provision is made for their distribution, of which full advantage is taken by the schools. The modern school, moreover, is generally equipped with a room, which is in constant use, specially designed for lantern illustrations. Thus, so far as the lantern is concerned, the schools have been generously treated.

The cinematograph film, however, is being used for educational purposes far more in America than in our own country. This is especially the case with adult education, in which the problem is an infinitely simpler matter than is that of the introduction of the kinema into the school for the normal purposes of instruction, in which a good case must be made for its value as against its competitor, the lantern.

There is no difficulty with propaganda films for various purposes, films dealing with general questions of health, those dealing with advanced science and specific industries, farming operations, general travel, and so on, provided always that they are prepared under the supervision of experts who are responsible for the sub-titles or captions. All are agreed on their value and great educational possibilities. They have, moreover, the advantage of being self-contained; each film tells its own, more or less complete, story. The difficulty begins when the film is used for continuous visual instruction in the general curriculum of the school.

The most promising feature of the situation as regards America is that the whole subject is being taken up by the universities, as is made abundantly clear by the Bulletin. The university extension division of the American university is a very important department, and being so intimately concerned with the extra-mural teaching of the adult, it comes into far closer personal touch with the schools than our own universities. The fact that in the Wisconsin experiment the majority of the films on educational subjects are edited by university professors is of far-reaching importance. The necessity for the collaboration of the expert and the film producer is emphasised in the Bulletin.

An admirable film was recently produced on a biological subject which would have much greater value and could be used with greater satisfaction if it were free from biological errors—errors that would not have crept in had its production been aided in and censored by men from the biology department of one of our universities. Illustrations could be multiplied almost indefinitely of films of the highest educational value

that could be produced in the university and with the aid of the university staff.

What is generally known in this country as the educational film, suffers under the grave disadvantage of having to serve two purposes. It has to be of a sufficiently popular nature to be acceptable to the normal patron of the kinema theatre, and at the same time to contain sufficient material of scientific interest to appeal to the person who has a fair background of knowledge of the subject. To serve this dual purpose many beautiful films have been prepared at great cost to the producer, but they have not met with sufficient popular favour to stimulate the further production of this type of film. During the sitting of the Cinema Commission many teachers who appeared as witnesses said that the kinema might be used with great advantage in teaching such subjects as nature study and geography.

The difficulty of a dual purpose to be served has also been experienced in America, as is shown by the following extracts from the Bulletin:

(1) We therefore have two rather distinct classes of borrowers—the schools on one hand, calling for material to use in formal class-room work, and on the other civic and community organisations of many sorts, whose needs and desires differ from one another to a greater or less degree and in particular from the somewhat stereotyped needs of the schools.

(2) The class approach to the study of a topic through the aid of slides or motion-pictures should be essentially the same as a laboratory exercise in science. . . . In other words visual instruction should be reduced to a pedagogical method.

It will be seen by the above that whereas at present the ordinary educational film has only a limited usefulness in the schools in such subjects as nature study and geography, the more important problem of its value for normal school subjects by the production of a different type of film has yet to be solved. Many experiments are being made in the filming of well-known text-books and in the production of definite kinema text-books which may yield results of considerable value. Meanwhile, a very important original research is being carried out by distinguished experts in London, the report of which will soon be published and which will give much valuable information on some fundamental questions as to the relative value of the kinema and the lantern for teaching purposes.

There is, undoubtedly, in the kinema great educational possibilities, and the success of the important developments in visual instruction at the University of Wisconsin is a happy augury for the future.

Obituary.

ARTHUR BACOT.

ARTHUR BACOT, entomologist to the Lister Institute, died of typhus on April 12 at Cairo, where he was engaged in investigating the etiology of this disease and the precise method of its transmission through the agency of lice. His colleague Dr. Arkwright, working in the same laboratory, contracted the disease a few days later. His condition was the cause of grave anxiety, but he is now fortunately making a good recovery.

How they became infected is uncertain. They were occupied in experiments with lice that they had fed

upon cases of typhus some time previously and had confirmed Nicolle's statement, hitherto unsupported, that the excreta of infected lice were capable of conveying the disease. Possibly they acquired the infection from such material. Experimental work upon typhus has already proved very costly, and Bacot's name is now added to the list of distinguished students, Conneff, Cornet, Jochmann, Luthje, v. Prowazek, Ricketts, Schussler, each of whom has fallen a victim to typhus while endeavouring to solve the problems of its etiology and epidemiology.

Bacot was born in 1866 and educated at Birkbeck