QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

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A MINIMAL INTENSITY PHOTOMETER

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SUMMARY

A spot photometer for measurement of illumination levels at night is described and a table of foot-candles related to density measurements is presented.

I. INTRODUCTION

In the course of researches undertaken on pasture webworms (*Oncopera* spp.) and tobacco looper moth (*Plusia argentifera* Guen.) by entomologists of the Department of Primary Industries, it was found desirable to construct a meter capable of measuring light levels throughout the night.

Early experiments were conducted in a darkroom with panchromatic safe-lighting only and the results obtained by rotating a circular densitometer wedge over a 6 Volt frosted bulb confirmed the feasibility of making an extinction type photometer which would measure down towards the axial threshold sensitivity of the human eye, i.e. less than 10^{-5} foot-candles. The lowest reading recorded in the open field at night to date has been 0·000089 foot-candles, whereas the minimum calibration on the photometer reaches as low as 0·0000039. It is felt that the reserve sensitivity with its factor of over 20 to 1 will be adequate for any abnormal conditions, but additional depression of the spot intensity may easily be achieved by the addition of a further neutral density filter below the spot.

II. DESCRIPTION

In the completed unit an Eveready 549 dry battery supplies 6V to a frosted 3·8W bulb below a photoelectric cell. External terminals are provided for use with a wet cell where continuous operation is required. A 5/32 in. hole drilled in the cell is centred by means of three set screws to a 5 mm diam. opal glass which forms the comparison spot in the middle of a 60 mm matt white disc. Acrylic white undercoat was found to provide satisfactory luminosity when sprayed onto the brass disc.

To ensure that the comparison spot is always used at the same intensity, the output from the P.E. cell is raised to a constant level of 300 on the 0-500 microammeter by means of a rheostat connected across the lamp. It should be noted that it is important while reading the intensity of the illumination to place the eye vertically above the opal spot.

Modification of the transmission through the spot is achieved by rotating under it a $3\frac{1}{2}$ in. diam. circular carbon wedge. A sprung worm drive connected to the chrome knob on the right hand side of the case has its drive shaft split and coupled again by a short length of plastic tube.

The necessity of maintaining absolute light-tight conditions while the photometer is operating at night meant that all the major parts had to be accommodated on a removable lid which can be screwed down onto light-trapping rebates; hence the need for flexibility in the drive shaft.

Below the circular wedge there is a filter sector with 10 mm holes having O, 10X, and 100X neutral density multipliers, and above the wedge a plain blue daylight filter modifies the colour temperature.

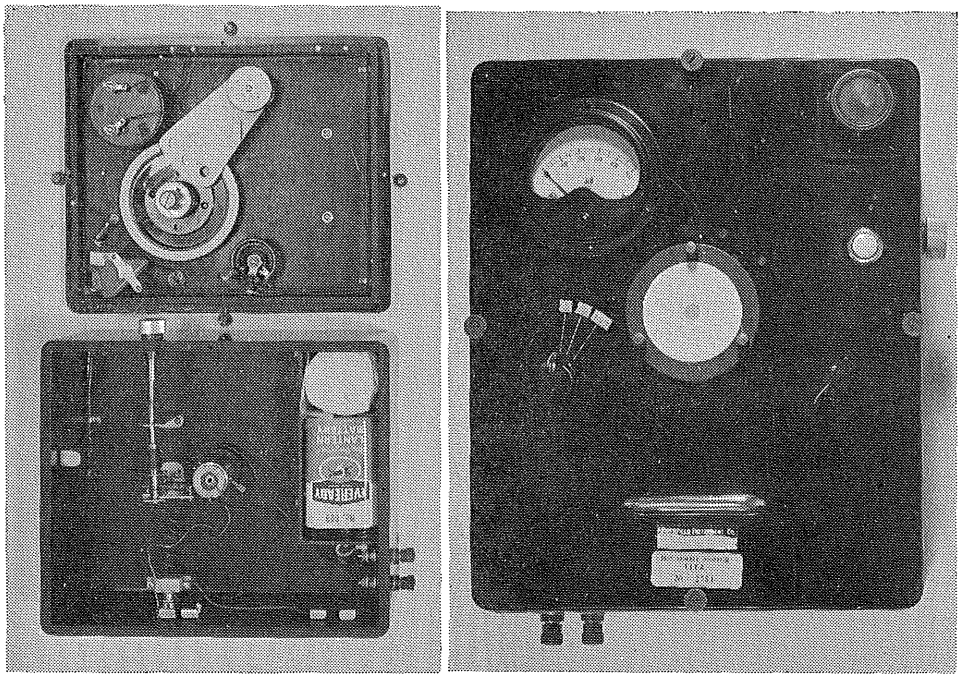

Fig. 1.—Views of the photometer.

The image of an illuminated wire registering against the scale in the densitometer wedge is erected by prisms and viewed under a magnifier, which is capped when not in use to prevent stray light affecting the spot extinction readings.

A strip indicator lamp mounted near the wire is operated only by a sprung press button switch to prevent battery drain.

The necessity of making readings before sunset led to the construction of a simple cylindrical mask having a factor of 150X. A section of aluminium irrigation pipe 4 in. long was perforated with two rows of holes backed by $\frac{1}{2}$ in. wide diffusing strips of plastic opal. The tube fits closely around the raised brass retaining ring of the matt white disc on the photometer lid, and has its upper end closed by a plate carrying the ocular tube from a microscope. An eyecapped low-power lens mounted on this tube focuses the comparison spot.

The photometer was calibrated by international standard candles and the readings checked with the S.E.I. photometer.

Accompanying photographs show an external view of the photometer and the case with lid removed to indicate the method of mounting the wedge, multiplier, prisms, rheostat and microammeter on the top panel.

Table 1 gives the illumination readings for the various densities on the circular wedge. Switching in the multiplier sector with its two neutral filters of 10X and 100X means modifying the figures by simple addition of noughts after the decimal point.

TABLE 1

DENSITY/ILLUMINATION VALUES

Density	Foot-candles	Density	Foot-candles	Density	Foot-candles
0·05	0·354	1·05	0·0354	2·05	0·00354
0·10	0·316	1·10	0·0316	2·10	0·00316
0·15	0·281	1·15	0·0281	2·15	0·00281
0·20	0·251	1·20	0·0251	2·20	0·00251
0·25	0·223	1·25	0·0223	2·25	0·00223
0·30	0·199	1·30	0·0199	2·30	0·00199
0·35	0·177	1·35	0·0177	2·35	0·00177
0·40	0·158	1·40	0·0158	2·40	0·00158
0·45	0·141	1·45	0·0141	2·45	0·00141
0·50	0·125	1·50	0·0125	2·50	0·00125
0·55	0·112	1·55	0·0112	2·55	0·00112
0·60	0·100	1·60	0·0100	2·60	0·00100
0·65	0·089	1·65	0·0089	2·65	0·00089
0·70	0·079	1·70	0·0079	2·70	0·00079
0·75	0·070	1·75	0·0070	2·75	0·000707
0·80	0·063	1·80	0·0063	2·80	0·000630
0·85	0·056	1·85	0·00562	2·85	0·000562
0·90	0·050	1·90	0·00501	2·90	0·000501
0·95	0·0446	1·95	0·00446	2·95	0·000446
1·00	0·0398	2·00	0·00398	3·00	0·000398

Zero = 0·398 foot-candles.

Density is defined as the logarithm to base 10 of the reciprocal of the transmission, i.e. $D = \log_{10} \frac{1}{T}$.

The instrument was manufactured by Greenfield Instrument Co., now Altoff Instruments, 25 York Street, Morningside, Queensland.

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