ENTOMOLOGICAL STUDIES FROM A HIGH TOWER IN MPANGA FOREST, UGANDA

XII. OBSERVATIONS ON EPHEMEROPTERA, ODONATA AND SOME OTHER ORDERS

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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 hydropsychid 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

Triaenodes 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, 1945*a*) 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, *Heliaeshna*, 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.

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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, Chaoboridea) ; 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.

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