# A MODIFIED GREENWICH NIGHT-CLOUD RECORDER USED FOR ECOLOGICAL WORK

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(*With Plate* 10 *and* 2 *Figures in the Text*)

In the course of some work in the Entomological Department at Rothamsted on the nocturnal activity of insects, it became necessary to have a measure of the cloudiness of the sky during the night. After considerable search and enquiry it was found that an instrument for providing this information existed at the Royal Observatory, Greenwich, and had been briefly described in the *Greenwich Meteorological Observations*, 1931 (Introduction, pp. 8–9).

The principle of the machine consists in producing an image of the pole star on a photographic plate by a lens of about 18 in. focal length. As the pole star is not quite at the centre of apparent rotation of the heavens, the image so produced makes a circle on the plate of about two-thirds of an inch in diameter. The camera is opened after dark and shut before dawn to prevent fogging. If the night is clear there is an unbroken arc of the image of the star on the photographic plate; if it is cloudy there is no image; and if it is partly cloudy the image forms a broken arc. The instrument at Greenwich is a large wood box camera, using a glass "quarter-plate" each night. It is placed out of doors and the shutter of the lens is opened and closed each night at specified times by a watchman.

At Rothamsted there was no night watchman, so the opening and closing of the shutter had to be made automatic. We also made other structural alterations including the use of a small roll film camera to contain the records for 16 successive nights and an arrangement that permitted the instrument to be indoors, taking the photograph through the lower part of a sash window facing to the north. The following is a description of the modified instrument which has now been in continual use for over 2 years and has proved quite satisfactory.

In the instrument as finally constructed (see Plate 10) we used the body of a small Zeiss Ikon Box Camera (*A*) taking two photographs on each of the 8 divisions ($1\frac{3}{8} \times 2\frac{1}{2}$ in.) of a V.P.K. film (Kodak film, No. 127). The camera body was extended by means of a brass tube (*B*) to a length of 18 in. and at the end a shutter (*C*) with an 18-in. focal length spectacle lens was fitted. Beyond the shutter is an extension shading tube (*D*) fitting loosely into a guard tube (*E*) which passes through a block of wood in the window frame, represented by the scale (see also Fig. 1). The lens is stopped down to an aperture of $\frac{1}{2}$ in. (F/36). The shutter is actuated by a weight (*F*) which can be wound up each day and is controlled by an escapement (*G*). The structure of the escapement

will depend on the exact nature of the movement required for working the shutter. In the present case every alternate half rotation allowed by the escapement either opens or closes the shutter. The timing is worked by the mechanism of an alarm clock ($H$)[1] reduced by Meccano gears to a 24-hour rotation on a timing disc ($I$). On the front of this disc are two movable struts ($K$) with pegs at the end of each which actuate the escapement. The

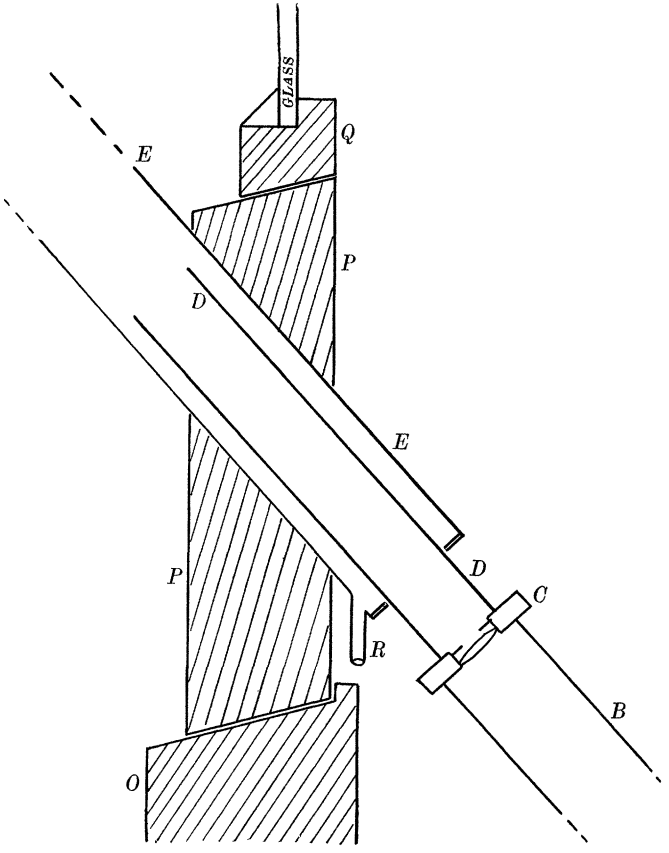



Fig. 1.

struts are tightened up by a central thumb screw. One of the pegs strikes the escapement in the late evening and allows the weight to open the shutter; and the second strikes the escapement before dawn and allows the shutter to be closed.

As the timing disc is marked with the 24 hours the pegs can be set to open and shut the shutter at any required time. A pointer ($L$) indicates the current time on the disc. The whole apparatus is fitted on a base board ($M$) which is in turn screwed to the side wall of the window.

[1] An electric synchromotor would probably be more satisfactory.

As it is not possible to see the image of the pole star on the focussing screen of the camera, two peep sights ($N_1$ and $N_2$) have been fitted. They are adjusted beforehand so that when the sun (or similar strong source of light) is in a line with them, its image is on the middle of the film. These peep sights are then sighted on the pole star on a clear night before the baseboard is screwed down, and final adjustments are made by developing one or two test films and making the necessary alterations to the screws.

Fig. 1 shows diagrammatically the method adopted for fitting the instrument to a sash-window frame. The lettering of the camera is the same as above. $O$ is the lower portion of the window frame. $P$ is a wood block about 11 by 3 in., running across the whole of the bottom of the window, through which the guard tube passes as nearly as possible at the correct angle. $Q$ is the lower window which now comes to rest on the top of the block. The way in which the inner shading tube projects into the guard tube is shown and also


Fig. 2.

the small side tube $R$ on the guard tube which allows the escape of any rain that may get in. The instrument is fixed on the extreme right of the window so that the mounting board can be screwed to that side of the window opening.

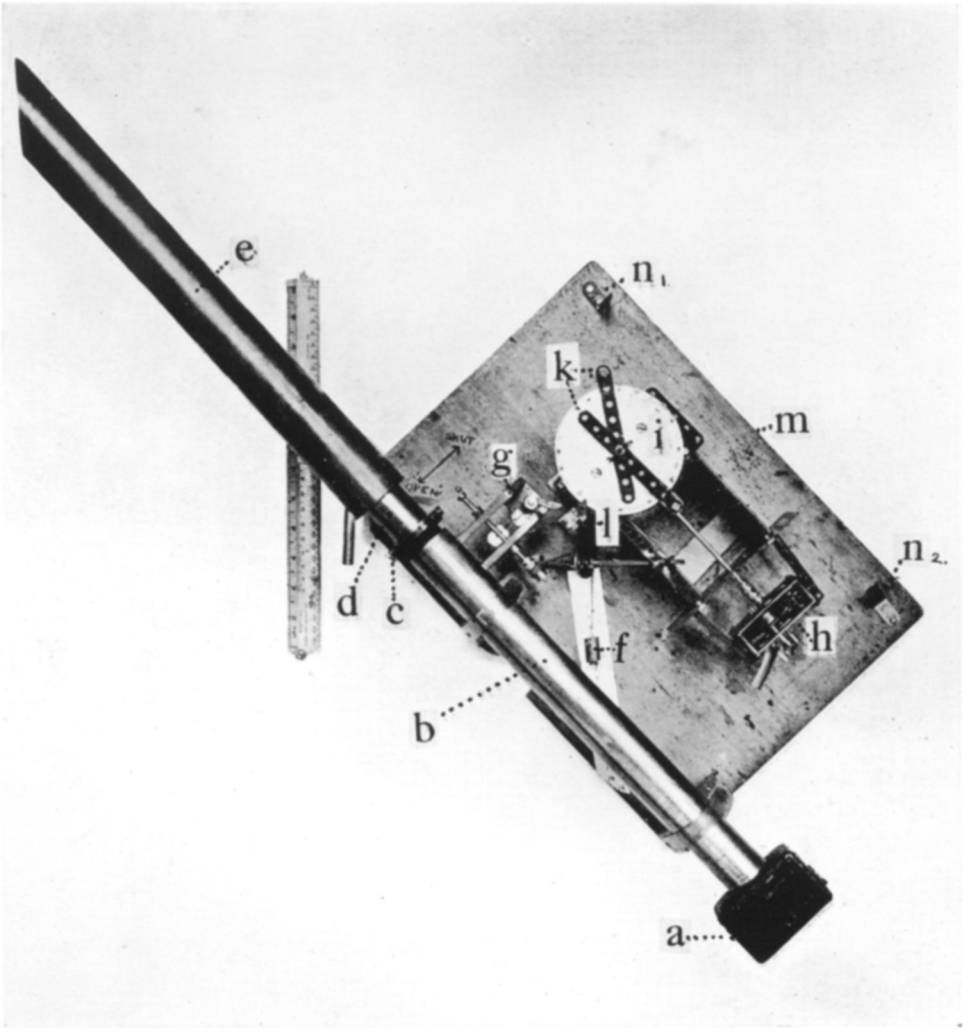
The timing of the shutter is changed every 10 days according to a table kindly supplied by Mr W. M. Witchell of Greenwich. The times are about 1 hr. 15 min. after sunset (or before sunrise) in mid-winter; falling to about 1 hr. 5 min. at the March equinox, then rising to about 1 hr. 35 min. at mid-summer and back to 1 hr. 5 min. at the September equinox.

Two typical results are shown full-size in Fig. 2. For detailed examination the film is superimposed on a photographically reduced scale, and examined with a low power microscope. It is possible to read to within a few minutes error the duration of clear and cloudy sky during the night.

General use of the results is of course based on the assumption that the sky in the neighbourhood of the pole star is a fair sample of the rest of the sky. This is reasonably correct in the latitude of London, but the instrument could not be used in the tropics where the pole star is only a few degrees above the horizon; nor, of course, is it in its present form of any value in the southern hemisphere.

## Summary

A simple instrument is described for automatically recording on a photographic film the duration of cloudiness at night over the pole star, based on one originally designed at Greenwich Observatory.




The complete instrument: for explanation see text.

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