A MINIATURE LIGHT TRAP WHICH AUTOMATICALLY SEGREGATES THE CATCH INTO HOURLY SAMPLES

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INTRODUCTION. In a study of mosquito biology it is essential to know the period of the day or night when the mosquito is active. A light trap with a device which automatically partitions the catch at hourly intervals is one method of providing data on activity times. As many areas in which investigations are conducted are remote from main electricity supply, traps need to be portable and to have a low current drain so that they can operate economically from battery supplies. The trap described divides a twelve-hour catch into hourly samples, will operate for two nights from a small six volt accumulator weighing only seven pounds, packs into a space fifteen inches by fifteen inches by twelve inches, weighs ten pounds, and can be constructed for a total outlay of less than five pounds Australian for materials.

Previously described traps of the partition type could be classified in two groups—falling disc types and turntable types, with the exception of a trap described by Bast (1960) which employed a system of solenoid-actuated shutters. Falling disc types of partition apparatus, as described by Horsfall (1962), Harcourt and Cass (1958), Taylor (1951) and Johnson (1950), require a high degree of precision in manufacture which renders miniaturization difficult. Turntable types described by Hutchins (1940), Williams (1935) and Nagel and Granoushy (1947) lend themselves more readily to miniaturization.

MATERIALS AND METHODS. The apparatus (Fig. 1) consists of a light trap positioned over a mechanism which automatically changes the collecting bottle each hour.

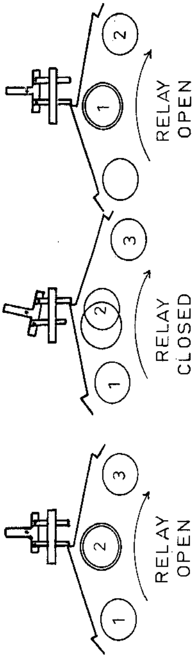
Partition Apparatus. The electrically controlled changing mechanism is of the turntable type in which a spring replaces the weight and pulley system used in larger models. The sequence of operation is illustrated in Figure 2. When the relay closes, the tube carrier advances several degrees until it is arrested by pin 2 of the escapement mechanism; when the relay opens, the carrier released by pin 2 rotates until it is stopped by pin 1, when the hole in the main plate is aligned with the next killing bottle. The operation is repeated at intervals determined by the setting of the time switch. The use of an escapement type mechanism prevents the bottle carrier from advancing more than one position for each impulse from the time clock. The device consists of a main plate (Fig. 3) made of ¼″ perspex, which carries the relay, escapement mechanism, and the main bearing on which the tube carrier rotates. The tube carrier (Fig. 4) is designed to carry twelve killing tubes, each one-and-one-quarter inches in diameter. Motive power is furnished by a spring from an alarm clock. The main bearing (Fig. 6) is the only part of the mechanism which requires accurate machining.

The escapement mechanism (Fig. 7) is activated by a 150-OHM relay with a throw of ⅛ inch.

Rain water is prevented from entering the partition apparatus by a collar of quarter-inch thick perspex cemented around the opening on the upper surface of the main plate, and by a one-inch wide strip of ⅛ inch thick perspex cemented around the edge of the main plate.

Time Switch. The time switch employed consists of an alarm clock movement with a bronze leaf soldered to the minute hand. The leaf makes contact once each hour with a brass contact attached to but insulated from the frame of the clock (Fig. 8). To ensure a posi-

Fig. 2.



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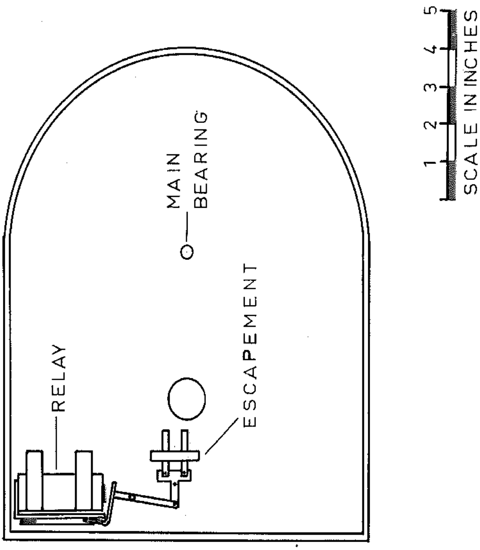
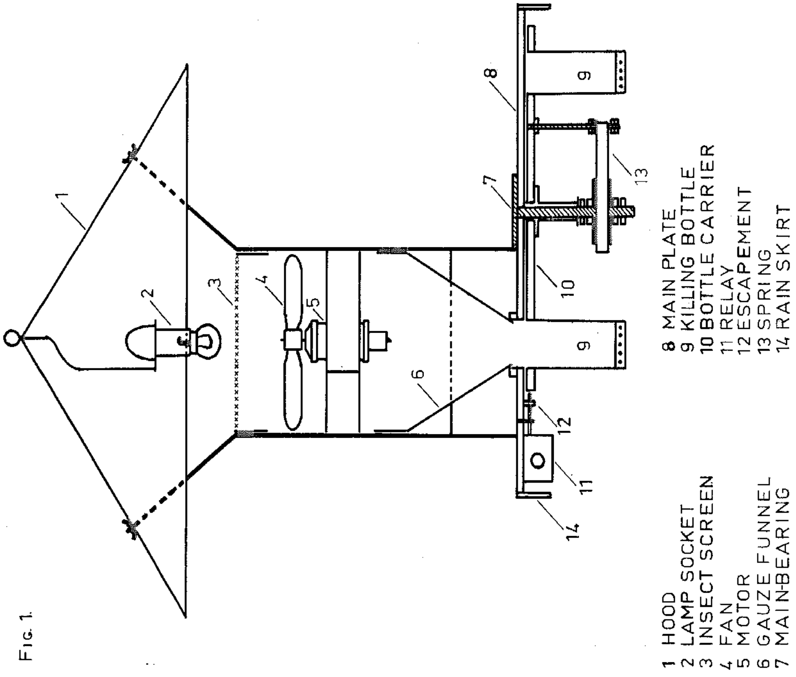
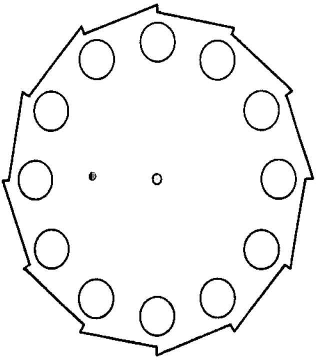


Fig. 1.





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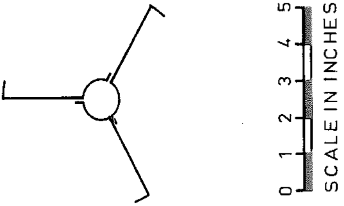

FIG. 5.

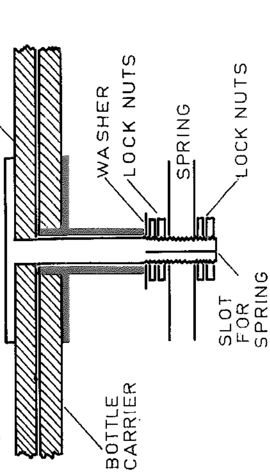

FIG. 6.

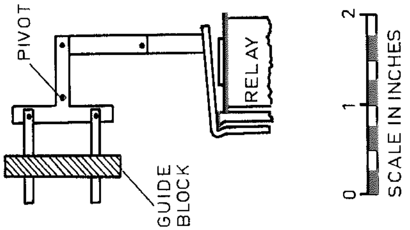

FIG. 7.

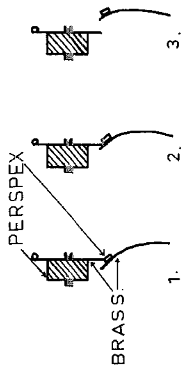

FIG. 8.

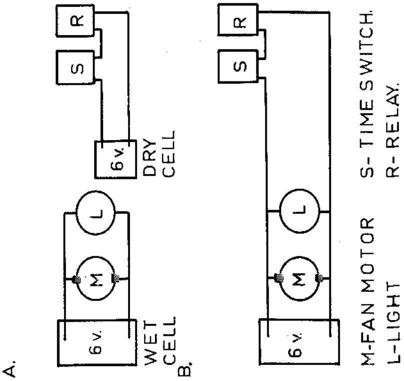

FIG. 9.

tive off-on switch action the leaf is modified according to Macfadyen and Kempson (1954). If desired a micro-switch as described by Horsfall (1962) could be substituted for the leaf contact. The clock and the 6 volt dry cell which energises the relay are fitted into a polystyrene box measuring 5″ x 8″ x 3″ which effectively weather-proofs the system. The electrical circuit is shown in Figure 9A. Figure 9B illustrates the circuit for a trap in which the escapement relay is powered by the accumulator supplying the trap motor and light.

Light Trap. The trap (Fig. 1) used with the partition apparatus is a miniature of the New Jersey type trap (Mulhern, 1942). If desired, a trap of the C.D.C. type (Sudia and Chamberlain, 1962) could be fitted with a gauze cone and used with the partition apparatus.

The main body of the trap is a seven-inch length of six-inch diameter tube of 0.018 cm thick galvanized iron. The hood is a cone of 0.022 cm thick aluminium, 15 inches in diameter and 5 inches deep. The hood is supported by 4 lengths of ⅛ inch diameter brazing rod soldered to the body of the trap. The legs which support the trap are extensions of the hood supports. The hood supports pass through holes in the hood and are secured by wing nuts, so that the hood may be readily removed for packing.

The light bulb holder is suspended by a wire screwed to the apex of the hood. The light bulb is a 6 volt, 3 watt automobile type. The screen to exclude larger insects is made of 3 mesh per inch gauze and is fitted horizontally. Mulhern (1953) recommends a vertical screen, but Barr *et al.* (1963) have shown that horizontal screens do not have such an adverse effect on the trap catch.

The motor used in the trap is a small 1½–6 volt DC permanent magnet type with ball bearing armature suspension. It appears to be similar to the "Aristorev" recommended by Sudia and Chamberlain (1962). The propeller is a model aeroplane type originally 7″ in diameter cut to fit the trap. The motor and propeller assembly are mounted on a 3-point mount (Fig. 5) made of 1 inch wide strips of sheet aluminium.

The funnel which guides the insects into the killing bottle is made of 40 mesh per inch brass gauze and has a 1″ copper strip at the upper end which allows removal for cleaning and facilitates accurate positioning within the trap.

RESULTS AND DISCUSSION. The trap described functioned without fault for twenty consecutive nights on a recent field trip to Mitchell River Mission, North Queensland (15°28′ S., 141°40′ E.). During the period nine hundred and forty-eight mosquitoes were captured, representing the following fourteen species:—*Anopheles bancroftii* Giles, *Anopheles annulipes* Walker, *Anopheles amictus hilli* Woodhill, *Ficalbia metallica* (Leicester), *Mansonia crassipes* (Van der Wulp), *Mansonia septempunctata* Theobald, *Uranotaenia albescens* Taylor, *Uranotaenia nivipes* (Theobald), *Aedes vigilax* (Skuse), *Culex annulirostris* Skuse, *Culex bitaeniorhynchus* Giles, *Culex pullus* Theobald and *Aedeomyia catasticta* Knab.

Times of capture for the three species which provide the bulk of the catch are listed in Table 1.

One striking feature of the collections was that, in contrast to the behaviour measured by human bait collections, *C. annulirostris* showed no peak of activity early in the night (Table 2). Means calculated according to Williams (1937) were used in the comparison of the two collections.

The numbers of insects taken in a light trap are influenced by 3 factors (Williams 1935)—activity, density and phototaxic response. Numerous examples of short term changes in phototaxis are quoted by Clements (1963), while Corbet (1961) presents evidence that swarming, oviposition and the acquisition of a blood meal affect the insects' response to light. Corbet expresses the opinion that a large proportion of the mosquitoes collected in light traps are engaged in non-specific locomotor activity.

The Mitchell River collections suggest

TABLE 1.—Light trap collection, Mitchell River, 1963.

Period	*Aedeomyia catasticta* No.	*Aedeomyia catasticta* %	*An. annulipes* No.	*An. annulipes* %	*C. annulirostris* No.	*C. annulirostris* %
7–8 p.m.	35	8.2	6	8.1	4	1.8
8–9 p.m.	91	21.4	9	12.2	10	4.5
9–10 p.m.	65	15.3	6	8.1	14	6.3
10–11 p.m.	24	5.4	7	9.5	16	7.2
11–12 p.m.	31	7.3	7	9.5	23	10.3
12–1 a.m.	22	5.2	7	9.5	21	9.4
1–2 a.m.	27	6.4	9	12.2	32	14.4
2–3 a.m.	39	9.2	11	4.9	25	11.2
3–4 a.m.	27	6.4	2	2.7	31	13.9
4–5 a.m.	34	8.0	9	12.2	30	13.5
5–6 a.m.	21	4.9	..	..	9	4.0
6–7 a.m.	9	2.1	1	1.4	8	3.6
Totals	425		74		223	

that host-seeking activity and the acquisition of a blood meal depress the phototaxic response. At Mitchell River *C. annulirostris* has been found to have a 72-hour gonotrophic cycle and therefore approximately 40 percent of the collection would be expected to be either gravid or freshly blood-fed. However, less than 5 percent of the catch were in these categories, suggesting that both mature ovaries and a fresh blood meal depress the phototaxic response.

Estimations of the age of mosquito populations based on the currently popular ampulla or ovariole dissections assume that there is no period of non-specific activity between oviposition and the seeking of a fresh blood meal. Davidson (1955) has found close agreement between survival rates of *Anopheles gambiae* calculated by ampulla dissections and by the immediate and delayed sporozoite rate technique, indicating that non-specific activity does not materially affect the results with this species. However, light trap collections indicate that in studies of culicine populations the duration and nature of non-specific activity must be studied. A saving in time and manpower could be effected in these studies by the use of automatic traps of the type described.

TABLE 2.—Comparison of light trap and human bait catches of *C. annulirostris*, Mitchell River, 1963.

Period	Number of mosquitoes collected: Light trap	Number of mosquitoes collected: Human bait	William's mean as %: Light trap	William's mean as %: Human bait
7–8 p.m.	4	60	1.8	20.2
8–9 p.m.	10	52	4.9	19.7
9–10 p.m.	14	23	5.6	14.4
10–11 p.m.	16	22	7.2	19.0
11–12 p.m.	23	15	9.1	10.9
12 p.m.–1 a.m.	21	8	8.4	2.9
1–2 a.m.	32	4	16.3	1.6
2–3 a.m.	25	4	11.8	2.9
3–4 a.m.	31	8	13.0	4.3
4–5 a.m.	30	2	13.0	0.7
5–6 a.m.	9	3	4.7	1.2
6–7 a.m.	8	4	4.0	2.3

SUMMARY. A miniature portable light trap which partitions the catch into hourly samples is described.

Collections made with the trap suggest that a substantial number of *C. annulirostris* are engaged in non-specific activity during the period of darkness.

ACKNOWLEDGMENTS. The author is indebted to Dr. R. L. Doherty for advice when preparing the manuscript and to Mr. W. Fergus who constructed the apparatus.

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