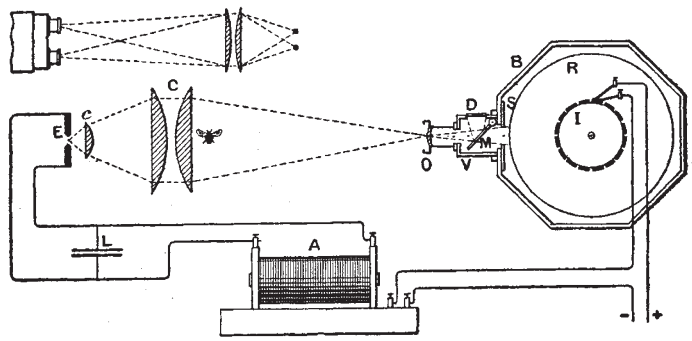
Welwitschia, Mrs. Thoday; further observations on the fossil flower, Dr. M. C. Stopes; chromosome reduction in the Hymenomycetes, Harold Wager; the sexuality of *Polystigma rubrum*, Prof. V. H. Blackman; telophases and prophases in Galtonia, Prof. Farmer and Miss Digby; a cytological paper, Dr. H. C. J. Fraser; the zoospores and trumpet-hyphæ of the Laminariaceæ, Dr. Lloyd Williams; plant distribution in the woods of north-east Kent, M. Wilson; the absorption of water by leguminous seeds, A. S. Horne. Papers are also expected by Prof. F. E. Weiss and others. The semi-popular lecture will be given this year by Prof. F. O. Bower; subject, sand dunes and golf links.

SECTION L (EDUCATIONAL SCIENCE).—The president for the meeting is Principal H. A. Miers, and his presidential address will be delivered on Thursday morning, September 1. It is intended to give up the whole of Friday, September 2, to the subject of educational research, and the meeting will be a joint one with the Anthropological Section. Prof. J. A. Green, of Sheffield, the secretary of a committee which has been investigating the mental and physical factors involved in education, will present a report on the present position of educational research at home and abroad. Dr. Gray will also present a report on behalf of a committee of the Anthropological Section on methods of observing and measuring mental characters. It is hoped that Prof. Münsterberg, of Harvard, will open the discussion, which promises to be an important one. Dr. Lucy H. Ernst, Prof. Lippmann, of Berlin, Dr. Kerr, the principal medical officer of the London County Council, and several members of his staff, Prof. C. S. Myers, Dr. T. P. Nunn, and Dr. Rivers, of Cambridge, amongst others, have signified their intention to take part, and reports will be presented, by the investigators, of serial observations on school children and others which have been conducted in London, Liverpool, Sheffield, Wolverhampton, and elsewhere. On Monday morning, September 5, Mr. J. G. Legge, Director of Education in Liverpool, will open a discussion on handwork and science in elementary schools. On Monday afternoon there will be a joint discussion with the Chemistry Section on the neglect of science in commerce and industry. Mr. R. Blair, the Education Officer of the London County Council, will open the discussion, and Prof. Bovey, Principal E. H. Griffiths, Sir William Tilden, and others have promised to take part. On Tuesday morning, September 6, the subject of open-air studies in schools of normal type will be taken up. There will be papers by Mr. J. E. Feasey, of Sheffield, Mr. G. G. Lewis, of Kentish Town, and Prof. Mark R. Wright, of Newcastle-on-Tyne, will read a paper on a training college under canvas. On Tuesday afternoon a joint meeting will be held with the Physiological Section for the discussion of voice production. Dr. A. A. Gray, Mr. H. H. Hulbert, Principal Burrell, of Isleworth, Prof. Wesley Mills, Mr. W. H. Griffiths, and others, will contribute papers.

## *THE ULTRA-RAPID KINEMATOGRAPH.*

A RECENT number of *La Nature* (April 30) contains a very interesting account of the latest work of the Marey Institute. By means of the new instrument, the ultra-rapid kinematograph invented by M. Bull, sharp stereoscopic kinematograph views may be obtained of such extremely rapid movements as, for instance, the flight of a fly or the breaking of a soap bubble. With the ordinary kinematograph the photographic film moves discontinuously, being arrested at the moment of each exposure. While this is simple enough at moderate speeds, it would be quite impossible where the exposures are at the rate of 2000 a second, and the mean speed of the film 4000 cm. a second. These are the figures that are necessary for the study of insect flight, and these are attained in the new instrument. With such a speed the movement of the film must be continuous, and a sharp image is possible only if the exposure does not exceed 1/400,000 second, and for this the electric spark gives a light of sufficiently short duration.

The apparatus is shown diagrammatically in the figure. R is a wheel 34·5 centimetres in diameter, which may be turned at a high speed by means of an electric motor. It carries two long strips of photographic film to receive the stereoscopic images. On the same axis, but outside the octagonal light-proof case, is fastened an interrupter, I, of fifty-four strips of copper, which serve to make and break the primary circuit of an induction coil fifty-four times every turn, or 2000 times a second. The secondary of the induction coil is connected with a pair of spark-gaps, E, arranged in series, the electrodes being of magnesium to increase




the light. The arrangement of the two gaps and their relation to the optical system are shown in plan (but reversed, left for right) in the upper left-hand corner of the figure. A condenser, L, is connected to the wires leading to the spark-gaps. The optical system is made clear by the figure, but the lenses are made of quartz and Iceland spar instead of glass, so as to be transparent to the actinic rays of short wavelength for which glass is opaque. A mirror, M, throws the pair of images on a ground-glass screen, D, or, on being turned up out of the way, it leaves a clear passage for them to be formed on the films. In order to prevent the photographs from being spoilt by multiple exposure, two shutters of thin steel, actuated by springs, are released electromagnetically one after the other, the interval being the duration of one turn of the wheel.

The movements photographed are determined as to time by fine wire prolongations of the prongs of a tuning-fork of 50 ~ a second, which are photographed at each successive exposure, and as to distance by a divided glass scale, which equally appears in every picture. It is, of course, necessary to ensure that the fly or other insect shall traverse the field of view just at the time that exposure is made. There is no difficulty in causing the creature to fly in the right direction, as a window is sufficient to determine the line of flight. One method by which M. Bull releases the fly at the right moment is by holding it in electromagnetically-operated forceps, which are relaxed by the same current which starts the first shutter. This works well enough with ordinary flies, but hymenoptera and some other insects hesitate and only make

their flight after the exposure is completed. For such cases, M. Bull encloses them in a glass tube with a very light mica door, which is moved by the insect in its flight, and which, making a contact, sets the shutter mechanism in action.

In order to study the movements represented on the films, which in nature are far too rapid to be followed by the eye, it is merely necessary to pass them through an ordinary kinematograph, making some fifteen exposures a second instead of the 1500 or 2000 a second employed in taking the photograph, and then the movement, 100 or more times as slow, will be seen, and in many cases easily followed. Where a still greater slowing is required, M. Bull arranges to make the film appear stationary for a much larger proportion of the whole interval than is usual, and then only two or three views a second are sufficient to give an apparently continuous movement. C. V. BOYS.

## *THE TOTAL SOLAR ECLIPSE, MAY 9, 1910.*

THE following two communications from Port Davey, dated May 7 and 9 respectively, complete the account of Mr. McClean's expedition to Tasmania. In spite of the trying weather conditions, a very complete installation of instruments was successfully erected, but, as previously reported, clouds prevented their use during the eclipse.

The photographs accompanying the report were taken by Mr. H. Winkelmann, and the three here reproduced have been selected to illustrate the setting up of some of the instruments.

*Port Davey, May 7, 1910.*

"The weather since April 27 was execrable until May 4, and was not good until the following afternoon. Continuous gales, heavy rains, and floods made progress absolutely impossible, and no trustworthy tests were made before May 4. The ground became a quagmire, and the instruments were covered with rust, in spite of paraffin and oil. Rain got into the concave grating slide-holder, and the cloth began to peel off. The cœlostat mirror was badly discoloured, in spite of coverings of Japara and Willesden canvas. The siderostat mirror was also permanently fogged and slightly spotted, and in the morning, on uncovering (when possible), was covered with moisture. In addition to this, the ground shook at every footstep, and everything vibrated. The barricades proved very useful in protecting the instruments from the wind, which was so strong that during the gusts it was impossible to walk against it. On several days no coverings could be taken off, and work was at a standstill. The *Wainui*, which came in on May 1, had to take refuge in Schooner Cove on the other side of the Bathurst Channel until the following day. Our boat, which had to go over to pick up Mr. Short, from Sydney, and his instruments, could not get back, and we had to cross behind Mundy Island and land a mile across country from our camp, leaving the boat in a cove until the next day.

"On May 4, however, there were a few intervals of sunshine during the afternoon, and on May 5 the afternoon was fairly bright after a drizzling morning, while May 5 was cloudless and with a gentle breeze from the east, and much progress was made. The instruments fed by the siderostat were in accurate position, and some trial photographs were taken with the concave grating spectrograph which on development proved to be good in every way.

"Mr. Short, who arrived on May 1, has decided to feed his five-foot camera from an auxiliary mirror from the siderostat, as, with the wind that is likely to occur, it would not be steady on the equatorial mount, and on this mount have been placed his telephoto and Worthington's camera, as the latter could not be run correctly with his clock.

"Considerable difficulty had been found in driving the siderostat after about 3.15 in the afternoon, and a device had been put up to help the mirror cell arm round after that time. Owing to bad weather, no complete examination had been possible until May 7, when the mirror and cell were removed, and it was found that one of the balance-arm bearings had not sufficient play to allow the rollers to continue in contact with the cell. Filing down was tried, but there was not sufficient material to do this fully, and so the bearing was reversed. This gave considerable improvement, but before the time at which eclipse would occur it was found that the rollers reached

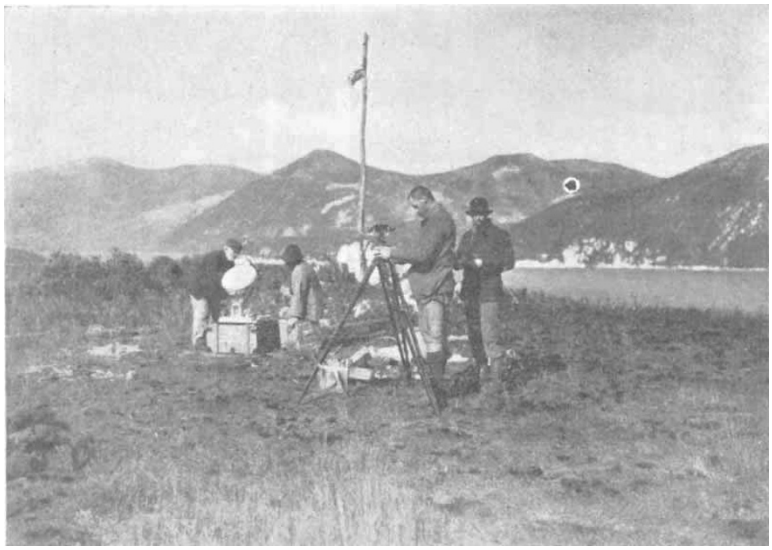


FIG. 1.—Beginning the erection of the instruments on Hixson Point. Figures from left to right—J. Brooks, F. K. McClean, A. Young, S. Dowsett.

the end of their slot, and greater power was required to drive them up the slope. Having no tools for continuing this groove, arrangements were made for a weight to be attached upwards to the cell arm, and this was found to answer; but considerable dangers of irregular drive are present in this method. An attempt was made to work the slow motions from the concave grating spectrograph, but, owing to the distance, no good results were obtained, and Mr. Dowsett was therefore placed in charge of the siderostat to follow instructions from the spectrograph, where the large image on the slit gives a quick idea of any movement either in right ascension or declination.

"Drills commenced on May 6 both separately and generally. The allocation of the instruments to the members of the party has been arranged as follows:—

| | |
|---|---|
| Siderostat ... ... ... ... | S. G. Dowsett |

*Instruments fed by siderostat.*

| | |
|---|---|
| Concave grating spectrograph ... | F. K. McClean |
| De la Rue coronagraph ... ... | A. Wilson |
| Short 5-ft. ,, ... ... | J. Short |