

ENTOMOLOGICAL STUDIES FROM A HIGH TOWER
IN MPANGA FOREST, UGANDA

XII. OBSERVATIONS ON EPHEMEROPTERA, ODONATA
AND SOME OTHER ORDERS

By PHILIP S. CORBET

(*East African Virus Research Institute, Entebbe, Uganda*)

INTRODUCTION

DURING the programme of work designed to study the activity and vertical distribution of biting Diptera in Mpanga Forest, casual observations were made on certain other orders of insects. These observations are included in the present series of papers since very little is known about the ecology of some of the groups concerned, and even less about their habits in a forest environment. The data are presented either as occurrence records, or as brief notes on habits or vertical distribution.

A description of the forest, and of the tower on which many of the observations were made, has been given in the introductory paper of this series (Part I). Certain additional facts should be mentioned here: the tower stood about 70 yards from the forest margin, and passed through the lower and upper limits of the uneven canopy at heights of about 50 and 70 feet, respectively. A small, well-shaded, forest stream passed within about 30 yards of the base of the tower. This stream was fed by a spring in the forest nearby; it was freely flowing in parts, and was typical of other streams in the forest at which collections were made. In these streams, there were some places where the turbid water was almost stationary over a bottom of leaf litter and fine silt, and others where the flow was sufficient to generate surface ripples over a bottom of coarse sand.

With the exception of the Odonata, and unless otherwise stated, all insects were collected in September and October, 1958, in mercury-vapour light-traps which were operated on the tower at ground level, 30 feet, 60 feet, 90 feet and 120 feet (Part VI). Owing to pressure of other work, collections could not be made after these months. Material was usually combined from all levels and all hours, but on a few occasions separate records were kept. Simple occurrence records are derived from the combined collections. The times recorded refer to "catch-time" in which the exact time of sunset is designated as 1800 hours (Lumsden, 1952).

EPHEMEROPTERA

All specimens were imagines.

BAËTIDAE

Procloëon rhodesiae (Barnard). 6 males, 1 female.

LEPTOPHLEBIIDAE

Adenophlebia burgeoni Navás. 7 males, 1 female. Also 1 male at 120 feet, 05-06 hours, 10.i.59.

Adenophlebioides ornatus (Ulmer). 6 males, 1 female. Also 2 males at 120 feet, 05-06 hours, 26.ix.59. Swarms were observed at 6-10 feet above the top platform on the tower (120 feet) on two mornings, each time between 0530 and 0535. Each swarm comprised two or three males, rising and falling in the typical dancing flight. From such swarms 1 male was caught on 10.i.59 and 2 males on 13.i.59.

ODONATA

Unless otherwise stated, specimens were adult and were collected over streams inside the forest during the day.

PLATYCNEMIDIDAE

Platycnemis congolensis Martin.

COENAGRIONIDAE

Pseudagrion serrulatum Karsch.

P. kibalense Longfield.

Enallagma longfieldae Fraser.

CALOPTERYGIDAE

Umma saphirina Forster. Adults of both sexes frequent paths or small gaps in the herb layer, where they settle on leaves in the sunlight. Two males were seen mutually displaying near a stream at a height of 15–20 feet in a shaft of sunlight penetrating the canopy. Adults are seldom seen near water during the day.

CHLOROCYPHIDAE

Chlorocypha straeleni Fraser.

GOMPHIDAE

Notogomphus lujai Schouteden. One mature male taken in a light-trap at 30 feet at 18–19 hours.

N. sp. Larvae found amongst leaf litter in a stream.

Paragomphus sp. probably *cognatus* Rambur. Larvae found in a stream, in a stretch where the flow was relatively fast.

AESHNIDAE

Acanthagyna bullata Karsch. A mature male found resting in heavy shade near ground level in daytime; a female seen ovipositing at about 16 hours on the vertical clay-bank of a shaded ditch about 6 inches above the water surface; several males hawking vigorously along the forest margin and in a nearby banana plantation at 17–18 hours.

A. villosa Grünberg. A mature male hawking along the forest margin at 1805; a mature male caught at 120 feet while hawking actively above the forest canopy at 1817 hours.

A. sp. probably *villosa*. An adult seen flying near the tower at 90 feet at about 1730; an adult seen flying rapidly over the tower at about 140 feet at 0542. Larvae found in a stream.

CORDULIIDAE

Phyllomacromia sylvatica Fraser. Larvae found in a stream.

LIBELLULIDAE

Tetrathemis corduliformis Longfield. Males frequent sunny situations in the herb layer, where they settle on leaves near the ground.

Notiothemis robertsi Fraser. Resembles *T. corduliformis* in habits. A mature male taken in a light-trap at ground level at 14–15 hours.

Micromacromia camerunica Karsch. Adults frequent sunny paths in forest during the day. A pair *in copula* settled on a bush at a height of about 6 feet at 14 hours.

Orthetrum hintzi Schmidt. A mature male taken in a light-trap at 30 feet at 18–19 hours.

O. julia Kirby. The commonest libellulid to be encountered in sunny situations on the forest floor. A mature male taken in a light-trap at 60 ft. at 21–22 hours; and two mature females probably of this species in light-traps at ground level at 00–01 hours, and at 30 feet at 20–21 hours. Larvae found in a stream amongst mud and leaf litter.

O. stemmale falsum Longfield. A mature female taken at ground level in forest.

LIBELLULIDAE

Hadrothemis camarensis Karsch. The only adults to be found were mature females which had been drowned in bamboo sections put out for mosquito-breeding surveys (Part IV, p. 282). These had presumably been ovipositing there, since larvae (from which adults were reared) were found in about 3 per cent. of bamboos at ground level, and also in a few on the tower up to 30 feet. It is likely that ovipositing females were drowned because the small internal diameter of the bamboo sections prevented their flying out.

H. infesta Karsch. Four mature males taken at ground level in forest.

Rhyothemis fenestrina (Rambur). On 17.ix.58 about fifty adults were seen to form a swarm-like group over the forest canopy at about 100 feet at about 15 hours. Such aggregations were frequently observed above the canopy in the mid-afternoon, or in mid-morning on sunny days. They were not seen at midday.

Pantala flavescens Fab. This migrant appears in large numbers in Uganda at certain well-defined times of year. At such times adults are common at Mpanga, hawking over open spaces or plantations outside the forest during the day and at sunset, and also high above the canopy during the day. Systematic directional movements can sometimes be discerned above the canopy.

Aethriamanta rezia Kirby. Adults, usually with immature colouring, were frequently seen perching on branches or leaves projecting from the top of the canopy.

ORTHOPTERA

BLATTIDAE

Gyna gloriosa (Stal). Adults were taken at light at 120 feet, and were also seen amongst grass in a plantation by the forest margin during the day.

TRICHOPTERA

POLYCENTROPIDIDAE

Dipseudopsis africana Ulmer.

D. capensis Walker.

HYDROPSYCHIDAE

Macronema capense var. *signatum* Walker. Adults were commonly taken at mercury-vapour light. During two catches, all males and females were recorded, the numbers of males caught at the five levels from ground level to 120 feet being 2, 1, 7, 6, 1 and of females 0, 1, 0, 1, 4. Thus both sexes were active at night, the males at all levels, and the females at least in the understorey and in and above the canopy. Males were caught in every hour from 18 to 04, except for 01; most were caught in the three hours after midnight. All the females except one were caught from 23 to 02. Nocturnal activity in this species appears to be greatest soon after midnight in and above the canopy.

Unidentified hydropsyhid larvae occurred in a forest stream.

CALAMOCERATIDAE

Anisocentropus usambarensis Ulmer. Five to ten males were observed swarming above a forest stream, at about 1730 on 31.i.58. Males were rising and falling between the water-surface and a height of about 3 feet, in a narrow passage left between emergent aquatic plants and the ground herb layer on either bank.

LEPTOCERIDAE

- Triadenodes* sp. nr. *darfurica* Mosely. 1 male, 4 females.
Oecetis aganda Mosely.
O. sp. 1 female.
Leptocerus intricatus Mosely.
Adicella sylvestris Kimmins.

SERICOSTOMATIDAE

- Goerodes turka* Mosely.
G. darfurensis Mosely.

DIPTERA

PSYCHODIDAE

- Telmatoscopus albipunctatus* Say. Six taken at ground level at 17–18 hours.
Brunettia sp. One at ground level, two at 30 feet, all at 17–18 hours.

CHAOBORIDAE

Adults were looked for, and recorded according to time and level, in all of the 15 catches made with light-traps between September, 1958 and January, 1959.

Chaoborus (Neochaoborus) anomalus Edwards. Adults, females only, were taken on only four nights. The numbers caught on the various dates, and at respective ages of the moon (given in brackets) were 227 on 25.ix.58 (13 days); 71 on 16.x.58 (5 days); 1 each on 23.x.58 (12 days) and 9.i.59 (0 days). Of the 300 taken, 288 (96.0 per cent.) were caught above the canopy, and 227 (75.7 per cent) at 120 feet. This species is very common in Lake Victoria, where it exhibits a lunar periodicity of emergence (Macdonald, 1956); it is not known to breed except in large lakes (Verbeke, 1958). The sporadic occurrence of this insect, sometimes in large numbers, above the canopy at Mpanga suggests that it was carried there by winds from Lake Victoria. At Mpanga, winds from the lake predominate at all times of the day and night (Part II, p. 266), and it is perhaps significant that on 25.ix.58 the wind was recorded as blowing from the south or south-east in every hour between midday and sunset. At Mpanga, on the tower, females were caught only between 18 and 24 hours, and there was a well-marked peak of activity at 19–20 hours.

C. (Sayomyia) ceratopogones Theobald. Three adult females were taken on three nights, namely 25.ix.58 (moon-age 13 days), 23.x.58 (12 days), and 2.i.59 (23 days). Two were caught at ground level at 18–19, and one at 30 feet at 19–20 hours. Although these records are few, this vertical distribution contrasts with that of *C. anomalus* and the two other lacustrine species, and is consistent with the finding that *C. ceratopogones* breeds in the forest itself. Larvae were found in heavily-shaded ground pools near the tower in November, 1957.

C. (S.) edulis Edwards. Two adult females were taken at 120 feet at 19–20 hours on 25.ix.58 (moon-age 13 days). This species is very abundant around the shores of Lake Victoria, in which it presumably breeds (see Macdonald, 1956). It exhibits a lunar periodicity of emergence (Corbet, 1958).

C. (S.) pallidipes Theobald. Four adult females were taken; one at 90 feet at 19–20 hours on 16.x.58 (moon-age 5 days); one at ground level at 22–23 hours on 2.x.58 (20 days); one at 90 feet at 04–05 hours, and one at ground level at 00–01 hours on 14.xi.58 (3 days). This species breeds commonly in Lake Victoria (Macdonald, 1956).

CHIRONOMIDAE

- Pentaneura (Ablabesmyia) nilotica* Kieffer.
Procladius (Procladius) albitalus Freeman.
Chironomus (Chironomus) chloronotus Kieffer.
C. (Dicrotendipes) chloronotus Kieffer.
C. (D.) multispinosus Freeman.
C. (Cryptochironomus) lindneri Freeman.
Stictochironomus festivus Kieffer.
Microtendipes taitae Kieffer.
M. bifasciatus Kieffer.
Polypedilum (Polypedilum) dewulfi Goetghebuer.
P. (P.) ephippium Freeman.
P. (P.) griseoguttatum Kieffer.
P. (P.) tropicum Kieffer.

ASILIDAE

- Promachus cornutus* (Hobby). One male and two females taken in a light-trap at 60 feet at 19–20 hours.

DISCUSSION

Apart from observations made by the Oxford University expedition to British Guiana and recorded by Hingston (1932), there seem to be few published accounts of insect behaviour above the canopy of tropical forest. In the Guiana forest, Hingston saw Odonata flying commonly around the crowns of emergent trees at heights of at least 120 feet, and recorded the occasional presence above the canopy of Ephemeroptera, Trichoptera and Chironomidae. He also described considerable activity in the canopy of other groups of insects with which the present paper is not immediately concerned.

Comparative observations which have been made inside and outside rain-forest, both horizontally (Haddow, 1945a) and vertically (Part II), indicate that the microclimatic barrier encountered by insects at the forest margin is much the same at ground level and at the top of the canopy, and further that this barrier tends to disappear at sunset. That is, the canopy is to be regarded as presenting a simple forest-edge situation, although perhaps one in which physical environmental factors are somewhat more severe during daytime than they are at ground level. Thus Schimper (quoted by Pittendrigh, 1948) recognised as a distinct community a group of epiphytes which occurred on low bushes of savannah and also at the top of the forest canopy; and Pittendrigh (1948) has shown that certain bromeliads, whose distribution is largely governed by light, occur both in the canopy and also at the forest edge near ground level.

Certain observations recorded here are in accord with this interpretation. During the daytime the insects seen above the canopy were not forest species, but those typically active in fairly open situations at ground level. *Aethriamanta rezia* was making short flights from a sunny perch above the canopy just as it does in a thicket situation near the ground; the aggregations of *Rhyothemis fenestrina* were similar to those which occur outside the forest margin at heights of 10–30 feet; and *Pantala flavescens* was flying across the canopy much as it does at about 10–15 feet over open ground.

At sunset and sunrise, as well as during the night, insects active above the canopy also include those which have come from inside the forest. The situation from which a given insect has come may sometimes be indicated by its vertical distribution, as illustrated here by the Chaoboridae.

The status of the canopy as a marginal site is well demonstrated by the crepuscular behaviour of *Acanthagyna villosa*. Adults rest inside forest or in heavily shaded sites during the day, and come out to feed in exposed places at sunset and

probably also at sunrise. This behaviour has also been observed in two species of the allied genus, *Heliaeschna*, at Zika Forest, near Entebbe, where, at sunset, hawking adults can be seen to be active at the forest edge from ground level to well above the canopy, while during the daytime they rest in deep shade inside the forest. In this connection it is also worth mentioning that the mosquito, *Mansonia metallica*, exhibits swarming activity at sunset both above the canopy (Part V, p. 290) and in open situations only about 8–10 feet above the ground. Thus further investigation may reveal that some of the other insects known to swarm above the canopy in the twilight periods, such as for instance certain Tabanidae (Part V, p. 298) and Ephemeroptera, may also do so in comparable situations near the ground outside forest.

Finally, brief mention should be made of two other findings reported here. The first concerns the capture in light-traps of Anisoptera late at night. There have been many recorded instances of Odonata being attracted to lights (*e.g.* Campos, 1931; Wright, 1944), but many have concerned individuals which arrived shortly after sunset, and which could therefore have been engaged in crepuscular feeding activity. At Mpanga, however, where hourly collections were made, we have unequivocal evidence of mature adults of *Orthetrum julia* being active as late as 00–01 hours. It is interesting to note that this dragonfly is also active in sunny situations on the forest floor during the day.

The second finding concerns the utilisation of bamboo sections by ovipositing females of *Hadrothemis camarensis*. Such behaviour is known to occur in dragonflies in the Malaysian Region (Leicester, 1903), where it has been recorded in several species (Lieftinck, 1954); but to my knowledge this habit has not previously been reported in any African dragonfly, despite the extensive work which has been undertaken using bamboo sections for mosquito larval surveys in the forests of that continent. Mellanby (1956) found dragonfly larvae in experimental containers in Nigeria, but the receptacles concerned had much wider mouths (internal diameter about 10 inches) than the bamboo sections used here (about 2 inches), and furthermore were outside forest. These observations at Mpanga suggest that *H. camarensis* (like an allied species, *H. coacta* Karsch) typically oviposits in small ground pools on the forest floor, and that this habit has enabled it to utilise uncovered receptacles of water near the ground. It is very unlikely that *H. camarensis* normally breeds in tree-holes, since it is apparently ill-adapted for ovipositing in cavities of small diameter.

ACKNOWLEDGMENTS

These records could not have been compiled without the willing assistance of the specialists who identified material for me. It is a pleasure to acknowledge their help: Ephemeroptera and Trichoptera: Mr. D. E. Kimmins; Odonata: Miss Cynthia Longfield and Mr. E. C. G. Pinhey; Orthoptera: Dr. D. R. Ragge; Diptera: Psychodidae and Chironomidae: Dr. P. Freeman; Asilidae: Mr. H. Oldroyd. In addition, Dr. J. Verbeke kindly confirmed identifications of Diptera: Chaoboridae.

SUMMARY

1. At Mpanga Forest casual observations were made on several groups of insects including Ephemeroptera, Odonata, Trichoptera and Diptera (Chaoboridae and Chironomidae). Observations were made from ground level to a height of 120 feet, about 50 feet above the top of the canopy.

2. Activities described include: swarming (Ephemeroptera, Trichoptera); crepuscular feeding (Odonata); nocturnal flight (Odonata, Trichoptera, Chaoboridae); and oviposition in small containers (Odonata).

3. The observations reported support the view that, from a microclimatic point of view, the canopy is similar to the forest margin near the ground.

REFERENCES

- ALLEE, W. C., 1926, Measurement of environmental factors in the tropical rain-forest of Panama. *Ecology* **7** : 273-302.
- AURIVILLIUS, C., 1925, *The African Rhopalocera*, in Seitz, A. *The Macrolepidoptera of the World*. **13**. Stuttgart.
- BAILEY, N. S., 1948, The hovering and mating of Tabanidae ; a review of the literature with some original observations. *Ann. ent. Soc. Amer.* **41** : 403-12.
- BATES, M., 1941, Laboratory observations on the sexual behaviour of Anopheline mosquitoes. *J. exp. Zool.* **86** : 153-73.
- 1944, Observations on the distribution of diurnal mosquitoes in a tropical forest. *Ecology* **25** : 159-70.
- 1947, The development and longevity of *Haemagogus* mosquitoes under laboratory conditions. *Ann. ent. Soc. Amer.* **40** : 1-12.
- BLANTON, F. S., GALINDO, P. and PEYTON, E. L., 1955, Report of a three year light trap survey for biting Diptera in Panama. *Mosq. News* **15** : 90-3.
- BLICKLE, R. L., 1959, Observations on the hovering and mating of *Tabanus bishoppi* Stone (Diptera, Tabanidae). *Ann. ent. Soc. Amer.* **52** : 183-90.
- BOSHELL-MANRIQUE, J. and OSORNO-MESA, E., 1944, Observations on the epidemiology of jungle fever in Santander and Boyaca, Columbia, September 1941 to April 1942. *Amer. J. Hyg.* **40** : 170-81.
- BRADLEY, G. H. and MCNEEL, T. E., 1935, Mosquito collections in Florida with the New Jersey Light Trap. *J. econ. Ent.* **28** : 780-6.
- BREEV, K., 1958, The use of ultra-violet light-traps for determining the fauna and ratio of species of mosquitoes. *Acad. Sci. U.S.S.R., Moscow (Symp. Parasit.)* **18** : 219-38.
- BUXTON, P. A. and HOPKINS, G. H. E., 1927, Researches in Polynesia and Melanesia. Entomology. *Lond. Sch. Hyg. trop. Med.*, Mem. No. 1 : xii + 260.
- CAMBOURNAC, F. J. C. and HILL, R. B., 1940, Observation on the swarming of *Anopheles maculipennis* var. *atroparvus*. *Amer. J. trop. Med.* **20** : 133-40.
- CAMPOS, R., 1931, La luz electrica y su influencia en los Odonatos. *Rev. del. Colegio Nacional Vicente Rocafuerte, Ecuador* **13** : 3-5.
- CHRISTOPHERS, S. R., 1911, The development of the egg follicle in anophelines. *Paludism* **2** : 73-88.
- COLLESS, D. H., 1956, The *Anopheles leucosphyrus* group. *Trans. R. ent. Soc. Lond.* **108** : 37-116.
- 1958, Recognition of individual nulliparous and parous mosquitoes. *Trans. R. Soc. trop. Med. Hyg.* **52** : 187.
- CORBET, P. S., 1958, Lunar periodicity of aquatic insects in Lake Victoria. *Nature, Lond.* **182** : 330-1.
- 1959a, Recognition of individual nulliparous and parous mosquitoes. *Trans. R. Soc. trop. Med. Hyg.* **53** : 297.
- 1959b, Age-grading by external characters in mosquitoes. *E.A. Virus Res. Inst. Ann. Rep.* No. 9, 1958-9 : 36-7. Nairobi. (Govt. Printer.)
- 1960a, Recognition of nulliparous mosquitoes without dissection. *Nature, Lond.* **187** : 525-6.
- 1960b, Patterns of circadian rhythms in insects. *Cold Spring Harbor Sympos. quant. Biol.* **25** : 357-60.
- and HADDOW, A. J., 1961, Observations on nocturnal flight activity in some African Culicidae (Diptera). *Proc. R. ent. Soc. Lond.* (A) **36** : 113.
- and TJØNNELAND, A., 1955, The flight activity of twelve species of East African Trichoptera. *Univ. Bergen Arbök. nat.* **1955** (9) : 1-49.
- CRAIG, W., 1944, The twilight ceremonies of horse-flies and birds. *Science* **99** : 125-6.
- CROSSKEY, R. W., 1958, The body weight in unfed *Simulium damnosum* Theobald, and its relation to the time of biting, the fat-body and age. *Ann. trop. Med. Parasit.* **52** : 149-57.
- CROXTON, F. E. and COWDEN, D. J., 1948, *Applied general statistics*. New York.

- DAUBNEY, R. and HUDSON, J. R., 1931, Enzootic hepatitis or Rift Valley fever; undescribed virus disease of sheep cattle and man from East Africa (with an account of an experimental inoculation of man by P. C. Garnham). *J. Path. Bact.* **34** : 545-79.
- DAVIES, L., 1957, A study of the age of females of *Simulium ornatum* Mg. (Diptera) attracted to cattle. *Bull. ent. Res.* **48** : 535-52.
- DETINOVA, T. S., 1945, Determination of the physiological age of the females of *Anopheles* by the changes in the tracheal system of the ovaries. *Med. Parasit.* **14** : 45-9. [In Russian : seen in *Rev. appl. Ent. (B)* **34** : 180.]
- 1959, *Age grouping Methods in Diptera of medical importance*. Course in Advanced Entomological Techniques. World Health Organization, WHO/Mal./238. London.
- DOWNES, J. A., 1950, Habits and life-cycle of *Culicoides nubeculosus* Mg. *Nature, Lond.* **166** : 510-11.
- 1955, Observations on the swarming flight and mating of *Culicoides* (Diptera : Ceratopogonidae). *Trans. R. ent. Soc. Lond.* **106** : 213-36.
- 1958, Assembly and mating in the biting Nematocera. *Proc. Xth Int. Congr. Ent.* **2** : 425-34.
- DUKE, B. O. L., 1955a, Studies on the biting habits of *Chrysops*. I. The biting-cycle of *Chrysops silacea* at various heights above the ground in the rain-forest at Kumba, British Cameroons. *Ann. trop. Med. Parasit.* **49** : 193-202.
- 1955b, Studies on the biting habits of *Chrysops*. II. The effect of wood fires on the biting density of *Chrysops silacea* in the rain-forest at Kumba, British Cameroons. *Ibid.* **49** : 260-72.
- 1958, Studies on the biting habits of *Chrysops*. V. The biting-cycles and infection rates of *C. silacea*, *C. dimidiata*, *C. langi* and *C. centurionis* at canopy level in the rain-forest at Bombe, British Cameroons. *Ibid.* **52** : 24-35.
- 1959, Studies on the biting habits of *Chrysops*. VI. A comparison of the biting habits, monthly biting densities and infection rates of *C. silacea* and *C. dimidiata* (Bombe form) in the rain-forest at Kumba, Southern Cameroons, U.U.K.A. *Ibid.* **53** : 203-14.
- and WIJERS, D. J. B., 1958, Studies on loiasis in monkeys. I. The relationship between human and simian *Loa* in the rain-forest zone of the British Cameroons. *Ibid.* **52** : 158-75.
- DUNN, L. H., 1926, Mosquitoes bred from dry material taken from holes in trees. *Bull. ent. Res.* **17** : 183-7.
- 1927a, Mosquito breeding in "test" water-containers. *Ibid.* **18** : 17-22.
- 1927b, Tree-holes and mosquito-breeding in West Africa. *Ibid.* **18** : 139-44.
- 1927c, Observations on the oviposition of *Aedes aegypti* Linn., in relation to distance from habitations. *Ibid.* **18** : 145-8.
- EDMUNDS, G. F., NIELSEN, L. T. and LARSEN, J. R., 1956, The life-history of *Ephoron album* (Say) (Ephemeroptera : Polymitarcidae). *Wassmann J. Biol.* **14** : 145-53.
- EVANS, G. C., 1939, Ecological studies on the rain forest of southern Nigeria. II. The atmospheric environmental conditions. *J. Ecol.* **27** : 436-82.
- FISHER, R. A., CORBET, A. S. and WILLIAMS, C. B., 1943, The relation between the number of species and the number of individuals in a random sample of an animal population. *J. anim. Ecol.* **12** : 42-58.
- FRASER DARLING, F., 1938, *Bird flocks and the breeding cycle*. Cambridge (Univ. Press).
- FRISCH, K. VON, 1948, *Aus dem Leben der Bienen*. 4th ed. Berlin and Vienna.
- FROHNE, W. C., 1959, Predation of dance flies (Diptera : Empididae) upon mosquitoes in Alaska, with special reference to swarming. *Mosq. News* **19** : 7-11.
- FROST, S. W., 1958, Traps and lights to catch night-flying insects. *Proc. Xth Int. Congr. Ent.* **2** : 583-7.
- GALINDO, P., 1958, Bionomics of *Sabethes chloropterus* Humboldt, a vector of sylvan yellow fever in Middle America. *Amer. J. trop. Med. Hyg.* **7** : 429-40.
- CARPENTER, S. J. and TRAPIDO, H., 1951, Ecological observations on forest mosquitoes of an endemic yellow fever area in Panama. *Ibid.* **31** : 98-137.
- GARNHAM, P. C. C., HARPER, J. O. and HIGHTON, R. B., 1946, The mosquitoes of the Kaimosi Forest, Kenya Colony, with special reference to yellow fever. *Bull. ent. Res.* **36** : 473-96.
- GERMAIN, R. and EVRARD, C., 1956, Etude écologique et phytosociologique de la forêt à *Brachystegia laurentii*. *Pub. Inst. nat. Et. Agr. Congo Belge, Ser. Sc.* **67**.

- GIBSON, N. H. E., 1942, Mating swarms in a Chironomid, *Spaniotoma minima*. *Nature, Lond.* **150** : 268.
- GILLET, J. D., 1946, Notes on the subgenus *Coquillettidia* Dyar (Diptera, Culicidae). *Bull. ent. Res.* **36** : 425-38.
- 1955, Behaviour differences in two strains of *Aedes aegypti*. *Nature, Lond.* **176** : 124.
- 1957, Age analysis of the biting-cycle of the mosquito *Taeniorhynchus* (*Mansonioides*) *africanus* Theobald, based on the presence of parasitic mites. *Ann. trop. Med. Parasit.* **51** : 151-8.
- 1958, Laboratory colonisation of the mosquito *Eretmapodites chrysogaster* Grah. *Bull. ent. Res.* **49** : 287-90.
- 1961, Laboratory observations on the life-history and ethology of *Mansonia* mosquitoes. *Ibid.* **52** : 23-30.
- CORBET, P. S. and HADDOW, A. J. (*in press*), Observations on the oviposition cycle of *Aedes* (*Stegomyia*) *aegypti* (Linnaeus). VI. *Ann. trop. Med. Parasit.*
- HADDOW, A. J. and CORBET, P. S., 1959, Observations on the oviposition-cycle of *Aedes* (*Stegomyia*) *aegypti* (Linnaeus). II. *Ibid.* **53** : 35-41.
- GILLIES, M. T., 1954, The recognition of age-groups within populations of *Anopheles gambiae* by the pre-gravid rate and the sporozoite rate. *Ibid.* **48** : 58-74.
- 1957, Age-groups and the biting-cycle in *Anopheles gambiae*. A preliminary investigation. *Bull. ent. Res.* **48** : 553-9.
- GLICK, P. A., 1939, The distribution of insects, spiders and mites in the air. *Tech. Bull. U.S. Dep. Agric.* **673**.
- HACKETT, L. W. and BATES, M., 1936, Swarming of the males of certain European anophelines in captivity. *Nature, Lond.* **138** : 506.
- HADAWAY, A. B., 1950, Observations on mosquito behaviour in native huts. *Bull. ent. Res.* **41** : 63-78.
- HADDOW, A. J., 1942, The mosquito fauna and climate of native huts at Kisumu, Kenya. *Ibid.* **33** : 91-142.
- 1945a, The mosquitoes of Bwamba County, Uganda. II. Biting activity with special reference to the influence of microclimate. *Ibid.* **36** : 33-73.
- 1945b, The mosquitoes of Bwamba County, Uganda. III. The vertical distribution of mosquitoes in a banana plantation and the biting-cycle of *Aedes* (*Stegomyia*) *simpsoni* Theo. *Ibid.* **36** : 297-304.
- 1946, The mosquitoes of Bwamba County, Uganda. IV.—Studies on the genus *Eretmapodites* Theobald. *Ibid.* **37** : 57-82.
- 1948, The mosquitoes of Bwamba County, Uganda. VI.—Mosquito breeding in plant axils. *Ibid.* **39** : 185-212.
- 1952, Further observations on the biting-habits of Tabanidae in Uganda. *Ibid.* **42** : 659-74.
- 1954, Studies of the biting habits of African mosquitoes. An appraisal of methods employed, with special reference to the twenty-four-hour catch. *Ibid.* **45** : 199-242.
- 1956a, Rhythmic biting activity of certain East African mosquitoes. *Nature, Lond.* **177** : 531-2.
- 1956b, Observations on the biting-habits of African mosquitoes in the genus *Eretmapodites* Theobald. *Bull. ent. Res.* **46** : 761-72.
- 1960, Studies on the biting habits and medical importance of East African mosquitoes in the genus *Aedes*. I.—Subgenera *Aedimorphus*, *Banksinella* and *Dunninus*. *Ibid.* **50** : 759-79.
- and CORBET, P. S., 1960, Observations on nocturnal activity in some African Tabanidae (Diptera). *Proc. R. ent. Soc. Lond.* (A) **35** : 1-5.
- — and GILLET, J. D., 1960, Laboratory observations on the oviposition-cycle in the mosquito *Aedes* (*Stegomyia*) *apicoargenteus* Theobald. *Ann. trop. Med. Parasit.* **54** : 392-6.
- and DICK, G. W. A., 1948, Catches of biting Diptera in Uganda, with anaesthetised monkeys as bait. *Ibid.* **42** : 271-7.
- — LUMSDEN, W. H. R. and SMITHBURN, K. C., 1951, Monkeys in relation to the epidemiology of yellow fever in Uganda. *Trans. R. Soc. trop. Med. Hyg.* **45** : 189-224.
- and GILLET, J. D., 1957, Observations on the oviposition-cycle of *Aedes* (*Stegomyia*) *aegypti* (Linnaeus). *Ann. trop. Med. Parasit.* **51** : 159-69.

- HADDOW, A. J. and GILLETT, J. D., 1958, Laboratory observations on the oviposition-cycle in the mosquito *Taeniorhynchus (Coquillettidia) fuscopennata* Theobald. *Ibid.* **52**: 320-5.
- — — and CORBET, P. S., 1959, Laboratory observations on pupation and emergence in the mosquito *Aedes (Stegomyia) aegypti* (Linnaeus). *Ann. trop. Med. Parasit.* **53**: 123-31.
- — — — 1961, Observations on the oviposition-cycle of *Aedes (Stegomyia) aegypti* (Linnaeus). *V. Ibid.* **55**: 343-56.
- — — and HIGHTON, R. B., 1947, The mosquitoes of Bwamba County, Uganda. V. The vertical distribution and biting cycle of mosquitoes in rain-forest, with further observations on microclimate. *Bull. ent. Res.* **37**: 301-30.
- — — MAHAFFY, A. F. and HIGHTON, R. B., 1950, Observations on the biting-habits of some Tabanidae in Uganda, with special reference to arboreal and nocturnal activity. *Ibid.* **41**: 209-21.
- — — VAN SOMEREN, E. C. C., LUMSDEN, W. H. R., HARPER, J. O. and GILLETT, J. D., 1951, The mosquitoes of Bwamba County, Uganda. VIII.—Records of occurrence, behaviour and habitat. *Ibid.* **42**: 207-38.
- HALBERG, F., HALBERG, E., BARNUM, C. P. and BITTNER, J., 1959, Physiologic 24-hour periodicity in human beings and mice, the lighting regimen and daily routine. In Withrow, Photoperiodism and related phenomena in plants and animals. *Amer. Assn. Adv. Sci.*, Pub. No. 55.
- HARKER, J. E., 1958, Diurnal rhythms in the animal kingdom. *Biol. Rev.* **32**: 1-52.
- HARPER, J. O., 1944, Notes on the swarming of males of *A. funestus* (Giles) in East Africa. *E. A. med. J.* **21**: 150-1.
- HARRIS, W. V., 1942, Notes on Culicine mosquitoes in Tanganyika Territory. *Bull. ent. Res.* **33**: 181-93.
- HASEMAN, L., 1943, The courting flights of tabanids. *Science* **97**: 285-6.
- HAYES, R. O., 1958, Observations on the swarming of *Culiseta melanura* (Coquillett.). *Mosq. News* **18**: 70-3.
- HEADLEE, T. J., 1928, The development of mechanical apparatus for detecting the presence of mosquitoes in various localities. *Proc. N.J. Mosq. Ext. Assn.* **15**: 160-8.
- — — 1932, The development of mechanical equipment for sampling the mosquito fauna and some results of its use. *Ibid.* **19**: 106-28.
- HEARLE, E., 1929, The life-history of *Aedes flavescens* Müller. *Trans. R. Soc. Canada* **23**: 85-101.
- HINE, J. S., 1960, Habits and life-histories of some flies of the family Tabanidae. *U.S. Dept. Agr. Bur. Ent. Tech. Bull.* **12**.
- HINGSTON, R. W. G., 1932, *A naturalist in the Guiana Forest*. New York. pp. xvi + 384.
- HOPKINS, B., 1960, Rainfall interception by a tropical forest in Uganda. *E.A. agric. J.* **25**: 255-8.
- HOPKINS, G. H. E., 1952, *Mosquitoes of the Ethiopian Region*. I.—*Larval bionomics of mosquitoes and taxonomy of culicine larvae*. London: Brit. Mus. (Nat. Hist.). pp. viii + 355.
- HORSFALL, W. H., 1943, Some responses of the malaria mosquito to light. *Ann. ent. Soc. Amer.* **36**: 41-45.
- — — 1955, *Mosquitoes. Their bionomics and relation to disease*. London.
- JOHNSON, C. G., 1953, The aerial dispersal of aphids. *Discovery* **14**: 19-22.
- KENNEDY, C. H., 1925, The distribution of certain insects of reversed behavior. *Biol. Bull.* **48**: 390-401.
- KENNEDY, J. S., 1940, The visual responses of flying mosquitoes. *Proc. zool. Soc. Lond.* (A) **109**: 221-42.
- KERR, J. A., 1933, Studies on the abundance, distribution and feeding habits of some West African mosquitoes. *Bull. ent. Res.* **24**: 493-510.
- KUMM, H. W. and NOVIS, O., 1938, Mosquito studies on the Ilha de Marajo, Para, Brazil. *Amer. J. Hyg.* **27**: 498-515.
- — — OSORNO-MESA, E. and BOSHELL-MANRIQUE, J., 1946, Studies on mosquitoes of the genus *Haemagogus* in Colombia (Diptera, Culicidae). *Amer. J. Hyg.* **43**: 13-28.
- LAARMAN, J. J., 1958, Research on the ecology of Culicine mosquitoes in a forest region of the Belgian Congo. *Acta Leidensia* **28**: 94-98.

- LEICESTER, G. F., 1903, A breeding place of certain forest mosquitoes in Malaya. *J. trop. Med.* **6** : 291-2.
- LEWIS, D. J., 1943, Mosquitoes in relation to yellow fever in the Nuba Mountains, Anglo-Egyptian Sudan. *Ann. trop. Med. Parasit.* **37** : 65-76.
- 1953, *Simulium damnosum* and its relation to onchocerciasis in the Anglo-Egyptian Sudan. *Bull. ent. Res.* **43** : 597-644.
- 1956a, Biting times of parous and nulliparous *Simulium damnosum*. *Nature, Lond.* **178** : 98-9.
- 1956b, The anopheline mosquitoes of the Sudan. *Bull. ent. Res.* **47** : 475-94.
- 1958, Observations on *Simulium damnosum* Theobald at Lokoja in Northern Nigeria. *Ann. trop. Med. Parasit.* **52** : 216-31.
- LIEFTINCK, M. A., 1954, Handlist of Malaysian Odonata. *Treubia* **22** (Suppl.). xiii + 202.
- LOVE, G. J. and SMITH, W. W., 1957, Preliminary observations on the relation of light trap collections to mechanical sweep net collections in sampling mosquito populations. *Mosq. News* **17** : 9-14.
- LOVERIDGE, A., 1942, Scientific results of a fourth expedition to forested areas in East and Central Africa. *Bull. Mus. comp. Zool.* **91** : 237-73.
- LUMSDEN, W. H. R., 1952, The crepuscular biting-activity of insects in the forest canopy in Bwamba, Uganda; a study in relation to the sylvan epidemiology of yellow fever. *Bull. ent. Res.* **42** : 721-60.
- 1955, Entomological studies, relating to yellow fever epidemiology, at Gede and Taveta, Kenya. *Ibid.* **46** : 149-83.
- 1957, The activity cycle of domestic *Aedes (Stegomyia) aegypti* (L.) (Dipt. Culicid.) in Southern Province, Tanganyika. *Ibid.* **48** : 769-82.
- MACCREARY, D., 1940, Report on the Tabanidae of Delaware. *Bull. Delaware agric. Exp. Sta.* **226** : 1-41.
- 1941, Comparative density of mosquitoes at ground level and at an elevation of approximately one hundred feet. *J. econ. Ent.* **34** : 174-79.
- MACDONALD, W. W., 1956, Observations on the biology of chaoborids and chironomids in Lake Victoria and on the feeding habits of the "elephant-snout fish" (*Mormyrus kannume* Forsk.). *J. anim. Ecol.* **25** : 36-53.
- MCCLELLAND, G. A. H., 1959, Observations on the mosquito, *Aedes (Stegomyia) aegypti* (L.), in East Africa. I.—The biting cycle in an outdoor population at Entebbe, Uganda. *Bull. ent. Res.* **50** : 227-35.
- and WEITZ, B., 1960, Further observations on the natural hosts of three species of *Mansonia* Blanchard (Diptera, Culicidae) in Uganda. *Ann. trop. Med. Parasit.* **54** : 300-4.
- MARSHALL, J. F., 1938, *The British Mosquitoes*. London: Brit. Mus. (Nat. Hist.).
- and STALEY, J., 1929, A newly observed reaction of certain species of mosquitoes to the bites of larval hydrachnids. *Parasitology* **21** : 158-60.
- MATTINGLY, P. F., 1949a, Studies on West African forest mosquitoes. Part I.—The seasonal distribution, biting cycle and vertical distribution of four of the principal species. *Bull. ent. Res.* **40** : 149-68.
- 1949b, Studies on West African forest mosquitoes. Part II.—The less commonly occurring species. *Ibid.* **40** : 387-402.
- MELLANBY, K., 1956, Mosquito populations at Ibadan in Nigeria. *Ibid.* **47** : 125-36.
- MUIRHEAD THOMSON, R. C., 1948, Studies on *Anopheles gambiae* and *A. melas* in and around Lagos. *Bull. ent. Res.* **38** : 527-58.
- MULHERN, T. D., 1934, A new development in mosquito traps. *Proc. N.J. Mosq. Ext. Assn.* **21** : 137-40.
- 1942, New Jersey mechanical trap for mosquito surveys. *Circ. N.J. agric. Exp. Sta.* **421** : 1-8.
- NIELSEN, E. T., 1958, The method of ethology. *Proc. Xth Int. Congr. Ent.* **2** : 563-5.
- and GREVE, A., 1950, Studies on the swarming habits of mosquitoes and other Nematocera. *Bull. ent. Res.* **41** : 227-58.
- and HAEGER, J. S., 1954, Pupation and emergence in *Aedes taeniorhynchus* (Wied.) *Ibid.* **45** : 757-68.
- 1960, Swarming and mating in mosquitoes. *Misc. Pub. ent. Soc. Amer.* **1** : 71-95.

- NIELSEN, E. T. and NIELSEN, A. T., 1953, Field observations on the habits of *Aedes taeniorhynchus*. *Ecology* **34** : 141-56.
- — 1958, Observations on Mosquitoes in Iraq. *Ent. Medd.* **28** : 282-321.
- OLDROYD, H., 1954, *The horse-flies of the Ethiopian Region*. II. London : Brit. Mus. (Nat. Hist.). pp. x + 341.
- PARKER, A. H., 1949, Observations on the seasonal and daily incidence of certain biting midges (*Culicoides* Latreille—Diptera, Ceratopogonidae) in Scotland. *Trans. R. ent. Soc. Lond.* **100** : 179-90.
- PETERSON, D. G. and WOLFE, L. S., 1958, The biology and control of black flies (Diptera : Simuliidae) in Canada. *Proc. Xth Int. Cong. Ent.* **3** : 551-64.
- PHILIP, C. B., 1933, Mosquito species breeding in "test" water containers in West Africa. *Bull. ent. Res.* **24** : 483-91.
- PITTEDRIGH, C. S., 1948, The Bromeliad—*Anopheles*—Malaria complex in Trinidad. I.—The Bromeliad flora. *Evolution* **2** : 58-89.
- 1950a, The ecoclimatic divergence of *Anopheles bellator* and *A. homunculus*. *Ibid.* **4** : 43-63.
- 1950b, The ecotopic specialisation of *Anopheles homunculus* and its relation to competition with *A. bellator*. *Ibid.* **4** : 64-78.
- PRATT, H. D., 1944, Studies on the comparative attractiveness of 25-, 50-, and 100-watt bulbs for Puerto Rican *Anopheles*. *Mosq. News* **4** : 17-22.
- PROVOST, M. W., 1952, The dispersal of *Aedes taeniorhynchus*. I. Preliminary studies. *Ibid.* **12** : 174-90.
- 1958, Mating and male swarming in *Psorophora* mosquitoes. *Proc. Xth Int. Congr. Ent.* **2** : 553-61.
- RABINOWITSCH, E. I., 1951, *Photosynthesis and related processes*. II (1). New York.
- RAO, V. V., ROY, B. B. and RAO, P. J., 1942, Observations on the swarming of *A. sundaicus* (Rodenwaldt) and *A. subpictus* (Grassi). *J. Malar. Inst. India* **4** : 405-8.
- RAO, T. R. and RUSSELL, P. F., 1938, Some field observations on the swarming and pairing of mosquitoes, particularly *A. annuloris*, in South India. *Ibid.* **1** : 395-403.
- — 1942, On the swarming, mating and ovipositing behaviour of *Anopheles culicifacies*. *Amer. J. trop. Med.* **22** : 417-27.
- RAY, J., 1710, *Historia insectorum*. London.
- RICHARDS, P. W., 1952, *The tropical rain-forest, an ecological study*. Cambridge (Univ. Press). pp. xviii + 450.
- ROBINSON, H. S. and ROBINSON, P. J. M., 1950, Some notes on the observed behaviour of Lepidoptera in flight in the vicinity of light-sources together with a description of a light-trap designed to take entomological samples. *Ent. Gaz.* **1** : 3-20.
- ROEDER, K. D. (Ed.), 1953, *Insect Physiology*. New York and London.
- ROTH, L. M., 1948, A study of mosquito behaviour. An experimental study of the sexual behaviour of *Aedes aegypti* (Linnaeus). *Amer. Midl. Nat.* **40** : 265-352.
- SAUBERER, F. and HÄRTEL, O., 1959, *Pflanze und Strahlung*. Leipzig.
- SEITZ, A. (Ed.), 1930, *The Macrolepidoptera of the World*. **14**. *The African Bombyces and Sphinges*. Stuttgart.
- SENIOR WHITE, R. A., 1953, On the evening biting activity of three neotropical *Anopheles* in Trinidad, British West Indies. *Bull. ent. Res.* **43** : 451-60.
- LEWIS, G. and LEE, P., 1953, On swarming and mating in *Anopheles aquasalis* Curry. *Ibid.* **44** : 163-73.
- SHANNON, R. C., 1931a, The environment and behaviour of some Brazilian mosquitoes. *Proc. ent. Soc. Wash.* **33** : 1-27.
- 1931b, On the classification of Brazilian Culicidae with special reference to those capable of harboring the yellow fever virus. *Ibid.* **33** : 125-57.
- SNOW, W. E., 1955, Feeding activities of some blood-sucking Diptera with reference to vertical distribution in bottomland forest. *Ann. ent. Soc. Amer.* **48** : 512-21.
- and CORBET, P. S., 1959, Studies on movements of mosquitoes at sunset. *E. A. Virus Res. Inst. Ann. Rep.* No. 9, 1958-59 : 38-9. Nairobi (Govt. Printer).
- STONE, A., KNIGHT, K. L. and STARCKE, H., 1959, *A synoptic catalog of the mosquitoes of the world*. Washington, Ent. Soc. Amer. pp. 358.
- SURTEES, G., 1959, On the distribution and seasonal incidence of Culicine mosquitoes in Southern Nigeria. *Proc. R. ent. Soc. Lond. (A.)* **34** : 110-20.

- TEESDALE, C., 1955, Studies on the bionomics of *Aedes aegypti* (L.) in its natural habitats in a coastal region of Kenya. *Bull. ent. Res.* **46** : 711-42.
- THOMPSON, B. W., 1953, Aircraft applications of insecticides in East Africa. III. Atmospheric turbulence in woodland. *Ibid.* **44** : 611-26.
- THURMAN, D. C. and THURMAN, E. B., 1955, Report of the initial operation of a mosquito light trap in Northern Thailand. *Mosq. News* **15** : 218-24.
- TINBERGEN, N., 1951, *The study of instinct*. Oxford (Univ. Press).
- TJØNNELAND, A., 1960, The flight activity of mayflies as expressed in some East African species. *Univ. Bergen Arbøk. nat.* **1960** (1) : 1-88.
- VARGAS, L., 1945, Notas sobre la oncocerciasis. I. Consideraciones sobre la poblacion de simulidos adultos. *Rev. Inst. Salub. Enferm. trop.* **6** : 51-9.
- VERBEKE J., 1958, Chaoboridae (Diptera Nematocera). *Exploration Parc. Nat. Albert, Mission G. F. de Witte*, **94** : 1-57.
- WEBB, W. E. and JONES, T., 1958, A study of the biology and control of Ambrosia Beetles (Scolytoidea) attacking timber in West Africa. *Proc. Xth Int. Congr. Ent.* **4** : 381-84.
- WELLINGTON, W. G., 1945, Conditions governing the distribution of insects in the free atmosphere. I-IV. *Canad. Ent.* **77** : 21-28.
- WESENBERG-LUND, C., 1920, *Contribution to the biology of the Danish Culicidae*. Copenhagen.
- WHARTON, R. H., 1953, The habits of adult mosquitoes in Malaya. IV. Swarming of Anophelines in nature. *Ann. trop. Med. Parasit.* **47** : 285-90.
- WIGGLESWORTH, V. B., 1950, *The principles of insect physiology* (4th ed.). London.
- WILLIAMS, C. B., 1924, An improved light trap for insects. *Bull. ent. Res.* **15** : 57-60.
- 1935, The times of activity of certain nocturnal insects, chiefly Lepidoptera, as indicated by a light-trap. *Trans. R. ent. Soc. Lond.* **83** : 523-55.
- 1936, The influence of moonlight on the activity of certain nocturnal insects, particularly of the Family Noctuidae, as indicated by a light trap. *Phil. Trans.* (B) **226** : 357-89.
- 1937, The use of logarithms in the interpretation of certain entomological problems. *Ann. appl. Biol.* **24** : 404-14.
- 1939, An analysis of four years' captures of insects in a light trap. I. *Trans. R. ent. Soc. Lond.* **89** : 79-132.
- FRENCH, R. A. and HOSNI, M. M., 1955, A second experiment on testing the relative efficiency of insect traps. *Bull. ent. Res.* **46** : 193-204.
- WILLIAMS, M. C., 1956, Bird-biting mosquitoes in the Entebbe area. *E. A. Virus Res. Inst. Ann. Rep. No. 6, 1955-56* : 42-44. Nairobi (Govt. Printer).
- WEITZ, B. and McCLELLAND, G. A. H., 1958, Natural hosts of some species of *Taeniorhynchus* Lynch Arribalzaga (Diptera : Culicidae) collected in Uganda, as determined by the precipitin test. *Ann. trop. Med. Parasit.* **52** : 186-90.
- WOODALL, J. P., CORBET, P. S. and HADDOW, A. J., 1960, An outbreak of Rift Valley fever near Entebbe: entomological studies and further isolations. *E.A. Virus Res. Inst. Ann. Rep. No. 10, 1959-60* : 24-5.
- WRIGHT, M., 1944, Some random observations on dragonfly habits with notes on their predaceousness on bees. *J. Tennessee Acad. Sci.* **19** : 295-301.
- YOUNG, C. J., 1921, Natural enemies of *Stegomyia calopus* Meigen. *Ann. trop. Med. Parasit.* **15** : 301-13.

THE
TRANSACTIONS
OF THE
ROYAL
ENTOMOLOGICAL SOCIETY
OF
LONDON

Entomological studies from a high tower
in Mpanga Forest, Uganda

	PAGE
I. Introduction, by A. J. HADDOW, PHILIP S. CORBET and J. D. GILLETT	249
II. Observations on certain environmental factors at different levels, by A. J. HADDOW and PHILIP S. CORBET	257
III. Light intensity at different levels, by INGE DIRMHIRN	270
IV. Mosquito breeding at different levels in and above the forest, by PHILIP S. CORBET	275
V. Swarming activity above the forest, by A. J. HADDOW and PHILIP S. CORBET	284
VI. Nocturnal flight activity of Culicidae and Tabanidae as indicated by light-traps, by PHILIP S. CORBET	301
VII. The biting behaviour of mosquitoes and tabanids, by A. J. HADDOW	315
VIII. The age-composition of biting mosquito populations according to time and level, by PHILIP S. CORBET	336
IX. Observations on Lepidoptera (Rhopalocera), by T. H. E. JACKSON	346
X. Observations on Sphingidae (Lepidoptera), by PHILIP S. CORBET	351
XI. Observations on Coleoptera, by KEITH W. BROWN	353
XII. Observations on Ephemeroptera, Odonata and some other orders, by PHILIP S. CORBET	356
References	362

LONDON:

PUBLISHED BY THE SOCIETY AND

SOLD AT ITS ROOMS, 41, QUEEN'S GATE, S.W.7.

Price £2 15s. 0d.