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BY

VICTOR FRANK EASTOP

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KEYS FOR THE IDENTIFICATION OF *ACYRTHOSIPHON* (HEMIPTERA : APHIDIDAE)

By V. F. EASTOP

SYNOPSIS

Keys are given for the identification of the viviparous morphs of the world fauna of *Acyrthosiphon* and of a few other species of similar genera which have been confused with *Acyrthosiphon*. References are given to the original descriptions, principal redescriptions and synonyms of each species. The known host plant range and geographical distribution are summarized and where possible references are given to accounts of the biology of each species.

CONTENTS

INTRODUCTION

The purpose of this paper is to provide a means of identifying specimens of the genus *Acyrthosiphon* Mordwilko, 1914. Only the viviparous morphs are considered, as the sexuales of most species have not been seen. The previous accounts of *Acyrthosiphon* (p. 6) each deal with only a particular geographical region and the most comprehensive contain less than one quarter of the world fauna. About 110 species have been described in or transferred to *Acyrthosiphon* but only 60 of these are both available and still regarded as members of *Acyrthosiphon*. There are about 90 valid described species which belong to the present concept of *Acyrthosiphon*.

There is a vast literature concerning the 'Pea aphid' *Acyrthosiphon* (*A.*) *pisum*, and a smaller amount concerning the 'Pelargonium aphid' *A.* (*A.*) *pelargonii*, the

'Rose-Grain aphid' *Acyrthosiphon* (*Metopolophium*) *dirhodum*, the 'Grass aphid' *A.* (*M.*) *festucae* and the 'Yellow Rose aphid' *Acyrthosiphon* (*Rhodobium*) *porosus* and a few other species occurring on cultivated plants. Because of the rather uniform general appearance (Text-figs 2–5 on pp. 29, 40, 42, and 45), there is a long history of misidentification and confusion between the few species occurring on tultivated plants and the more numerous species occurring on wild plants. Although the majority of *Acyrthosiphon* species are palaearctic in origin a few species are now found in most parts of the world. Some of the European species were described as new when first found in the continents to which they had been introduced and conversely some indigenous species have been misidentified with pests described from Europe.

Hundreds of specimens from many localities and collection dates have been studied for a few species but only one or two specimens for other species. Because the variation at least within the latter species must be much greater than can be estimated at present, the keys have been constructed on the principle of removing species one at a time. This has the disadvantage that the genus is not split into easily remembered groups but has the advantage that specimens must always be taken to their correct couplet and cannot be misled to the wrong part of the key by an early couplet. A few species, some morphs of which are difficult to distinguish from *Acyrthosiphon* but which properly belong in other genera, have been included in both the keys and the host plant catalogue.

Since the first draft of this paper, Hille Ris Lambers (1966 : 17) has transferred *primulae* Theobald to *Microlophium* and Ilharco (1968 : 133–142) has argued that *Rhodobium* should be regarded as fully distinct from *Acyrthosiphon*. It has been thought more useful to leave both species in *Acyrthosiphon* here rather than to omit them. The host plants of a few other species once regarded as *Acyrthosiphon* but now placed elsewhere are also included in the host plant catalogue. The present generic position of these species is indicated on pp. 87–91, together with a brief synonymy relevant to their sojourn in *Acyrthosiphon*. This paper is intended to aid the recognition of *Acyrthosiphon*-like aphids from different parts of the world rather than to indicate their evolutionary relationships.

The 'Specimens studied' are in the collection of the British Museum (Natural History) unless specified otherwise.

GENERIC AND SUBGENERIC SYNONYMY

ACYRTHOSIPHON Mordwilko, 1914

Aphis L., partim, auctores diversi, 1776–1855.
Siphonophora Koch, partim, auctores diversi, 1855–1901.
Nectarophora Oestlund, partim, auctores diversi, 1887–1911.
Macrosiphum Passerini, partim, auctores diversi, 1860–1952.

Subgenus *Acyrthosiphon* Mordwilko, 1914 : 75–198; Hille Ris Lambers, 1947 : 211–260; Stroyan, 1952 : 10. Type-species: *Aphis pisi* Kaltenbach, 1843, which is a synonym of *Aphis pisum* Harris, 1776.

Macchiatiella Del Guercio, 1917 : 210–211 nec 1909 : 5; 1931 : 292–499 partim. Type-species: *Macchiatiella trifolii* Del Guercio, 1917, which is a synonym of *Aphis pisum* Harris, 1776, which is the type-species of *Acyrthosiphon*.

?*Macrocaudus* Shinji, 1930 : 78–79. Type-species: *Macrocaudus phaseoli* Shinji, 1930 : 79–80, which may be a synonym of *Acyrthosiphon gossypii* Mordwilko, 1914, which is the type-species of *Tenuisiphon*.

Mirotarsus Börner, 1939 : 83; 1952 : 153. Type-species: *Siphonophora cyparissiae* Koch, 1855.

Tenuisiphon Mordwilko, 1948 : 215; Shaposhnikov, 1964 : 603. Type-species: *Acyrthosiphon gossypii* Mordwilko, 1914.

Hottesina Börner, 1950 : 12–13; 1952 : 151. Type-species: *Hottesina superba* Börner, 1950, which is a synonym of *Acyrthosiphon nigripes* Hille Ris Lambers, 1935.

Subgenus *Liporrhinus* Börner, 1939 : 82–83; Hille Ris Lambers, 1947 : 200, 257–260. Type-species: *Aphis chelidonii* Kaltenbach, 1843.

Subgenus *Metopolophium* Mordwilko, 1914 : 82; 1919 : 270–297; Hille Ris Lambers, 1947 : 211–260; Stroyan, 1952 : 45–46. Type-species: *Aphis dirhoda* Walker, 1849.

Goidanichiellum Martelli, 1950 : 314, 318–324. Type-species: *Macrosiphum dirhodum* (Walker, 1849) which is the type-species of *Metopolophium*.

Subgenus *Rhodobium* Hille Ris Lambers, 1947 : 255–257. Type-species: *Macrosiphum rosaefolium* Theobald, 1915, which is a synonym of *Myzus porosus* Sanderson, 1900.

Subgenus *Tlja* Mordwilko, 1914 : 72–73; 1932 : 55; 1948 : 211, 216. Type-species: *Macrosiphum lactucae* (Passerini, 1860), not mentioned until Mordwilko, 1932 : 55. *Tlja* was originally included in a key to genera without mention of any species.

Lactucobium Hille Ris Lambers, 1947 : 255–257. Type-species: *Acyrthosiphon scariolae* Nevsky, 1929, which is probably a synonym of *Siphonophora lactucae* Passerini, 1860, which is the type-species of *Tlja*, and is the species Hille Ris Lambers described, even if it is not synonymous with *scariolae*.

GENERIC DIAGNOSIS

Medium sized to rather large, body $1\frac{1}{2}$–$3\frac{3}{4}$ mm long, green, brownish green, yellow or pink aphids. Antennal tubercles usually well developed. Head usually smooth but the inner sides of the antennal tubercles sometimes scabrous or the under sides of the tubercles are weakly spinulose. Antennae $\frac{2}{5}$–$1\frac{1}{2}$ (but usually $\frac{7}{10}$–$1\frac{1}{4}$) times as long as the body. Third antennal segment of apterae usually bearing 1–3 rhinaria near its base but sometimes without secondary rhinaria and sometimes with more numerous rhinaria extending over the whole length of the segment. Alatae viviparae usually with secondary rhinaria confined to the third antennal segment but a few species also have secondary rhinaria on the fourth segment and rarely also on the fifth. Antennal and body hairs usually inconspicuous. The longest hairs on the third antennal segment are usually only $\frac{1}{6}$–$\frac{2}{3}$ as long as the basal diameter of the segment and the longest hairs on the anterior abdominal segments are usually from $\frac{1}{3}$ to equal in length to the proximal articular diameter of the third antennal segment. Processus terminalis $1\frac{3}{5}$–$9\frac{1}{2}$ times as long as the base of the sixth antennal segment but commonly 3–5 times as long. Ultimate rostral segment 90–190μ long, reaching to between the mid and hind coxae, normal in shape or rather short in some of the species living on Gramineae, Leguminosae and Euphorbiaceae. Ultimate rostral segment without or bearing 1–19 accessory hairs, commonly with 4–10. Wing venation normal. First tarsal segments usually bearing 3 hairs but a few species belonging to several different groups bear 5 hairs on the first tarsal segments. Empodial hairs about half as long as the claws. Hind tibiae of larvae without spinules. Apterae with mid thoracic furca stalked. Spiracles reniform, those of abdominal segments 1 and 2 about 3 spiracular diameters apart. Lateral abdominal tubercles often present on segments 2–4 but rather inconspicuous. Siphunculi cylindrical or tapering, $\frac{1}{11}$–$\frac{1}{2}$ (commonly $\frac{1}{5}$–$\frac{1}{3}$) as long as the body. Siphunculi $\frac{4}{5}$–4 (commonly $1\frac{1}{3}$ to twice) as long as the cauda which bears 5–23 hairs. Eighth abdominal tergite bearing 2–13 (commonly 4–6) hairs.

BIOLOGY. Mostly holocyclic on Rosaceae, Leguminosae, Euphorbiaceae or Gramineae. When heteroecious the primary host is *Rosa* or perhaps sometimes other Rosaceae: host plant catalogue on pp. 92–99.

DISTRIBUTION. World-wide but particularly palaearctic.

NOTES. As understood here, a genus of about 100 described species. Hille Ris Lambers (1947 : 211–260, 272–296, 300–304) has given detailed accounts of the Western European species. Mordwilko (1914 : 75–236; 1919 : 237–297), Narzikulov & Umarov (1969 : 154–194), Nevsky (1929 : 77–92) and Shaposhnikov (1964 : 601–603) give accounts of the Russian species, Shinji (1935 : 249–253; 1941 : 705–724), Takahashi (1931 : 62–65) and Tao (1963 : 190–192) give keys to the Oriental species. Eastop (1958 : 18–21; 1966 : 421–427) separates the species which have been introduced to East Africa and Australia respectively. The American species are mostly to be found in accounts of *Macrosiphum* but Richards (1963 : 254) has given a key to Canadian *Acyrthosiphon*.

According to Article 30 (a) of the International Code of Zoological Nomenclature adopted by the 15th International Congress of Zoology (1961 : 31) the gender of *Acyrthosiphon* is masculine. The original spelling of trivial names has been retained as far as possible except when they were evidently adjectives agreeing with a feminine or neuter genus. In a few cases of doubt, as with the insect described as *Aphis dirhoda*, the well known form *dirhodum* has been retained.

KEY TO THE SPECIES OF *ACYRTHOSIPHON* Mordwilko
(including some species of other genera that may be confused with it)

Apterae viviparae

1 Siphunculi 0·9–1·3 mm long, attenuated before the apex and then abruptly expanded into a flange with a diameter $1\frac{1}{2}$ to twice that of the attenuated sub-apical part. Processus terminalis 6–8 times as long as the base of the sixth antennal segment, the ultimate rostral segment and the second segment of the hind tarsus, which are each about 140–180μ long. Longest hair on eighth abdominal tergite 50–75μ long. Siphunculi $2\frac{1}{2}$–3 times as long as the cauda, which bears 7–15 hairs. Antennal tubercles well developed with almost parallel inner margins. On *Urtica*, Holarctic **MICROLOPHIUM** (p. 84)

– Siphuncular flange less well developed, the apical siphuncular diameter 1–$1\frac{2}{5}$ that of the sub-apical diameter. If siphunculi more than 0·9 mm long, then either the processus terminalis, ultimate rostral segment or body hairs are shorter 2

2 (1) Third antennal segment bearing 6–20 rhinaria concentrated on the distal half. Fourth antennal segment rarely without but usually bearing 1–6 rhinaria. Mid-thoracic furca with widely separated arms. Body $3\frac{1}{3}$–$4\frac{2}{3}$ as long as the weakly clavate siphunculi, which are 0·3–0·4 mm long and $1\frac{1}{2}$–$1\frac{3}{4}$ times as long as the cauda. Processus terminalis $5\frac{1}{2}$–$7\frac{1}{4}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment 160–190µ long, $1\frac{1}{5}$–$1\frac{2}{5}$ as long as the second segment of the hind tarsus and bearing 7–15 accessory hairs. Cauda bearing 7–10 hairs. On *Silene alba*, Central and Southern Europe . . . . **Volutaphis schusteri** (p. 85)

– Third antennal segment often with 6 or more rhinaria but they are placed in a row and not concentrated on the distal half of the segment. Fourth antennal segments without rhinaria. Arms of the mid-thoracic furca arising from a common base and if the body is less than 5 times as long as the siphunculi, the base of the mid-thoracic furca is elongate. Siphunculi usually cylindrical or tapering, but if the distal two-fifths are slightly swollen the siphunculi are 1·1–1·7 mm long and $2\frac{1}{2}$–4 times as long as the cauda 3

3 (2) All abdominal tergites bearing conspicuous capitate hairs, those on the third abdominal tergites 80–110µ long. Third antennal segment also bearing conspicuous capitate hairs from 20–50µ long. Abdominal dorsum uniformly pigmented and the pigmentation extending laterally almost as far as the spiracles.

Siphunculi 220–370µ long, with a well developed flange, 2–$2\frac{1}{2}$ times as long as the cauda, which usually bears only 5 hairs. Ultimate rostral segment 1–$1\frac{1}{3}$ times as long as the second segment of the hind tarsus and bearing 4–6 accessory hairs. On Gramineae, holarctic *Cryptaphis* (p. 82) . . . 4

– If body hairs capitate then those on the middle abdominal tergites are shorter, not exceeding 40µ. The antennal hairs are usually also shorter and the abdomen is usually pale dorsally 5

4 (3) Siphunculi dark, as dark as or darker than the abdominal tergum, $6\frac{1}{2}$–8 times as long as their middle diameter and $4\frac{1}{2}$–6 times as long as the longest hair on third antennal segment. On *Bromus*, Manitoba . **Cryptaphis bromi** (p. 82)

– Siphunculi dusky, as dark as or paler than the abdominal tergum, 10–14 times as long as their middle diameter and 8–15 times as long as the longest hair on the third antennal segment. On *Festuca*, *Holcus* and more rarely than other grasses in Central and Western Europe . . . **Cryptaphis poae** (p. 83)

5 (3) Processus terminalis only $\frac{2}{3}$ to equal in length to the base of the sixth antennal segment. First tarsal segments bearing only 2 hairs. Secondary rhinaria absent.

Ultimate rostral segment only $\frac{1}{2}$–$\frac{3}{5}$ as long as the second segment of the hind tarsus but bearing 4 or 5 accessory hairs. Body about 5 times as long as the slender siphunculi, which are $2\frac{3}{4}$–3 times as long as the cauda, which bears 7–13 hairs. Eighth abdominal tergite bearing 7–13 conspicuous hairs. Antennal tubercles little developed. On *Potentilla fruticosa*, Ontario **Myzaphis canadensis** (p. 84)

– Processus terminalis $1\frac{1}{5}$–$10\frac{1}{2}$ times as long as the base of the sixth antennal segment. First tarsal segments usually bearing 3 hairs, rarely with 4 or 5 and very rarely the first segments of the hind tarsi bear only 2 hairs. Most species with at least one rhinarium near the base of the third antennal segment . 6

6 (5) Antennal segments I & III, cauda and femora brown or black, all other appendages black.

Longest hairs on third antennal segments 45–60μ long. Body 2–$3\frac{1}{5}$ times as long as the siphunculi, which are 0·9–1·3 mm long and $2\frac{1}{4}$–$3\frac{1}{2}$ times as long as the cauda. Ultimate rostral segment only 110–120μ long, $\frac{2}{5}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus 7

– Usually with only the tips of the appendages dark and with the cauda pale . 8

7 (6) Ultimate rostral segment $\frac{3}{4}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus which is about 140μ long. Processus terminalis 4–$4\frac{2}{3}$ as long as the base of the sixth antennal segment which is $2\frac{1}{4}$–$2\frac{2}{3}$ as long as the ultimate rostral segment. Body 2–$2\frac{1}{3}$ as long as the siphunculi, which are $2\frac{3}{4}$–$3\frac{1}{2}$ times as long as the cauda, which bears only 6 hairs. On *Purshia*, Colorado **_Macrosiphum purshiae_** (p. 85)

– Ultimate rostral segment $\frac{2}{5}$–$\frac{1}{2}$ as long as the second segment of the hind tarsus, which is 260–270μ long. Processus terminalis $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment, which is 3–$3\frac{3}{4}$ as long as the ultimate rostral segment. Body $2\frac{1}{3}$–$3\frac{1}{10}$ as long as the siphunculi which are $2\frac{1}{4}$–$2\frac{3}{4}$ as long as the cauda, which bears 12–18 hairs. On Umbelliferae, Europe . 16

8 (6) Abdomen bearing conspicuous and evidently capitate hairs which are 5–11μ wide near the apex. Siphunculi $1\frac{1}{2}$–$2\frac{1}{4}$ times as long as the cauda which usually bears only 5 hairs (Text-fig. 1). Processus terminalis 1·3–1·8 mm long, 7–$9\frac{1}{2}$ times as long as the base of the sixth antennal, segment and $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the siphunculi.

Ultimate rostral segment $\frac{4}{5}$–$\frac{19}{20}$ as long as the second segment of the hind tarsus and bearing 4–7 accessory hairs. The longest hairs on the third abdominal tergites are 25–35μ long and those on the eighth tergites are 40–50μ long. Body 4–5 times as long as the siphunculi. On *Aster*, North Eastern United States of America . . . **_A. (A.) asterifoliae_** (p. 26)

– Long abdominal hairs when present pointed, or if with somewhat thickened or blunt apices, their greatest sub-apical diameter does not exceed the basal diameter of the hairs, 2–5μ. Cauda bearing 5–23 hairs, if with only 5 or 6, then the processus terminalis is usually very much shorter, but if only a little shorter (1·1–1·4 mm in *pseudodirhodum*, which has 5–10 caudal hairs) then the siphunculi are only about equal in length to the cauda. . . 9

9 (8) Processus terminalis 1·1–1·4 mm long, 6–10 times as long as the base of the sixth antennal segment and $2\frac{1}{4}$–$3\frac{1}{4}$ times as long as the siphunculi. Ultimate rostral segment 100–120μ long, $\frac{7}{10}$–$\frac{9}{10}$ as long as the second segment of the hind tarsi and bearing 2–6 accessory hairs.

Body $4\frac{3}{4}$–$6\frac{1}{2}$ times as long as the siphunculi which are $\frac{4}{5}$–$1\frac{1}{5}$ as long as the cauda which bears 5–10 hairs. First antennal segments usually bearing 6–9 but sometimes with up to 12 hairs. Third antennal segment bearing 5–30 rhinaria. On *Rosa* and *Spiraea*, Eastern North America **_A. (A.) pseudodirhodum_** (p. 67)

– Processus terminalis usually shorter, but if not, then siphunculi usually relatively longer so that the processus terminalis is less than twice as long as the siphunculi. If the processus terminalis is $4\frac{1}{2}$–$6\frac{1}{2}$ times as long as the base of the sixth antennal segment and $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the siphunculi, then the ultimate rostral segment is only $\frac{1}{2}$–$\frac{2}{3}$ as long as the second segment of the hind tarsus 10

10 (9) Processus terminalis 1·3–1·6 mm long, $4\frac{1}{2}$–$6\frac{1}{2}$ times as long as the base of the sixth antennal segment and $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the siphunculi.

Siphunculi $1\frac{1}{10}$–$1\frac{2}{5}$ as long as the cauda which bears 9–12 hairs. Ultimate rostral segment 130–160μ long, $\frac{1}{2}$–$\frac{2}{3}$ as long as the second segment of the hind tarsus (200–270μ) and usually bearing 6 accessory hairs. Third antennal segments usually bearing 1–5 rhinaria. On *Mertensia*, Colorado

A. (A.) niwanista (p. 50)

– Processus terminalis usually less than 1 mm long but if more than 1 mm long, then it is less than twice as long as the siphunculi 11

11 (10) Siphunculi 0·8–1·1 mm long, mostly black but the very base paler, 2–2¾ times as long as the pale cauda which bears 6–8 hairs. Antennae and tibiae pale or dusky, except for the very apices of the segments, which are dark. Ultimate rostral segment 1⅕–1⅓ times as long as the second segment of the hind tarsus and bearing 8–11 accessory hairs. First segments of fore tarsi bearing 4 or 5 hairs, of mid and hind legs 3 or 4 hairs. Processus terminalis 3¾–6½ times as long as the base of the sixth antennal segment.

Proximal ⅖ of the third antennal segment bearing 4–14 rhinaria in an irregular row or cluster. On *Rubus*, Japan & Taiwan

A. (A) rubiformosanus (p. 68)

– If siphunculi long and black then cauda, antennae and tibiae usually black also and the ultimate rostral segment is relatively shorter, being only about half as long as the second segment of the hind tarsus. If the first tarsal segments bear more than 3 hairs, then the siphunculi are less than 1½ times as long as the cauda, the processus terminalis is less than 4½ times as long as the base of the sixth antennal segment and the ultimate rostral segment is only about half as long as the second segment of the hind tarsus. . . 12

12 (11) First tarsal segments bearing 5 hairs. Ultimate rostral segment only 90–130μ long, ⅖–⅗ as long as the second segment of the hind tarsus (180–240μ).

Siphunculi from equal in length to 1½ times as long as the cauda. Processus terminalis 3–3⅓ times as long as the base of the sixth antennal segment . 13

– First tarsal segments normally bearing only 3 hairs; if an occasional fourth hair is present then the ultimate rostral segment is more than ⅗ as long as the second segment of the hind tarsus 15

13 (12) Body 7–10 times as long as the siphunculi which are 1⅕–1½ times as long as the cauda (200–280μ) which bears 5–7 hairs. Siphunculi 1–1½ times as long as the base of the sixth antennal segment. Processus terminalis 3–3¾ times as long as the base of the sixth antennal segment. Alternating between *Rosa* and *Capnoides-Corydalis*, Colorado . ***A. (A.) tutigula*** (p. 71)

– Body 3½–7 times as long as the siphunculi which are 1–1⅖ times as long as the cauda (300–600μ) which bears 9–15 hairs. Siphunculi 1¾–3 times as long as the base of the sixth antennal segment. Processus terminalis 3⅔–4½ times as long as the base of the sixth antennal segment. On *Euphorbia*, Europe (*A.* (*A.*) *cyparissiae*, s. lat.) 14

14 (13) Front half of head, antennal segments III to VI, distal ¾ of siphunculi, proximal ⅓ of tibiae and distal apices of femora and tibiae black. Usually in more cool situations . . . ***A. (A.) cyparissiae*** sensu stricto (p. 34)

– Only the distal apices of the siphunculi, tibiae and antennal segments black, the remainder of the insect pale to dusky. Usually in warmer situations

A. (A.) cyparissiae form ***propinquum*** (p. 35)

15 (12) Head, antennae, tibiae, distal ⅔ of femora, siphunculi, cauda and tibiae black. Body 2¼–3⅕ times as long as the siphunculi which are more than 1 mm long and 2¼–2¾ times as long as the cauda, which bears 12–18 hairs.

Ultimate rostral segment ⅖–½ as long as the second segment of the hind tarsus and bearing 4 accessory hairs. Processus terminalis 2½–3½ times as long as the base of antennal VI. On *Umbelliferae* 16

– Cauda usually pale and only the tips of the other appendages dark. If cauda brown then the body is 5–5½ times as long as the siphunculi which are

$1\frac{2}{5}$–$1\frac{2}{3}$ as long as the cauda which bears not more than 10 hairs 18

16 (7, 15) On *Seseli* . . . . **A. (A.) *nigripes blattnyi*** (p. 49)

– On *Laserpitium* and *Peucedanum* 17

17 (16) Only the basal $\frac{1}{5}$–$\frac{1}{4}$ of the hind femora pale. Ultimate rostral segment $\frac{2}{5}$–$\frac{1}{2}$ as long as the second segment of the hind tarsus. On *Laserpitium* **A. (A.) *n. nigripes*** (p. 49)

– Basal half of hind femora pale. Ultimate rostral segment $\frac{11}{20}$–$\frac{13}{20}$ as long as the second segment of the hind tarsus. On *Peucedanum* **A. (A.) *nigripes peucedani*** (p. 49)

18 (15) Siphunculi more than 1 mm long and $2\frac{2}{3}$–5 times as long as the cauda. Ultimate rostral segment $\frac{3}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus. . 19

– Siphunculi usually less than 1 mm long but if more then only $1\frac{1}{5}$–$1\frac{9}{10}$ times as long as the cauda 20

19 (18) Processus terminalis 6–9 times as long as the base of the sixth antennal segment which is $1\frac{1}{4}$–$1\frac{3}{4}$ times as long as the ultimate rostral segment which is $\frac{7}{10}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus and bears only 2 accessory hairs. First antennal segments bearing 8 or 9 hairs. Siphunculi from half as long to nearly as long as the body and 3–4 times as long as the cauda which bears 7 or 8 hairs. On *Amelanchier*, North America **A. (A.) *macrosiphum*** (p. 47)

– Processus terminalis $2\frac{3}{4}$–4 times as long as the base of the sixth antennal segment, which is 2–$2\frac{1}{2}$ times as long as the ultimate rostral segment, which is $\frac{3}{5}$–$\frac{3}{4}$ as long as the second segment of the hind tarsi and bears 7 or 8 accessory hairs. First antennal segments bearing 12–18 hairs. Siphunculi $\frac{1}{3}$–$\frac{1}{2}$ as long as the body and $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the cauda which bears 9–13 hairs. (Text-fig. 4). Mostly on Leguminosae and Malvaceae, Southern Russia, Middle East, North Africa, India . . **A. (A.) *gossypii*** (p. 41)

20 (18) Antennal tubercles distinctly scabrous. Small dark ante-siphuncular sclerites present, remainder of dorsum pale. Ultimate rostral segment 110–120μ long, about equal in length to the second segment of the hind tarsus (110–125μ) and usually bearing only 2 accessory hairs. Processus terminalis $3\frac{3}{4}$–$5\frac{1}{4}$ times as long as the base of the sixth antennal segment.

Siphunculi $1\frac{3}{5}$ to twice as long as the cauda, which bears 4 long hairs proximally and 2–4 short distal hairs. Third antennal segment usually bearing 1–3 but sometimes without, rhinaria near its base. Living hidden under the runners of *Trifolium*, North Western Europe **_Subacyrthosiphon cryptobius_** (p. 84)

– Antennal tubercles smooth or imbricated. Ante-siphuncular sclerites usually not pigmented unless dorsal pigmentation is also present. If the ante-siphuncular sclerite is dark when the dorsum is pale then the ultimate rostral segment is $\frac{7}{10}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus and the processus terminalis is $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment 21

21 (20) Small pigmented ante-siphuncular sclerite present, dorsum pale.

Body 4–$4\frac{1}{2}$ times as long as the siphunculi which are $1\frac{1}{2}$–$1\frac{9}{10}$ as long as the cauda which bears 8–10 hairs. Third antennal segment bearing 4–11 rather large rhinaria extending over the proximal $\frac{1}{3}$–$\frac{7}{8}$ of its length. Ultimate rostral segment 120–140μ long and bearing 9–11 accessory hairs. Second segments of hind tarsi 155–195μ long. Processus terminalis $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment. (Text-fig. 3). On *Sonchus*, Pakistan. . . . . **A. (A.) *ghanii*** (p. 38)

– Ante-siphuncular sclerites not pigmented unless dorsal abdominal pigmentation is also present 22

22 (21) Antennal tubercles spinulose, well developed, with almost parallel inner margins, median tubercle evident: spinules extending on to the ventral surface of the head near the antennal tubercles. Third antennal segment bearing 4–16 rather large rhinaria in a row over the basal half of more of the segment. Cauda bearing 5–8, usually 7, hairs, the basal 2 pairs being long and pointed and the apical 2–4 hairs short and blunt, less than $\frac{1}{3}$ as long as the more proximal caudal hairs. Ultimate rostral segment 95–130μ long, $\frac{4}{5}$ to equal in length to the second segment of the hind tarsus.

Dorsal cephalic hairs short and inconspicuous, 6–8μ long; hairs on the 8th abdominal tergite 7–14μ long. Processus terminalis $3\frac{1}{3}$–$4\frac{3}{5}$ times as long as the base of the sixth antennal segment. On *Rosa* and *Fragaria*, widespread . . . . ***A. (Rhodobium) porosus*** (p. 79)

– Antennal tubercles usually smaller and less spinulose, under surface of head not at all spinulose. When the third antennal segment bears more than 4 rhinaria the rhinaria are usually small. All caudal hairs usually pointed and the distal hairs more than half as long as the proximal hairs. If the distal caudal hairs are short and blunt then the ultimate rostral segment is less than $\frac{3}{4}$ as long as the second segment of the hind tarsus . . . 23

23 (22) Cauda $\frac{3}{5}$–$\frac{3}{4}$ as long as the siphunculi and bearing 9–13 hairs, the basal two pairs of which are long and fine-pointed but the apical hairs are short and blunt, from 10 to 20μ long, less than $\frac{2}{5}$ as long as the basal caudal hairs. The first antennal segments bear 8 to 10 hairs. Third antennal segment bearing 7–30 rhinaria. Processus terminalis 3–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment short, only about $1\frac{1}{3}$ as long as broad at base and $\frac{3}{5}$–$\frac{3}{4}$ as long as the second segment of the hind tarsus. On *Euphorbia*, Bulgaria . ***A. (A.) thracicus*** (p. 70)

– Usually with all caudal hairs pointed, the distal hairs being more than half as long as the proximal hairs. When the apical caudal hairs are short and blunt, then they are at least 25μ long and the third antennal segment bears only 1–3 rhinaria. When the third antennal segment bears 7 or more rhinaria then both the ultimate rostral segment and the processus terminalis are relatively longer 24

24 (23) Ultimate rostral segment 110–140μ long, $\frac{3}{5}$–$\frac{7}{10}$ as long as the second segment of the hind tarsus (180–200μ) and bearing 16–25 accessory hairs.

Processus terminalis $2\frac{1}{2}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment. Third antennal segment without or bearing 1–11, but usually 3–6 rhinaria. Body $3\frac{1}{2}$–$4\frac{4}{5}$ times as long as the siphunculi which are $1\frac{2}{5}$ to twice as long as the cauda which bears 7–10 hairs. On *Lactuca*, Europe, Central Asia, Middle East, North America . ***A. (Tlja) lactucae*** (p. 81)

– If the ultimate rostral segment bears more than 14 accessory hairs then it is longer than the second segment of the hind tarsus 25

25 (24) Third antennal segment without rhinaria. Processus terminalis $2\frac{3}{4}$–$3\frac{1}{3}$ times as long as the base of the sixth antennal segment. Body $2\frac{3}{4}$–$3\frac{1}{3}$ times as long as the siphunculi which are $1\frac{3}{4}$–$2\frac{1}{4}$ times as long as the cauda which bears 9–14 hairs. Ultimate rostral segment 130–150μ long, $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus (150–180μ) and bearing 8–10 accessory hairs.

First antennal segments usually bearing 8 or 9 hairs. On *Chelidonium*, Central Europe . . . . . ***A. (Lipporhinum) chelidonii*** (p. 72)

– Third antennal segment usually bearing at least one rhinarium; if without rhinaria on the third antennal segment then either the processus terminalis is relatively longer or shorter, the ultimate rostral segment bears fewer accessory hairs or the body is $4\frac{1}{2}$–$7\frac{1}{4}$ times as long as the siphunculi . . 26

26 (25) Body $7\frac{3}{4}$–$9\frac{1}{2}$ times as long as the siphunculi which are $\frac{4}{5}$–$1\frac{1}{10}$ as long as the cauda which bears 10–17 hairs. Siphunculi about half as long as the third antennal segment. Ultimate rostral segment 90–120μ long, $\frac{3}{5}$–$\frac{7}{10}$ as long as the second segment of the hind tarsus (160–180μ long) and bearing 4 accessory hairs.

Eighth abdominal tergite usually bearing 6 hairs. Processus terminalis $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment. On *Elymus*, Colorado . . . . ***Hyalopteroides palmerae*** (p. 83)

– Siphunculi usually relatively longer, but if not then the third antennal segment is relatively shorter and about equal in length to the siphunculi and the ultimate rostral segment is relatively longer and bears 5–9 accessory hairs . 27

27 (26) Ultimate rostral segment 90–110μ long, $\frac{2}{5}$–$\frac{3}{5}$ as long as the second segment of the hind tarsi (170–210μ long) and bearing only 2–4 accessory hairs. Body $3\frac{3}{4}$–$4\frac{3}{4}$ times as long as the siphunculi which are $1\frac{1}{5}$–$1\frac{3}{5}$ as long as the cauda which bears 12–21 hairs. Antennal tubercles moderately developed, without a median tubercle. On *Euphorbia*, Europe (*A.* (*A.*) *euphorbiae*) . . 28

– Ultimate rostral segment usually more than $\frac{3}{5}$ as long as the second segment of the hind tarsi but if not then the frons with a median tubercle, the body is $4\frac{3}{4}$–6 times as long as the siphunculi and the insect lives on Gramineae . 29

28 (27) First antennal segments bearing 7–9 hairs. Cauda bearing about 12 hairs. On *Euphorbia palustris*, Central Europe . . ***A. (A.) e. euphorbiae*** (p. 36)

– First antennal segments bearing 8–18, but usually 12 or more hairs. Cauda bearing 13–21 usually 16 or more, hairs. On *Euphorbia esula*, Europe ***A. (A.) euphorbiae neerlandicum*** (p. 37)

29 (27) Eighth abdominal tergite bearing only 2 hairs. Ultimate rostral segment about $\frac{2}{3}$ as long as the second segment of the hind tarsus and bearing 2 or 3 accessory hairs.

Third antennal segment bearing 2–7 tuberculate rhinaria. Antennal tubercles weakly developed, median tubercle broad and flat. Body $5\frac{3}{4}$–$6\frac{2}{3}$ as long as the siphunculi which are $1\frac{2}{5}$–$2\frac{1}{5}$ as long as the cauda, which bears about 6 hairs. On *Gramineae*, India ***A. (Metopolophium) chandrani*** (p. 74)

– Eighth abdominal tergite usually bearing 4–13 hairs, if with only 2 or 3 then the ultimate rostral segment is $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus and bears 6–9 accessory hairs. 30

30 (29) First antennal segments bearing 9–23, usually 12 or more, hairs. Ultimate rostral segment $\frac{3}{5}$–$\frac{19}{20}$ as long as the second segment of the hind tarsus. Body $2\frac{3}{4}$–$4\frac{1}{2}$ times as long as the strongly tapering siphunculi (Text-fig. 7b) which are $1\frac{1}{5}$–$1\frac{4}{5}$ as long as the cauda which bears 8–23 hairs. Processus terminalis 3–5 times as long as the base of the sixth antennal segment which is $1\frac{1}{2}$–$2\frac{1}{2}$ times as long as the ultimate rostral segment. On *Leguminosae* (*A.* (*A.*) *pisum s. lat.*) 31

– First antennal segments bearing 5–13, but rarely more than 11 hairs . . 32

31 (30) Base of the sixth antennal segment 2–$2\frac{1}{2}$ times as long as the ultimate rostral segment which is $\frac{2}{3}$–$\frac{17}{20}$ as long as the second segment of the hind tarsus and bears 3–7 or rarely 8 accessory hairs. Cauda bearing 8–14 hairs. On many Papilionaceae, widespread ***A. (A.) p. pisum*** & ***A. (A.) pisum spartii*** (pp. 58 & 65)

– Base of sixth antennal segment $1\frac{1}{2}$ to twice as long as the ultimate rostral segment which is $\frac{3}{4}$–$\frac{19}{20}$ as long as the second segment of the hind tarsus and bears rarely 6 or 7 but usually 8–12 accessory hairs. Cauda bearing 11–23 hairs. On *Ononis*, Europe . . . . ***A. (A.) pisum ononis*** (p. 64)

32 (30) Ultimate rostral segment 100–110μ long, $\frac{1}{2}$–$\frac{2}{3}$ as long as the second segment of the hind tarsus and bearing only 1–3 accessory hairs. Processus terminalis about $1\frac{1}{5}$ mm long, $5\frac{3}{4}$–$7\frac{1}{4}$ times as long as the base of the sixth antennal

segment and nearly twice as long as the siphunculi which are $1\frac{1}{4}$–$1\frac{2}{5}$ as long as the cauda.

Longest hair on the eighth abdominal tergite about 15μ long. On Gramineae, Russia & Sweden. ***A. (Metopolophium) graminearum*** (p. 78)

– If the ultimate rostral segment is less than $\frac{2}{3}$ as long as the second segment of the hind tarsus, then the processus terminalis is less than $5\frac{1}{2}$ times as long as the base of the sixth antennal segment and less than $1\frac{2}{3}$ as long as the siphunculi 33

33 (32) Ultimate rostral segment only about half as long as the second segment of the hind tarsus and without or with 1–3 accessory hairs. Siphunculi $1\frac{1}{5}$–$1\frac{2}{5}$ times as long as the cauda which bears 15–21 hairs.

Body about 6 times as long as the siphunculi. Processus terminalis $4\frac{1}{2}$–$5\frac{1}{2}$ times as long as the base of the sixth antennal segment. Host plant unknown, Quebec. . . . ***A. (Metopolophium) beiqueti*** (p. 74)

– Ultimate rostral segment $\frac{3}{5}$–$1\frac{2}{5}$ as long as the second segment of the hind tarsus and only rarely bearing less than 4 accessory hairs, if without or with only 1–3 accessory hairs then the cauda bears only 5–8 hairs. Cauda bearing 5–13 hairs, if with 11–13 hairs then either the ultimate rostral segment $\frac{4}{5}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus or if shorter, then the siphunculi are $1\frac{2}{5}$–$1\frac{3}{4}$ as long as the cauda 34

35 (34) Ultimate rostral segment $\frac{3}{5}$–$\frac{7}{10}$ as long as the second segment of the hind tarsus and bearing 4–7 accessory hairs. Body $4\frac{3}{4}$–6 times as long as the siphunculi which are $1\frac{2}{5}$–$1\frac{3}{4}$ as long as the cauda which bears 7–13 hairs. Processus terminalis $2\frac{1}{2}$–4 times as long as the base of the sixth antennal segment. Antennal segments III to V with dusky apices so that the base of VI is paler than the apex of V. On *Rosa* and many Gramineae ***A. (Metopolophium) dirhodum*** (p. 74)

– Ultimate rostral segment $\frac{2}{3}$–$1\frac{2}{5}$ as long as the second segment of the hind tarsus, if less than $\frac{7}{10}$ then either the body is 3–4 times as long as the siphunculi which are $1\frac{7}{10}$ to twice as long as the cauda which bears 7–10 hairs and the processus terminalis is $4\frac{1}{2}$–$5\frac{1}{3}$ times as long as the base of the sixth antennal segment (*ignotus*, p. 44), or the body is $3\frac{4}{5}$–5 times as long as the siphunculi which are $1\frac{3}{5}$–$2\frac{1}{10}$ times as long as the cauda which bears only 6–9 hairs and the processus terminalis is $3\frac{1}{2}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment, and antennal flagellum darkening gradually from base to apex so that the base of the sixth segment is as dark as or darker than the apex of the fifth segment (*albidus*, p. 72) 35

35 (34) Body $2\frac{1}{10}$–$2\frac{4}{5}$ as long as the siphunculi.

Siphunculi $1\frac{2}{5}$–$1\frac{9}{10}$ as long as the cauda which bears 7–11 hairs. Processus terminalis $4\frac{1}{4}$–5 times as long as the base of the sixth antennal segment. Ultimate rostral segment from $\frac{7}{10}$ to equal in length to the second segment of the hind tarsus and bearing 4–6 accessory hairs. First antennal segments bearing 6–8 hairs 36

– Body $2\frac{9}{10}$–$8\frac{1}{4}$ times as long as the siphunculi 37

36 (35) Siphunculi $5\frac{1}{2}$–$6\frac{1}{2}$ times as long as the ultimate rostral segment, which is $\frac{7}{10}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus and usually bears 4 accessory hairs. Cauda bearing 4 long proximal and 3 short and blunt distal hairs. On *Vaccinium*, Germany, Sweden . . . . ***A. (A.) knechteli*** (p. 46)

– Siphunculi $3\frac{3}{4}$–5 times as long as the ultimate rostral segment which is $\frac{9}{10}$ to equal in length to the second segment of the hind tarsi and usually bearing 6 accessory hairs. Cauda bearing 8–11 pointed hairs. On *Potentilla* (*Dasyophora*), North America . . . . ***A. (A.) wasintae*** (p. 71)

37 (35) Body $5\frac{1}{2}$–$8\frac{1}{4}$ times as long as the siphunculi. Mostly arctic or alpine species . 38

– Body $2\frac{9}{10}$–$5\frac{1}{2}$ times as long as the siphunculi 44

38 (37) Processus terminalis $1\frac{2}{3}$ to twice as long as the siphunculi and $2\frac{1}{4}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment. Siphunculi from equal in length to $1\frac{1}{3}$ times as long as the cauda which bears 7–8 hairs. Ultimate rostral segment $\frac{7}{10}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus and bearing 3–7 accessory hairs. Third antennal segment bearing 1–5 rhinaria 39

– Processus terminalis $\frac{1}{2}$–$1\frac{1}{3}$ as long as the siphunculi 40

39 (38) First antennal segment bearing 5–6 hairs. Eighth abdominal tergite bearing 7–8 hairs. On *Vaccinium uliginosum*, Greenland, Iceland, Baffin Is., Switzerland . . . . ***A. (A.) brachysiphon*** (p. 32)

– First antennal segments bearing about 9 hairs. Eighth abdominal tergite bearing 5–6 hairs. Host plant unknown, Norway ***A. (A.) aurlandicus*** (p. 30)

40 (38) Processus terminalis $1\frac{1}{5}$–$2\frac{9}{10}$ as long as the base of the sixth antennal segment. Ultimate rostral segment $\frac{4}{5}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsi. Body often more than $5\frac{3}{4}$ times as long as the siphunculi which are $1\frac{3}{4}$–$2\frac{3}{4}$ as long as the base of the sixth antennal segment. Scandinavian and arctic species 41

– Processus terminalis 3–4 times as long as the base of the sixth antennal segment. Ultimate rostral segment $\frac{7}{10}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus. Body $5\frac{1}{2}$–$5\frac{3}{4}$ times as long as the siphunculi which are 3–4 times as long as the base of the sixth antennal segment 44

41 (40) Dorsum bearing dark, segmentally arranged, paired dorsal bands. Siphunculi dusky. Processus terminalis $1\frac{1}{4}$–$1\frac{3}{5}$ times as long as the base of the sixth antennal segment.

Siphunculi $1\frac{1}{4}$–$1\frac{1}{3}$ as long as the cauda which bears 7 hairs. Host plant unknown, Spitzbergen . . . . . . ***A. (A.) svalbardicus*** (p. 70)

– Dorsum and siphunculi pale. Processus terminalis $1\frac{3}{5}$–$2\frac{9}{10}$ times as long as the base of the sixth antennal segment 42

42 (41) Longest hairs on the eighth abdominal tergite less than 20μ long. First antennal segments bearing only 5 hairs.

Third antennal segment without or with only one rhinarium. Body 6–$7\frac{1}{2}$ times as long as the siphunculi which are $1\frac{2}{5}$–$1\frac{4}{5}$ as long as the almost triangular cauda which bears 6 or 7 hairs. Processus terminalis 2–$2\frac{1}{2}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment $\frac{9}{10}$ to equal in length to the second segment of the hind tarsus and bearing 4–6 accessory hairs. On *Poa arctica*, Spitzbergen ***A. (A.) calvulus*** (p. 32)

– Longest hairs on eighth abdominal tergite 20–45μ long. First antennal segments bearing 6–8 hairs. 43

43 (42) Third antennal segment usually without, sometimes bearing one, rhinarium. Cauda bearing 6–8 hairs. Processus terminalis $1\frac{3}{5}$–$2\frac{3}{5}$ times as long as the base of the sixth antennal segment. On *Honkenya* and other maritime plants, North Western Europe . . . . . ***A. (A.) auctus*** (p. 30)

– Third antennal segment bearing 1–3 rhinaria. Cauda bearing 8–13 hairs. Processus terminalis $2\frac{1}{5}$–$2\frac{9}{10}$ times as long as the base of the sixth antennal segment. On *Dryas*, Sweden, Greenland, Southampton Is. ***A. (A.) brevicornis*** (p. 32)

44 (37, 40) Processus terminalis $5\frac{9}{10}$–$7\frac{1}{5}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment $1\frac{1}{10}$–$1\frac{2}{5}$ as long as the second segment of the hind tarsus and bearing 8–14 accessory hairs. Cauda bearing only 7 hairs, the apical hair being short and blunt.

Body $2\frac{9}{10}$–4 times as long as the siphunculi which are $1\frac{2}{3}$–$2\frac{1}{5}$ times as long as the cauda. Siphunculi often with 1–3 rows of polygonal reticulation near the apex. First antennal segments usually bearing 6 or 7 hairs. On Compositae, South America and West Indies **A. (A.) *bidenticola*** (p. 31)

– Processus terminalis $1\frac{3}{5}$–$6\frac{3}{5}$ times as long as the base of the sixth antennal segment but if more than $5\frac{1}{2}$ times as long, then either the ultimate rostral segment is only $\frac{3}{4}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus or if it is $\frac{9}{10}$–$1\frac{2}{5}$ as long, then all the 6–12 caudal hairs are long and pointed 45

45 (44) Processus terminalis $2\frac{1}{2}$–3 times as long as the base of the sixth antennal segment (210–290μ long) and $1\frac{1}{10}$–$1\frac{2}{5}$ as long as the siphunculi. Ultimate rostral segment about $\frac{3}{4}$ as long as the second segment of the hind tarsus and bearing 2–4 accessory hairs. Cauda of oviparae bearing 9–13 hairs, of which at least the distal 3 have blunt apices.

Body $3\frac{3}{4}$–$4\frac{3}{4}$ times as long as the siphunculi which are just thicker than the middle diameter of the tibiae and $1\frac{3}{5}$–$1\frac{9}{10}$ times as long as the cauda. Body hairs short, those on the anterior tergites 4μ long and those on the eighth abdominal tergite about 16μ long. On *Genista anglica*, Switzerland **A. (A.) *ericetorum*** (p. 36)

– Processus terminalis usually more than 3 times as long as the base of the sixth antennal segment but if not, then the ultimate rostral segment $\frac{19}{20}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsi and the cauda bears only 6–10 hairs, or if the ultimate rostral segment is only about $\frac{3}{4}$ as long as the second segment of the hind tarsus and bears only 3 or 4 accessory hairs, then the processus terminalis is $1\frac{2}{3}$–$2\frac{1}{4}$ times as long as the siphunculi or the base of the sixth antennal segment is less than 200μ long 46

46 (45) Processus terminalis $1\frac{3}{5}$–3 times as long as the base of the sixth antennal segment and $\frac{9}{10}$–$1\frac{1}{4}$ times as long as the siphunculi. Ultimate rostral segment $\frac{19}{20}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus and bearing 4–9 accessory hairs. Third antennal segment without or bearing only 1 or 2 rhinaria 47

– Processus terminalis usually 3–$6\frac{3}{5}$ times as long as the base of the sixth antennal segment but if only $2\frac{1}{5}$–3 times as long then the ultimate rostral segment is only $\frac{7}{10}$–$\frac{19}{20}$ as long as the second segment of the hind tarsi and is without or bears 1–7 accessory hairs, but if with 3 or more then the processus terminalis is $1\frac{2}{3}$–$2\frac{1}{4}$ times as long as the siphunculi. Third antennal segment usually bearing 1 or more rhinaria 48

47 (46) Siphunculi 1–$1\frac{3}{5}$ times as long as the cauda which bears 6–8 hairs. Third antennal segment usually without, sometimes bearing a single rhinarium. First antennal segments bearing 6–8 hairs. Eighth abdominal tergite bearing 6–8 hairs. On *Dryas*, arctic . . . **A. (A.) *brevicornis*** (p. 32)

– Siphunculi $1\frac{4}{5}$–$2\frac{1}{10}$ times as long as the cauda which bears 5–7 hairs. Third antennal segment bearing 0–2 rhinaria. First antennal segments bearing 8–10 hairs. Eighth abdominal tergites bearing 4–5 hairs. On *Deschampsia & Festuca* in the shade, North West Europe **Acyrthosiphon (Metopolophium) *tener*** (p. 79)

48 (46) Siphunculi only 1–$1\frac{1}{3}$ as long as the cauda, which bears 7 or 8 hairs. Body $5\frac{1}{4}$–$6\frac{1}{2}$ times as long as the siphunculi. Processus terminalis 3–$4\frac{1}{3}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment $\frac{7}{10}$–$\frac{4}{5}$ as long as the second segment of the hind tarsi. 49

– Siphunculi usually $1\frac{2}{3}$–$2\frac{2}{5}$ times as long as the cauda but if only $1\frac{1}{5}$–$1\frac{2}{5}$ times as long, then body only 3–$4\frac{1}{2}$ times as long as the siphunculi (*loti*, p. 46) . 50

49 (48) Siphunculi dusky, about 6 times as long as their middle diameter and $\frac{1}{2}$–$\frac{2}{3}$ as long as the width of the head across the eyes. Processus terminalis usually

more than twice as long as the cauda. First antennal segments bearing 5–6 hairs. On *Vaccinium*, arctic and alpine . **A. (A.) brachysiphon** (p. 32)

– Siphunculi pale, about 10 times as long as their middle diameter and about equal in length to the width of the head across the eyes. Processus terminalis about $1\frac{1}{2}$ times as long as the cauda. First antennal segments bearing 8 or 9 hairs. (On *Euphorbia*?), Pakistan . . . **A. (A.) moltshanovi** (p. 48)

50 (48) Siphunculi $2\frac{1}{5}$–$3\frac{1}{10}$ (rarely less than $2\frac{2}{5}$) times as long as the cauda which bears only 6–8 hairs. Processus terminalis $3\frac{4}{5}$–$5\frac{1}{5}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment 1–$1\frac{1}{4}$ times as long as the second segment of the hind tarsus and bearing 8–12 accessory hairs. First antennal segments bearing 9–11 hairs. On *Primula*, widespread **A. (A.) primulae** (p. 66)

– Siphunculi $1\frac{2}{5}$–$2\frac{2}{3}$ as long as the cauda, if more than $2\frac{1}{5}$ then the processus terminalis is $5\frac{1}{2}$–$7\frac{1}{2}$ times as long as the base of the sixth antennal segment, or the ultimate rostral segment is $\frac{3}{4}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus, or the cauda bears more hairs or the first antennal segments bear fewer hairs 51

51 (50) Siphunculi 2–$2\frac{2}{3}$ as long as the rather triangular cauda which bears 7 or 8 hairs (Text-fig. 2). Processus terminalis 3–$4\frac{1}{10}$ as long as the base of the sixth antennal segment. Ultimate rostral segment $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus, and bearing 5–7 accessory hairs. Cauda $1\frac{2}{5}$ to twice as long as the base of the sixth antennal segment. Longest hair on the eighth abdominal tergite 35–50μ long. Body $3\frac{1}{5}$–$3\frac{2}{3}$ as long as the siphunculi.

Siphunculi strongly imbricated and are 12–16 times as long as their middle diameter which is from equal to $1\frac{1}{3}$ times the middle diameter of the hind tibiae. Base of the sixth antennal segment $1\frac{1}{10}$–$1\frac{1}{2}$ times as long as the ultimate rostral segment. On *Astragalus*, Pakistan **A. (A.) astragali** (p. 27)

– Siphunculi $1\frac{2}{5}$–$2\frac{2}{5}$ as long as the cauda, if more than twice as long, then the processus terminalis is $4\frac{1}{5}$–$7\frac{1}{2}$ times as long as the base of the sixth antennal segment and/or the ultimate rostral segment is longer than the second segment of the hind tarsus, or if shorter bears 1–3 accessory hairs, or the cauda has a distinct basal constriction and is either $2\frac{1}{4}$–$2\frac{2}{3}$ times as long as the base of the sixth antennal segment or the longest hair on the 8th abdominal tergite is less than 35μ long, or the body is $4\frac{1}{2}$–$5\frac{1}{2}$ times as long as the siphunculi . 52

52 (51) Abdominal tergites 1–4 each bearing 8–10 evidently blunt or weakly capitate hairs, 25–40μ long. Ultimate rostral segment 1–$1\frac{1}{5}$ as long as the second segment of the hind tarsi and bearing 4–8 accessory hairs. Processus terminalis 3–4 times as long as the base of the sixth antennal segment.

Dorsum pale but strongly sclerotic. Hairs on eighth abdominal tergite 40–50μ long. On *Potentilla*, Canada . . . **A. (A.) scalaris** (p. 69)

– Dorsal abdominal setae less conspicuous, usually both shorter and less capitate, those on the anterior abdominal tergites usually 10–25μ long. If the ultimate rostral segment is longer than the second segment of the hind tarsus then the processus terminalis is usually more than 4 times as long as the base of the sixth antennal segment 53

53 (52) Processus terminalis $4\frac{1}{2}$–6 times as long as the base of the sixth antennal segment and ultimate rostral segment only $\frac{2}{3}$–$\frac{17}{20}$ as long as the second segment of the hind tarsus and bearing 4–6 accessory hairs. Body 3–4 times as long as the siphunculi which are $1\frac{2}{3}$ to twice as long as the cauda which bears 7–10 hairs 54

– Processus terminalis usually shorter but if $4\frac{1}{2}$–6 times as long as the base of the sixth antennal segment then the ultimate rostral segment is at least $\frac{9}{10}$

and is usually as long as or longer than the second segment of the hind tarsus 55

54 (53) Eighth abdominal tergite usually bearing 6 hairs which are 25–30μ long. Ultimate rostral segment bearing 5 or 6 accessory hairs. First antennal segments bearing 9 or 10 hairs. On *Spiraea*, Europe ***A. (A.) ignotus*** (p. 44)

– Eighth abdominal tergite bearing 4–9 hairs which are only 15–25μ long. Ultimate rostral segment bearing 4 accessory hairs. First antennal segment bearing 6–10 hairs. On *Trifolium*, Eastern Asia ***A. (A.) kondoi*** (p. 46)

55 (52) Tergum smoky brown. Ultimate rostral segment $\frac{3}{4}$–$\frac{19}{20}$ as long as the second segment of the hind tarsus and without or with only 1 or 2 accessory hairs. Siphunculi $2\frac{1}{10}$–$2\frac{1}{3}$ times as long as the cauda which bears only 5 or 6 hairs. Processus terminalis $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment. On *Poa*, Europe . . ***A. (Metopolophium) frisicum*** (p. 78)

– Tergum usually unpigmented. Ultimate rostral segment usually bearing 4–23 accessory hairs, but if with only 2 or 3 then the siphunculi $1\frac{2}{5}$–$2\frac{1}{10}$ times as long as the cauda and processus terminalis 3–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment 56

56 (55) Ultimate rostral segment $\frac{9}{10}$–$1\frac{2}{5}$ as long as the second segment of the hind tarsus and bearing 6–23 accessory hairs. Processus terminalis $4\frac{1}{5}$–$7\frac{1}{2}$ times as long as the base of the sixth antennal segment 57

– Ultimate rostral segment $\frac{2}{3}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus and bearing 2–11 but rarely more than 8 accessory hairs. Processus terminalis 3–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment. If ultimate rostral segment more than $\frac{4}{5}$ as long as the second segment of the hind tarsus then the processus terminalis is less than $4\frac{1}{5}$ times as long as the base of the sixth antennal segment. Mostly on Leguminosae and Gramineae 59

57 (56) Base of the sixth antennal segment 180–210μ long, distinctly longer than the ultimate rostral segment which is 130–170μ long and bears 6–11 accessory hairs. On *Rosa*, *Cytisus* and Gramineae, Central Europe 58

– Base of sixth antennal segment 100–170μ long, as long as or shorter than the ultimate rostral segment which is 110–190μ long and bears 6–23 accessory hairs. On Rosaceae (other than *Rosa*) and Geraniaceae, widespread ***A. (A.) pelargonii/rubi*** complex (pp. 52 & 67)

58 (57) Siphunculi 3–$4\frac{1}{2}$ times as long as the ultimate rostral segment which bears 6 accessory hairs. Body $3\frac{1}{10}$–$4\frac{1}{5}$ times as long as the siphunculi which are $1\frac{1}{2}$–$1\frac{9}{10}$ as long as the cauda which bears 6–9 hairs. On *Cytisus*, central Europe ***A. (A.) parvus*** (p 51)

– Siphunculi $5\frac{1}{4}$–$6\frac{1}{2}$ times as long as the ultimate rostral segment which bears 8–11 accessory hairs. Body 4–5 times as long as the siphunculi which are $1\frac{4}{5}$–$2\frac{1}{10}$ as long as the cauda which bears 9–13 hairs. On *Rosa* and *Poa alpina*, alpine . . . . . ***A. (Metopolophium) alpinus*** (p. 73)

59 (56) Siphunculi and cauda brown. Third antennal segment bearing 3–8 rhinaria. Processus terminalis 3–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment. Body 5–$5\frac{1}{2}$ times as long as the siphunculi which are $1\frac{1}{2}$–$1\frac{3}{5}$ as long as the cauda which bears 9 or 10 hairs. *Taraxacum*, Canadian arctic ***A. (Metopolophium) arctogenicolens*** (p. 73)

– Siphunculi pale or dusky, cauda pale 60

60 (59) Third antennal segment bearing 5–15 rhinaria. Body 4–5 times as long as the siphunculi which are $1\frac{2}{5}$–$1\frac{3}{5}$ as long as the cauda which bears only 5 or 6 rather short hairs. Processus terminalis $3\frac{1}{3}$–$4\frac{1}{3}$ times as long as the base of sixth antennal segment. Mongolia . . . . ***A. (A.) dauricum*** (p. 36)

– Third antennal segment without or bearing 1–4 rhinaria 61

61 (60) Siphunculi gradually decreasing in diameter from base to apex, about 10 times as long as their middle diameter which is about $1\frac{1}{2}$ times as thick as the middle diameter of the hind tibiae. Body 3–4 times as long as the siphunculi which are $4\frac{3}{4}$–$6\frac{3}{4}$ times as long as the ultimate rostral segment and $1\frac{1}{2}$–$2\frac{1}{10}$ times as long as the cauda which bears 7–10 hairs. On *Caragana*, *Colutea* and *Coronilla emerus*, Europe and introduced to North America **A. (A.) caraganae** (p. 33)

– Siphunculi more slender, tapering from the base to the middle but thereon cylindrical and with their middle diameter little if any more than that of the hind tibiae. If middle diameter of siphunculi up to $1\frac{1}{4}$ times that of the hind tibiae, then the body is $4\frac{1}{3}$–$5\frac{1}{3}$ times as long as the siphunculi . . . 62

62 (61) Body $2\frac{9}{10}$–$3\frac{9}{10}$ times as long as the siphunculi, only in large specimens (body length $2\frac{1}{2}$ mm or more) more than $3\frac{1}{2}$ times as long. Siphunculi $1\frac{4}{5}$–$2\frac{2}{5}$ times as long as the cauda which bears 5–8 hairs, only small specimens (body length $1\frac{1}{2}$–2 mm) with siphunculi less than twice as long as the cauda.

Siphunculi very slender, usually 16–22 times as long as their least middle diameter but small specimens (body length $1\frac{1}{2}$–2 mm) may have siphunculi only 13–16 times as long as their middle diameter. Siphunculi usually $4\frac{1}{2}$–$5\frac{1}{2}$ times as long as the ultimate rostral segment but in small specimens only $3\frac{3}{4}$–$4\frac{1}{2}$ times as long. First antennal segments bearing 5–8 hairs. On *Bidens pilosa* and more rarely other dicotyledons, Yemen, North and East Africa . . . . **A. (A.) bidentis** (p. 31)

– Body $3\frac{1}{5}$–$5\frac{1}{2}$ times as long as the siphunculi but if less than $3\frac{9}{10}$ then the siphunculi are less than $1\frac{4}{5}$ times as long as the cauda. 63

63 (62) Ultimate rostral segment 140–150μ, long and slender, 5–$6\frac{1}{4}$ times as long as its diameter across the 6 primary hairs at the apex of the fourth segment.

Processus terminalis 3–$3\frac{2}{3}$ times as long as the base of the sixth antennal segment and 3–4 times as long as the ultimate rostral segment, which bears 8 accessory hairs. Body $3\frac{1}{5}$–$4\frac{2}{5}$ times as long as the siphunculi which are $1\frac{1}{2}$–$1\frac{4}{5}$ as long as the cauda which is strongly constricted on the basal half. Longest hairs on eighth abdominal tergite 30–40μ long. On Papaveraceae, Middle East, Southern Russia . . . . . . **A. (A.) ilka** (p. 44)

– Ultimate rostral segment 90–130μ long and 3–$4\frac{1}{2}$ times as long as the diameter across the distal primary hairs. Central and Western Europe . . . 64

64 (63) Ultimate rostral segment 110–130μ long and $3\frac{3}{4}$–$4\frac{1}{2}$ times as long as its diameter across the 6 distal primary hairs. Body $3\frac{1}{5}$–$4\frac{2}{5}$ as long as the siphunculi which are $1\frac{1}{5}$–$1\frac{4}{5}$ as long as the cauda. On *Lotus*, Europe. **A. (A.) loti** (p. 46)

– Ultimate rostral segment 90–130μ long and 3–$4\frac{1}{4}$ times as long as its diameter across the 6 distal primary hairs, if more than $3\frac{3}{4}$ times as long then the body is $4\frac{1}{2}$–$5\frac{1}{2}$ times as long as the siphunculi. On *Rosa* and Gramineae (sg. *Metopolophium*) 65

65 (64) Longest hairs on the eighth abdominal tergite 35–45μ long. Ultimate rostral segment 120–130μ long and bearing 6–9 accessory hairs. On *Rosa* and Gramineae, alpine. . . . . . **A. (Metolophium) montanus** (p. 79)

– Longest hairs on the eighth abdominal tergite 12–30μ long. Ultimate rostral segment 90–120μ long and bearing 2–6 accessory hairs. On Gramineae, Europe 66

66 (65) Antennae about as long as or longer than the body which is $3\frac{4}{5}$–5 times as long as the siphunculi which are $1\frac{3}{4}$–$2\frac{1}{10}$ times as long as the cauda and $3\frac{1}{2}$–5 times as long as the second segment of the hind tarsi. Processus terminalis $3\frac{1}{2}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment which is $1\frac{1}{10}$–$1\frac{1}{2}$ (rarely less than $1\frac{1}{5}$) times as long as the second segment of the hind tarsus. On *Arrhenatherum* . . **A. (Metopolophium) albidus** (p. 72)

– Antennae $\frac{3}{5}$–$\frac{9}{10}$ as long as the body which is $4\frac{1}{2}$–$5\frac{1}{3}$ times as long as the siphunculi which are $2\frac{1}{2}$–$4\frac{1}{2}$ times as long as the second segment of the hind tarsi. Processus terminalis 3–4 times as long as the base of the sixth antennal segment which is 1–$1\frac{1}{3}$, but rarely more than $1\frac{1}{4}$ times as long as the second segment of the hind tarsi. Various Gramineae
A. (*Metopolophium*) *festucae* (p. 77)

Alatae viviparae

1 Processus terminalis only $1\frac{1}{5}$–$1\frac{1}{2}$ times as long as the base of the sixth antennal segment. Secondary rhinaria distributed, III, 6–13; IV, 1–4; V, 3. First tarsal segments bearing only 2 hairs.
Ultimate rostral segment 60–75μ long and bearing 3–5 accessory hairs. On *Potentilla*, Ontario . . . . . . ***Myzaphis canadensis*** (p. 84)

– Processus terminalis 2–10 times as long as the base of the sixth antennal segment. First tarsal segments usually bearing 3, sometimes with 5, hairs 2

2 (1) Processus terminalis $7\frac{1}{2}$–8 times as long as the base of the sixth antennal segment and $2\frac{1}{4}$–$2\frac{2}{3}$ as long as the weakly clavate siphunculi. Secondary rhinaria distributed, III, 34–41; IV, 5–8; V, 0–1.
Ultimate rostral segment 160–180μ long and bearing 13–19 accessory hairs. On *Melandrium*, Europe . . . . . ***Volutaphis schusteri*** (p. 85)

– Processus terminalis 2–10 times as long as the base of the sixth antennal segment but when more than twice as long as the siphunculi usually without but rarely bearing 1 or 2 rhinaria on the fourth antennal segment . . . 3

3 (1) Processus terminalis 8–10 times as long as the base of the sixth antennal segment and 3–$3\frac{1}{2}$ times as long as the siphunculi. Secondary rhinaria distributed, III, 22–26; IV, 1 or 2. Body 6–$6\frac{1}{2}$ times as long as the siphunculi which are $1\frac{1}{10}$–$1\frac{1}{4}$ times as long as the cauda which bears 7–9 hairs. Ultimate rostral segment 90–100μ long and $\frac{7}{10}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus. On *Spiraea*, Eastern North America **A. (A.) *pseudodirhodum*** (p. 67)

– Processus terminalis 2–$9\frac{1}{2}$ times as long as the base of the sixth antennal segment, but if more than twice as long as the siphunculi then the fourth antennal segment is without secondary rhinaria 4

4 (3) Secondary rhinaria distributed, III, 13–20; IV, usually 5–11, abnormally 2–4; V, 0–4. Processus terminalis 450–700μ long, $3\frac{1}{2}$–$4\frac{3}{4}$ times as long as the base of the sixth antennal segment and 1–$1\frac{2}{3}$ as long as the siphunculi.
Siphunculi $1\frac{1}{3}$ to twice as long as the cauda which bears 6–8 hairs, the distal 2–5 of which are short and capitate. Longest hairs on the eighth abdominal tergite only 8–18μ long. On *Rosa* and *Fragaria*, widespread
A. (*Rhodobium*) *porosus* (p. 79)

– Secondary rhinaria usually confined to the third antennal segment, but if the fourth segment bears 1 to 3 then the processus terminalis is 1·3–1·5 mm long and the siphunculi are about 1 mm long, and weakly clavate . . . 5

5 (4) Body $1\frac{2}{5}$ to twice as long as the siphunculi. Secondary rhinaria distributed, III, 19–27; IV, 0–3; V, 0.
Siphunculi 0·9–1·2 mm long, weakly calavate and $2\frac{3}{4}$–4 times as long as the cauda which bears 7–9 hairs. Processus terminalis 1·3–1·5 mm long and 7–9 times as long as the base of the sixth antennal segment. Ultimate rostral segment 100–130μ long, $\frac{3}{4}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus and bearing only 2 accessory hairs. On *Amelanchier*, North America . . . . **A. (A.) *macrosiphum*** (p. 47)

– Body $2\frac{1}{5}$–$9\frac{1}{2}$ times as long as the siphunculi. Secondary rhinaria confined to the third antennal segment. 6

6 (5) Body $2\frac{1}{5}$–3 times as long as the siphunculi which are $2\frac{1}{2}$–$3\frac{1}{3}$ times as long as the cauda which bears 10–15 hairs.

Processus terminalis 0·9–1·3 mm long and $3\frac{1}{4}$–$4\frac{1}{4}$ times as long as the base of the sixth antennal segment. Third antennal segment bearing 10–21 rhinaria. First antennal segment bearing 12–18 hairs. Ultimate rostral segment 120–140μ long, $\frac{2}{3}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus and bearing 7–9 accessory hairs. On Leguminosae, Malvaceae and sometimes other plants, Middle East . . . . . . ***A. (A.) gossypii*** (p. 41)

– Body $2\frac{4}{5}$–$9\frac{1}{2}$ times as long as the siphunculi but if $2\frac{4}{5}$–3 times then the siphunculi are only $1\frac{1}{2}$–$2\frac{1}{10}$ times as long as the cauda 7

7 (6) Siphunculi 0·8–1·1 mm long, and with a well developed apical flange with a diameter $1\frac{1}{2}$ to twice that of the attenuated sub-apical part. Body $3\frac{1}{3}$–$4\frac{1}{4}$ times as long as the siphunculi which are $2\frac{1}{3}$–3 times as long as the cauda which bears 7–11 hairs.

Antennal tubercles well developed with almost parallel inner margins. Processus terminalis $5\frac{3}{4}$–$7\frac{1}{2}$ times as long as the base of the sixth antennal segment which is 180–260μ long and $1\frac{1}{5}$–$1\frac{3}{5}$ as long as the ultimate rostral segment, which is about equal in length, 140–170μ ,to the second segment of the hind tarsi and bears 6–13 accessory hairs. Longest hair on 8th abdominal tergite 50–110μ long. On *Urtica*, Holarctic . . ***Microlophium*** (p. 84)

– Siphuncular flange less well developed. If siphunculi more than 0·8 mm, then siphunculi not more than $2\frac{1}{4}$ times as long as the cauda, processus terminalis only 3–5 times as long as the base of the sixth antennal segment, ultimate rostral segment 120–150μ long and only $\frac{3}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus and longest hairs on 8th abdominal tergites only 15–40μ long. 8

8 (7) All abdominal tergites bearing conspicuous capitate hairs, those on the third abdominal tergites 45–75μ long, and those on the 8th tergites 45–65μ long. Third antennal segment also bearing conspicuous capitate hairs, 18–40μ long.

Abdomen pigmented dorsally with well developed transverse bands or an almost solid patch. Body $5\frac{1}{4}$–$7\frac{1}{4}$ times as long as the siphunculi which are 250–340μ long, with a well developed flange, and are $1\frac{3}{4}$–$2\frac{1}{2}$ times as long as the cauda which bears 4–6 hairs. Ultimate rostral segment 100–120μ long, equal in length or up to $1\frac{1}{5}$ as long as the second segment of the hind tarsus. Third antennal segment bearing 6–11 rhinaria. Processus terminalis $4\frac{1}{4}$–$5\frac{1}{2}$ times as long as the base of the sixth antennal segment. On Gramineae, Holarctic *Cryptaphis* (p. 82). 9

– If the body hairs are capitate, then those on the middle abdominal tergites are shorter. Antennal hairs usually less conspicuous 10

9 (8) Siphunculi 11–$15\frac{1}{2}$ times as long as the longest hair on the third antennal segment and 2–$2\frac{1}{2}$ times as long as the cauda. Processus terminalis $4\frac{1}{3}$–$5\frac{1}{10}$ times as long as the base of the sixth antennal segment. On *Holcus* and other Gramineae, Europe . . . . . . ***Cryptaphis poae*** (p. 83)

– Siphunculi 5–$9\frac{1}{2}$ times as long as the longest hair on the third antennal segment and $1\frac{3}{4}$–$2\frac{1}{10}$ as long as the cauda. Processus terminalis 5–6 times as long as the base of the sixth antennal segment. On *Bromus*, Manitoba ***Cryptaphis bromi*** (p. 82)

10 (8) First tarsal segments bearing 5 hairs. Body 6–$9\frac{1}{2}$ times as long as the siphunculi which are $1\frac{1}{10}$–$1\frac{2}{3}$ as long as the cauda. Ultimate rostral segment $\frac{2}{3}$–$\frac{3}{5}$ as long as the second segment of the hind tarsus. Processus terminalis $3\frac{1}{2}$–5 times as long as the base of the sixth antennal segment. If processus terminalis $3\frac{1}{2}$–$4\frac{1}{4}$ times as long as the base of the sixth antennal segment, then the third antennal segment bears 45–70 rhinaria 11

– First tarsal segments bearing 3 hairs. If body more than 6 times as long as the siphunculi, then the ultimate rostral segment is more than $\frac{3}{5}$ as long as the second segment of the hind tarsi and if $\frac{3}{5}$–$\frac{3}{4}$ then the processus terminalis is rarely more than $3\frac{1}{2}$ times as long as the base of the sixth antennal segment, and when $3\frac{1}{2}$–$4\frac{1}{10}$ times as long the third antennal segment bears 15–30 rhinaria 12

11 (10) Third antennal segment bearing 45–70 rhinaria. Processus terminalis $3\frac{1}{2}$–4 times as long as the base of the sixth antennal segment. Body $7\frac{1}{2}$–$9\frac{1}{4}$ times as long as the siphunculi which are $1\frac{1}{5}$–$1\frac{2}{3}$ times as long as the cauda. On *Corydalis*, North America . . . . . . ***A. (A.) tutigula*** (p. 71)

– Third antennal segment bearing 4–12 rhinaria. Processus terminalis $4\frac{1}{3}$–5 times as long as the base of the sixth antennal segment. Body 6–$6\frac{1}{2}$ times as long as the siphunculi which are $1\frac{1}{10}$–$1\frac{1}{4}$ times as long as the cauda. On *Euphorbia*, Europe . . . . . . ***A. (A.) cyparissiae*** (p. 34)

12 (10) Processus terminalis 1·5–1·8 mm long, 5–$9\frac{1}{2}$ times as long as the base of the sixth antennal segment and 3–4 times as long as the siphunculi.

Body $3\frac{3}{4}$–$5\frac{1}{4}$ times as long as the siphunculi which are 350–600μ long. Ultimate rostral segment 105–120μ long and bearing 4–6 accessory hairs. Third antennal segment bearing 12–21 rhinaria. North America . . 13

– Processus terminalis 0·3–1·4 mm long but if more than 1·0 mm, then less than $2\frac{1}{3}$ times as long as the siphunculi 14

13 (12) Siphunculi $1\frac{1}{2}$–$2\frac{1}{3}$ times as long as the cauda which bears only 5 or 6 hairs. Ultimate rostral segment $\frac{9}{10}$ to almost equal in length to the second segment of the hind tarsus which is 120–135μ long. First antennal segments bearing 10–17 hairs. On *Aster* . . . . ***A. (A.) asterifoliae*** (p. 26)

– Siphunculi $1\frac{2}{5}$–$1\frac{3}{4}$ times as long as the cauda which bears 9–12 hairs. Ultimate rostral segment $\frac{2}{5}$–$\frac{3}{5}$ as long as the second segment of the hind tarsus which is 200–230μ long. First antennal segments bearing 6–8 hairs. On *Mertensia* . . . . ***A. (A.) niwanista*** (p. 50)

14 (12) Ultimate rostral segment 120–130μ long, equal to $1\frac{1}{10}$ as long as the second segment of the hind tarsus and bearing only 2 accessory hairs. Longest hairs on eighth abdominal tergite 10–15μ long.

Processus terminalis $4\frac{1}{2}$–$5\frac{1}{4}$ times as long as the base of the sixth antennal segment which is $1\frac{1}{4}$–$1\frac{1}{2}$ times as long as the ultimate rostral segment. Body 5–$6\frac{3}{4}$ times as long as the siphunculi which are $1\frac{3}{4}$–$2\frac{1}{5}$ as long as the cauda which bears 4–6 hairs, the apical pair being short and capitate. On *Trifolium*, Europe. . . . . . ***Subacyrthosiphon cryptobius*** (p. 84)

– Ultimate rostral segment usually with 4 or more accessory hairs, if with only 1–3 then the segment is less than $\frac{9}{10}$ as long as the second segment of the hind tarsi. Longest hairs on 8th tergite 17–60μ 15

15 (14) Ultimate rostral segment 120–140μ long, $\frac{3}{5}$–$\frac{7}{10}$ as long as the second segment of the hind tarsus and bearing 16–24 accessory hairs. Third antennal segment bearing 11–18 rhinaria. Processus terminalis $2\frac{4}{5}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment. Body $4\frac{1}{2}$–6 times as long as the siphunculi which are $1\frac{1}{5}$–$1\frac{4}{5}$ times as long as the cauda which bears 7–10 hairs. On *Lactuca*, holarctic . . . . ***A. (Tlja) lactucae*** (p. 81)

– If the ultimate rostral segment bears more than 15 accessory hairs then it is at least $\frac{9}{10}$ as long as the second segment of the hind tarsus 16

16 (15) First antennal segments bearing 11–20 hairs. Base of the sixth antennal segment 240–390μ long and $1\frac{3}{5}$–$2\frac{2}{3}$ times as long as the ultimate rostral segment. Siphunculi 0·55–1·15 mm long and slender on the apical half.

Body $2\frac{3}{4}$–$5\frac{1}{2}$ times as long as the siphunculi. Third antennal segment bearing 5–29 rhinaria. Processus terminalis $2\frac{3}{4}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment. Ultimate rostral segment 120–160μ long and $\frac{2}{3}$–$\frac{19}{20}$ as long as the second segment of the hind tarsi and bears 5–10 accessory hairs. Cauda bearing 7–15 hairs. On Leguminosae, widespread (*A.* (*A.*) *pisum*) 17

– First antennal segments bearing 5–11 hairs, but if with 10 or 11 hairs then either the base of the sixth antennal segment or the siphunculi shorter . 19

17 (16) Ultimate rostral segment bearing 8–10 accessory hairs. Base of the sixth antennal segment, 250–280μ long, $1\frac{3}{5}$–$1\frac{9}{10}$ as long as the ultimate rostral segment, which is $\frac{4}{5}$–$\frac{19}{20}$ as long as the second segment of the hind tarsus. Cauda bearing 12–16 hairs. On *Ononis*, Europe ***A. (A.) pisum ononis*** (p. 64)

– Ultimate rostral segment bearing 5–7 accessory hairs. Base of the sixth antennal segment 240–390μ long, $1\frac{3}{4}$–$2\frac{2}{3}$ as long as the ultimate rostral segment which is $\frac{2}{3}$–$\frac{17}{20}$ as long as the second segment of the hind tarsi. Cauda bearing 7–15 hairs 18

18 (17) Siphunculi $1\frac{1}{10}$–$1\frac{2}{3}$ times as long as the cauda. Eighth abdominal tergite bearing 7–12 hairs. On herbaceous Leguminosae . ***A. (A.) p. pisum*** (p. 58)

– Siphunculi $1\frac{1}{2}$–$2\frac{1}{10}$ times as long as the cauda. Eighth abdominal tergite bearing 6–8 hairs. On *Sarothamnus* . . ***A. (A.) pisum spartii*** (p. 65)

19 (16) Eighth abdominal tergite bearing only 2 hairs. Ultimate rostral segment about $\frac{2}{3}$ as long as the second segment of the hind tarsus.

Processus terminalis 2–3 times as long as the base of the sixth antennal segment. On Gramineae, India . ***A. (Metopolophium) chandrani*** (p. 74)

– Eighth abdominal tergite usually bearing 4–9 hairs, if rarely with only 3 then the ultimate rostral segment is $\frac{4}{5}$ or more as long as the second segment of the hind tarsus 20

20 (19) Processus terminalis 0·9–1·2 mm long, 6–8 times as long as the base of the sixth antennal segment. Cauda bearing only 6 or 7 hairs. Ultimate rostral segment 110–160μ long, $1\frac{1}{20}$–$1\frac{1}{3}$ as long as the second segment of the hind tarsi and bearing 10–14 accessory hairs.

Body 3–$4\frac{1}{4}$ times as long as the siphunculi which are $1\frac{3}{4}$–$2\frac{1}{5}$ times as long as the cauda. Third antennal segment bearing 12–19 rhinaria. Longest hairs on the eighth abdominal tergite 20–35μ long On Compositae, South America and West Indies . . . . . . ***A. (A.) bidenticola*** (p 31)

– Processus terminalis usually shorter but if not, then cauda bearing 8–11 hairs and Ultimate rostral segment $\frac{3}{5}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus 21

21 (20) Body $6\frac{1}{3}$–$9\frac{1}{2}$ times as long as the siphunculi. Third antennal segment bearing 4–12 rhinaria. Ultimate rostral segment $\frac{3}{4}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus.

Siphunculi $1\frac{1}{10}$–$1\frac{2}{5}$ as long as the cauda which bears 6–10 hairs. Processus terminalis 2–4 times as long as the base of the sixth antennal segment. Arctic and alpine 22

– Body $3\frac{1}{3}$–$6\frac{2}{3}$ as long as the siphunculi but if more than 6 times then the third antennal segment bearing 8–30 rhinaria and the ultimate rostral segment often less than $\frac{3}{4}$ as long as the second segment of the hind tarsus . . 24

22 (21) Third antennal segment bearing 11–12 rhinaria Processus terminalis 2–$2\frac{1}{4}$ times as long as the base of the sixth antennal segment, 1–$1\frac{1}{5}$ times as long as the siphunculi and $1\frac{1}{5}$–$1\frac{1}{3}$ as long as the cauda which bears 10 hairs Ultimate rostral segment $\frac{3}{4}$–$\frac{4}{5}$ as long as the second segment of the hind tarsus Body 9–$9\frac{1}{2}$ times as long as the siphunculi. On sand dunes, North Western Europe . . . . ***A. (A.) auctus*** (p. 30)

– Third antennal segment bearing 4–6 rhinaria. Processus terminalis $2\frac{1}{2}$–$4\frac{1}{4}$ times as long as the base of the sixth antennal segment, $1\frac{1}{5}$–$2\frac{1}{4}$ times as long as the siphunculi and $1\frac{1}{2}$–$2\frac{1}{4}$ times as long as the cauda, which bears 6–8 hairs. Ultimate rostral segment $\frac{4}{5}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus. Body $6\frac{1}{4}$–$7\frac{3}{4}$ times as long as the siphunculi. Alpine and arctic . 23

23 (22) Processus terminalis $3\frac{1}{2}$–4 times as long as the base of the sixth antennal segment. Siphunculi 3–$4\frac{1}{5}$ times as long as the ultimate rostral segment which is $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus. On *Vaccinium*, arctic and alpine . . . . **A. (A.) brachysiphon** (p. 32)

– Processus terminalis $2\frac{1}{2}$–$3\frac{1}{3}$ times as long as the base of the sixth antennal segment. Siphunculi 2–3 times as long as the ultimate rostral segment which is $\frac{9}{10}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus. On *Dryas*, arctic . . . . **A. (A.) brevicornis** (p. 32)

24 (21) Siphunculi 400–650μ long and $2\frac{1}{4}$–$3\frac{1}{5}$ times as long as the cauda which bears 6–8 hairs. Dorsum bearing transverse dark bands. Processus terminalis $3\frac{2}{3}$–5 times as long as the base of the sixth antennal segment. Third antennal segment bearing 30–55 rhinaria. Ultimate rostral segment $\frac{9}{10}$–$1\frac{1}{4}$ times as long as the second segment of the hind tarsus and bearing 8–12 accessory hairs.

Longest hair on eighth abdominal tergite 40–55μ. On *Primula*, widespread **A. (A.) primulae** (p. 66)

– Siphunculi $1\frac{1}{3}$–$2\frac{2}{3}$ as long as the cauda but if more than $2\frac{1}{5}$ then either the abdominal dorsum pale and the processus terminalis 5–$6\frac{1}{2}$ times as long as the base of the sixth antennal segment (*pelargonii* group) or the processus terminalis only $2\frac{3}{4}$–$3\frac{1}{3}$ times as long as the base of the sixth antennal segment or the cauda triangular without a basal constriction, the third antennal segment bearing only 14–18 rhinaria and the ultimate rostral segment $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus 25

25 (24) Siphunculi 320–430μ long and $2\frac{1}{5}$–$2\frac{2}{3}$ times as long as the cauda which bears only 5 or 6 hairs. Abdomen bearing conspicuous transverse dark dorsal bands. Processus terminalis $2\frac{3}{4}$–$3\frac{1}{3}$ times as long as the base of the sixth antennal segment.

Ultimate rostral segment $\frac{3}{4}$–$\frac{9}{10}$ as long as the second segments of the hind tarsi and bearing only 1 or 2 accessory hairs. On *Poa*, Europe **A. (Metopolophium) frisicum** (p. 78)

– Siphunculi $1\frac{1}{3}$–$2\frac{1}{3}$ times as long as the cauda but if more than $2\frac{1}{10}$ then the abdominal dorsum is pale and the processus terminalis is $3\frac{1}{3}$–$6\frac{1}{2}$ times as long as the base of the sixth antennal segment. 26

26 (25) Ultimate rostral segment 100–110μ long, about equal in length to the second segment of the hind tarsi and bearing 4–7 accessory hairs. Processus terminalis $2\frac{1}{5}$–$2\frac{4}{5}$ as long as the base of the sixth antennal segment. Abdominal dorsum bearing dark bands.

Body $5\frac{2}{3}$–$6\frac{2}{3}$ as long as the siphunculi which are $1\frac{1}{5}$–$2\frac{1}{10}$ times as long as the cauda, which bears 5–7 hairs. On *Deschampsia* and *Festuca*, Europe **A. (Metopolophium) tener** (p. 79)

– If the ultimate rostral segment is $\frac{9}{10}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus, then it is 120–190μ long, the processus terminalis is $3\frac{4}{5}$–$8\frac{1}{4}$ times as long as the base of the sixth antennal segment and the abdominal dorsum is pale. 27

27 (26) Abdomen bearing dark dorsal bands.

Ultimate rostral segment $\frac{3}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus. On *Rosa* and Gramineae, Europe 28

– Abdominal dorsum pale 30

28 (27) Dark dorsal abdominal bands well developed. Body $4\frac{1}{3}$–$6\frac{1}{3}$ times as long as

the siphunculi. Ultimate rostral segment bearing 5–9 accessory hairs. Third antennal segment bearing 7–26 rhinaria.

Processus terminalis $2\frac{3}{4}$–$4\frac{1}{2}$ times as long as the base of the sixth antennal segment. Cauda bearing 5–8 hairs (s.g. *Metopolophium* partim) . . 29

– Dark dorsal bands only weakly developed and present only in old specimens. Body $3\frac{2}{3}$–5 times as long as the siphunculi. Ultimate rostral segment bearing 7–11 accessory hairs. Third antennal segment bearing 4–31 rhinaria 30

29 (28) Ultimate rostral segment 100–115μ long, $\frac{7}{10}$–$\frac{9}{10}$ as long as the second segment of the hind tarsi (120–160μ). Siphunculi $1\frac{1}{2}$–$1\frac{9}{10}$ times as long as the cauda. On Gramineae, N.W. Europe. . **A. (*Metopolophium*) *festucae*** (p. 77)

– Ultimate rostral segment 120–130μ long, $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsi. Siphunculi $1\frac{7}{10}$–$2\frac{1}{10}$ as long as the cauda. On *Rosa* and *Poa alpina*, alpine. . . . **A. (*Metopolophium*) *montanus*** (p. 79)

30 (27, 28) Ultimate rostral segment 120–150μ long, more than twice as long as its own basal width and bearing 5–8 accessory hairs, but only $\frac{3}{5}$–$\frac{17}{20}$ as long as the second segment of the hind tarsus which is 160–190μ long. Body $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the siphunculi.

Third antennal segment usually a little longer than the processus terminalis and bearing 5–13 rhinaria. Processus terminalis $2\frac{1}{2}$–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment and the second segments of the hind tarsi. Siphunculi $1\frac{2}{3}$ to twice as long as the cauda which bears 8–11 hairs. Longest hairs on eighth abdominal tergite 30–40μ long. On *Chelidonium*, Europe & Korea . . **A. (*Lipporhinus*) *chelidonii*** (p. 72)

– When ultimate rostral segment $\frac{3}{5}$–$\frac{17}{20}$ as long as the second segment of the hind tarsus, it is 90–140μ long and is either less than $1\frac{3}{4}$ as long as its basal width, or if 120–140μ long and more than twice as long as its basal width, then the body is $3\frac{3}{5}$–5 times as long as the siphunculi. . 31

31 (30) Ultimate rostral segment 90–130μ long, $\frac{3}{5}$–$\frac{3}{4}$ as long as the second segment of the hind tarsus and less than $1\frac{3}{4}$ as long as its own basal diameter and bearing 4–7 accessory hairs. Processus terminalis $2\frac{2}{3}$–$4\frac{1}{5}$ times as long as the base of the sixth antennal segment. On *Rosa* and Gramineae (s.g. *Metopolophium* partim). 32

– Ultimate rostral segment $\frac{7}{10}$–$1\frac{1}{3}$ times as long as the second segment of the hind tarsus, when $\frac{7}{10}$–$\frac{4}{5}$ as long then more than $1\frac{4}{5}$ times as long as its own basal diameter 33

32 (31) Third antennal segment bearing 14–29 rhinaria extending over nearly the whole length of the segment. Body $4\frac{3}{4}$–$6\frac{2}{3}$ as long as the siphunculi which usually have brownish apices and are $2\frac{1}{3}$–$3\frac{1}{4}$ times as long as the second segment of the hind tarsi which are 150–190μ long. Siphunculi 3–$3\frac{1}{4}$ times as long as the second segments of the hind tarsi in medium or large aphids with the siphunculi 460–610μ long. Siphunculi 11–13 times as long as their minimum diameter. Cauda bearing 8–15 hairs. Longest hair on 8th abdominal tergite 25–45μ long. On *Rosa* and Gramineae, widespread **A. (*Metopolophium*) *dirhodum*** (p. 74)

– Third antennal segment bearing 7–18 but rarely more than 14 rhinaria extending over its basal $\frac{2}{3}$–$\frac{7}{8}$. Body $4\frac{1}{5}$–5 times as long as the siphunculi which are usually uniformly pale and $2\frac{4}{5}$–4 times as long as the second segments of the hind tarsi which are 125–155μ long. Siphunculi only $2\frac{4}{5}$–3 times as long as the second segments of the hind tarsi in small specimens with siphunculi 360–420μ long. Siphunculi 13–20 times as long as their minimum diameter. Cauda bearing 5–8 hairs. Longest hair on 8th abdominal tergite 20–30μ long. On *Arrhenatherum*, Europe **A. (Metopolophium) albidus** (p. 72)

33 (31) Processus terminalis 4 (but rarely less than 5)–$8\frac{1}{4}$ times as long as the base of the sixth antennal segment which is $\frac{9}{10}$–$1\frac{1}{10}$ as long as the ultimate rostral segment. Third antennal segment bearing 12 (but rarely less than 17)–31 rhinaria. Ultimate rostral segment $\frac{17}{20}$–$1\frac{1}{3}$ times as long as the second segment of the hind tarsus and bearing 7 (but rarely less than 10)–18 accessory hairs. On Geraniaceae and herbaceous Rosaceae **A. pelargonii/rubi** complex (pp. 52 & 67)

– Processus terminalis 3–5 times as long as the base of the sixth antennal segment which is at least as long as but usually $1\frac{1}{10}$–$1\frac{2}{3}$ as long as the ultimate rostral segment. Third antennal segment bearing 4–26 (but rarely more than 16) rhinaria. Ultimate rostral segment $\frac{7}{10}$–$1\frac{1}{10}$ but rarely more than $\frac{9}{10}$, as long as the second segment of the hind tarsus and bearing 6–11 accessory hairs. On *Rosa*, Leguminosae, Compositae and Gramineae . . . 34

34 (33) Ultimate rostral segment $\frac{9}{10}$–$1\frac{1}{10}$ as long as the second segment of the hind tarsus.

Body $3\frac{1}{2}$–$4\frac{1}{4}$ times as long as the siphunculi which are $1\frac{2}{3}$ to twice as long as the cauda, which bears 6–8 hairs. Third antennal segment bearing 7–12 rhinaria. On *Cytisus* . . . . **A. (A.) parvus** (p. 51)

– Ultimate rostral segment $\frac{7}{10}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus 35

35 (34) Siphunculi $2\frac{1}{2}$–3 times as long as the second segment of the hind tarsus. Processus terminalis 3–$3\frac{1}{2}$ times as long as the base of the sixth antennal segment which is $1\frac{1}{2}$–$1\frac{2}{3}$ as long as the ultimate rostral segment which bears 8–10 accessory hairs.

Third antennal segment bearing 11–16 rhinaria. Body $4\frac{1}{2}$–5 times as long as the siphunculi which are $1\frac{1}{2}$ to twice as long as the cauda, which bears 9 or 10 hairs. On *Sonchus*, Pakistan . . . **A. (A.) ghanii** (p. 38)

– Siphunculi 3–$4\frac{1}{4}$ times as long as the second segment of the hind tarsus. Processus terminalis $3\frac{1}{5}$–$5\frac{2}{3}$ as long as the base of the sixth antennal segment which is 1–$1\frac{1}{2}$ times as long as the ultimate rostral segment . . . 36

36 (35) Cauda 240–270μ long, triangular without a basal constriction and bearing 6 or 7 hairs. Siphunculi 2–$2\frac{1}{4}$ times as long as the cauda and 14–16 times as long as their own middle diameter. Hairs on the seventh and eighth abdominal tergites arising from transverse dark bands about as dark as the lateral abdominal sclerites.

Body 4–5 times as long as the siphunculi. Third antennal segment bearing 15–17 rhinaria and usually a little shorter than the processus terminalis which is $3\frac{1}{2}$–4 times as long as the base of the sixth antennal segment. Ultimate rostral segment 120–145μ long, twice as long as its own basal width, $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsus and bearing 5–7 accessory hairs. Longest hairs on the eighth abdominal tergite 35–45μ, on third abdominal tergite 12–15μ. On *Astragalus*, Pakistan **A. astragali** (p. 27)

– Cauda with a basal constriction, and at least half as long as the siphunculi in the species normally occurring on Leguminosae. When the siphunculi are more than twice as long as the cauda then they are also 16–21 times as long as their own middle diameter and the seventh and eighth abdominal tergites are pale 37

37 (36) Siphunculi tapering from base to apex, 8–13 times as long as their middle diameter which is $1\frac{1}{2}$ to twice that of the hind tibiae.

Body $3\frac{1}{3}$–$4\frac{1}{4}$ times as long as the siphunculi which are $1\frac{1}{2}$ to twice as long as the cauda which bears 8–13 hairs. Siphunculi 3½–4½ times as long as the second segment of the hind tarsus. Third antennal segment bearing 6–13 rhinaria. On *Caragana, Colutea, Coronella emerus.* Europe and North America . . . . **A. (A.) caraganae** (p. 35)

– Siphunculi more slender, 15–21 times as long as their middle diameter and 9/10–1¼ times as thick as the middle diameter of the hind tibiae, or if only 9–13 times as long as their middle diameter then they are 1–1⅗ as thick as the middle diameter of the hind tibiae 37

38 (37) Siphunculi 1⅓–1⅔ as long as the cauda which bears 6–9 hairs, 9–13 times as long as their middle diameter which is 1–1⅗ as thick as the middle diameter of the hind tibiae. Third antennal segment bearing 4–10 rhinaria. Body 4–4¼ times as long as the siphunculi, which are 3–3½ times as long as the the second segment of the hind tarsi. On *Lotus*, Europe **A. (A.) loti** (p. 46)

– Siphunculi 1¾–2⅓ times as long as the cauda and 16–21 times as long as their own middle diameter which 9/10–1¼ times as thick as the middle diameter of the hind tibiae. Third antennal segment bearing 10–26 rhinaria. Body 3⅔–5 times as long as the siphunculi which are 3–4 times as long as the second segment of the hind tarsi 39

39 (38) Lateral sclerites of abdominal segments 2–4 with a small dark area anterior to the tubercle and with the remainder of the sclerite much paler. Third antennal segment bearing 10–16 rhinaria. Processus terminalis 3⅖–4⅕ times as long as the base of the sixth antennal segment. Ultimate rostral segment bearing 6–8 accessory hairs. On Compositae and more rarely other herbaceous dicotyledons. Yemen, North and East Africa **A. (A.) bidentis** (p. 31)

– Lateral abdominal tubercles more uniformly pigmented, the area anterior to the tubercle only a little darker than the remainder of the sclerite. Third antennal segment bearing 11–26 rhinaria. Processus terminalis 3⅘–5 times as long as the base of the sixth antennal segment. Ultimate rostral segment bearing 8–11 accessory hairs. On *Rosa* and *Poa alpina*, alpine **A. (Metopolophium) alpinus** (p. 73)

THE SPECIES OF *ACYRTHOSIPHON*

Acyrthosiphon (A.) asterifoliae (Strom, 1934)

(Text-fig. 1)

Macrosiphum asterifoliae Strom, 1934 : 619–620.
Acyrthosiphon asterifoliae (Strom) Pepper, 1965 : 183, 202.

Specimens studied. U.S.A.: Penn., State College, *Aster* sp., 17.viii.1962, 5 apterae, 2 alatae (*J. O. Pepper*), B.M. 1966–306; Wis., Milwaukee, *Aster* sp., 15.ix. 1934, 1 apt., 1 al. (*L. G. Strom*), B.M. 1964–655.

Host plants. *Aster* sp. or spp. (Compositae).

Distribution. U.S.A., Pennsylvania & Wisconsin.

Biology. According to Pepper (1965 : 183) it lives on the lower leaves and falls off readily when disturbed.

Notes. Resembles *Pleotrichophorus* Börner, 1930, but lacks the fan-shaped hairs characterizing that genus.

Acyrthosiphon (A.) astragali **sp. n.**

(Text-fig. 2)

Apterae viviparae: described from 6 specimens with body length $2\frac{1}{5}$–$2\frac{2}{3}$ mm. Macerated specimens with distal apices of antennal segments III–V, apical half of the base of antennal VI, distal apices of femora, tibiae, siphunculi and spiracular plates dusky to dark. Antennal segments I, II and the processus terminalis sometimes dusky, remainder of insect pale. Antennal tubercles moderately developed and with a weakly developed median tubercle. As the inner side of the antennal tubercles are slightly scabrous, the general appearance of the front of the head resembles that often found in the subgenus *Metopolophium*. Antennae a little longer than the body, which is $3\frac{1}{5}$ to $3\frac{1}{2}$ times as long as the siphunculi. Processus terminalis $3\frac{2}{5}$–$4\frac{1}{10}$ times as long as the base of the sixth antennal segment. Third antennal segment bearing 1 or 2 rhinaria near its base and hairs up to 11–13μ long, that is about $\frac{1}{3}$ as long as the basal diameter of the segment. First antennal segments bearing 7–9 hairs. Posterior dorsal cephalic hairs 16–17μ long, about half as long as the basal diameter of the third antennal segment. Ultimate rostral segment reaching to the hind coxae, 130–145μ long, $\frac{4}{5}$–$\frac{9}{10}$ as long as the second segment of the hind tarsi and bearing 6 or 7 accessory hairs. First tarsal segments bearing 3 hairs. Longest hairs on (posterior margin of) hind femur 22–27μ long. Dorsal abdominal hairs 11–14μ long on the anterior tergites but 38–48μ long on the eighth abdominal tergite, which bears 4 to 6 hairs. Sub-genital plate bearing 3–6 hairs on the anterior half and a row of 7–8 hairs along the posterior margin. Siphunculi evidently imbricated over their entire length and $2\frac{1}{10}$–$2\frac{3}{5}$ as long as the cauda. The cauda is more triangular and less constricted on the basal half than in most other *Acyrthosiphon* and bears 7 or 8 pointed hairs.

Alatae viviparae: described from two specimens with body length $2\frac{1}{4}$–$2\frac{3}{5}$ mm. Head and thorax dark, antennae dark except for the very base of the third segment and the basal half of the sixth segment. The distal one third of the femora and the very apices of the tibiae are also dark. Lateral abdominal sclerites on segments 2 to 4 dusky to dark, with sometimes a small central imbricated area even darker. Body $4\frac{1}{4}$–$4\frac{3}{5}$ as long as the siphunculi. Third

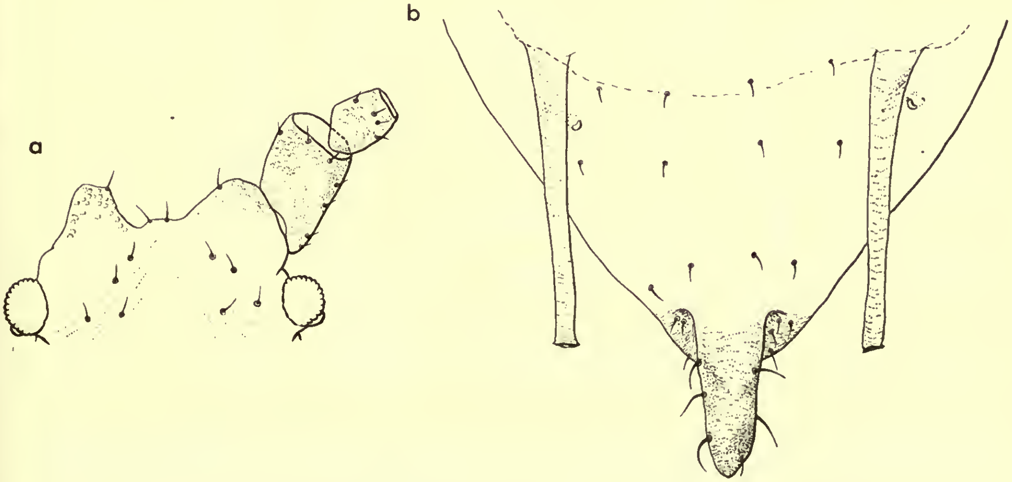

FIG. 1. *Acyrthosiphon asterifoliae*, aptera, a, head; b, apex of abdomen. × 80.

antennal segment bearing 15–17 rhinaria extending over most of its length. Fourth antennal segment without rhinaria. Media of the fore wing twice branched in 3 wings and only once branched in the other. In the specimen with the once branched media, the cauda bears only 6 hairs. This caudal chaetotaxy is asymmetrical and looks abnormal. Apparently the most distal lateral hair is missing from the side where the media of the forewing is only once branched. In this specimen the sub-genital plate bears 5 hairs on the anterior half and a row of 9 along the posterior margin. The other alata bears 12 hairs on the anterior half of the sub-genital plate and 9 along the posterior margin. The specimen shows no other ovipariform features: the hind tibiae of both alatae being typical for viviparae of *Acyrthosiphon*. The lateral abdominal sclerites sometimes bear very small tubercles, smaller even than the hair bases.

Table 1: Measurements of *Acyrthosiphon astragali* sp. n. in mm.

	Body length	siphunculi	cauda	Antennal segments				ultimate rostral segment	second segment of hind tarsus	Rhinaria on antennal segments		No. of hairs on		
				III	IV	V	VI			III	IV	ultimate rostral segment	eighth abdominal tergite	cauda
1.	2.22	.67	.28	.63	.54	.52	.17+.63	.13	.15	1	0	6	6	8
		.68		.61	.51	.51	.19+.65		.16	1	0			
2.	c2.4	.63	.28	.58	.49	.49	.16+.61	.13	.16	1	0	-	4	8
		.63		.58	.50	.51	.17+.63		.17	1	0			
3.	2.44	.72	.28	.61	.56	.52	.19+.70	.14	.17	1	0	6	6	7
		.71		.63	.52	.51	.19+.72		.18	1	0			
4.	c2.2	.75	.35	.73	.61	.57	.18+.73	.14	.17	2	0	7	5	7
		.75		.72	.59	.59	.18 -		-	1	0			
5.	c2.2	.65	.31	.59	.51	.51	.17+.61	.14	.16	1	0	5	5	8
		.65		.63	.50	.51	.16+.62		.15	1	0			
6.	2.28	.52	.24	.66	.51	.58	.18+ -	.13	.16	17	0	6	5	6
		.52		.66	-	-	-		.16	15	-			
7.	2.53	.55	.26	.73	.59	.61	.19+.73	.14	.16	16	1	-	5	7
		.55		.73	-	-	-		.16	15	-			

1 (type) - 5, apterae viviparae, 6 & 7 alatae viviparae, Pakistan, Madyar, *Astragalus* sp., 3.i.1963, C.I.B.C.

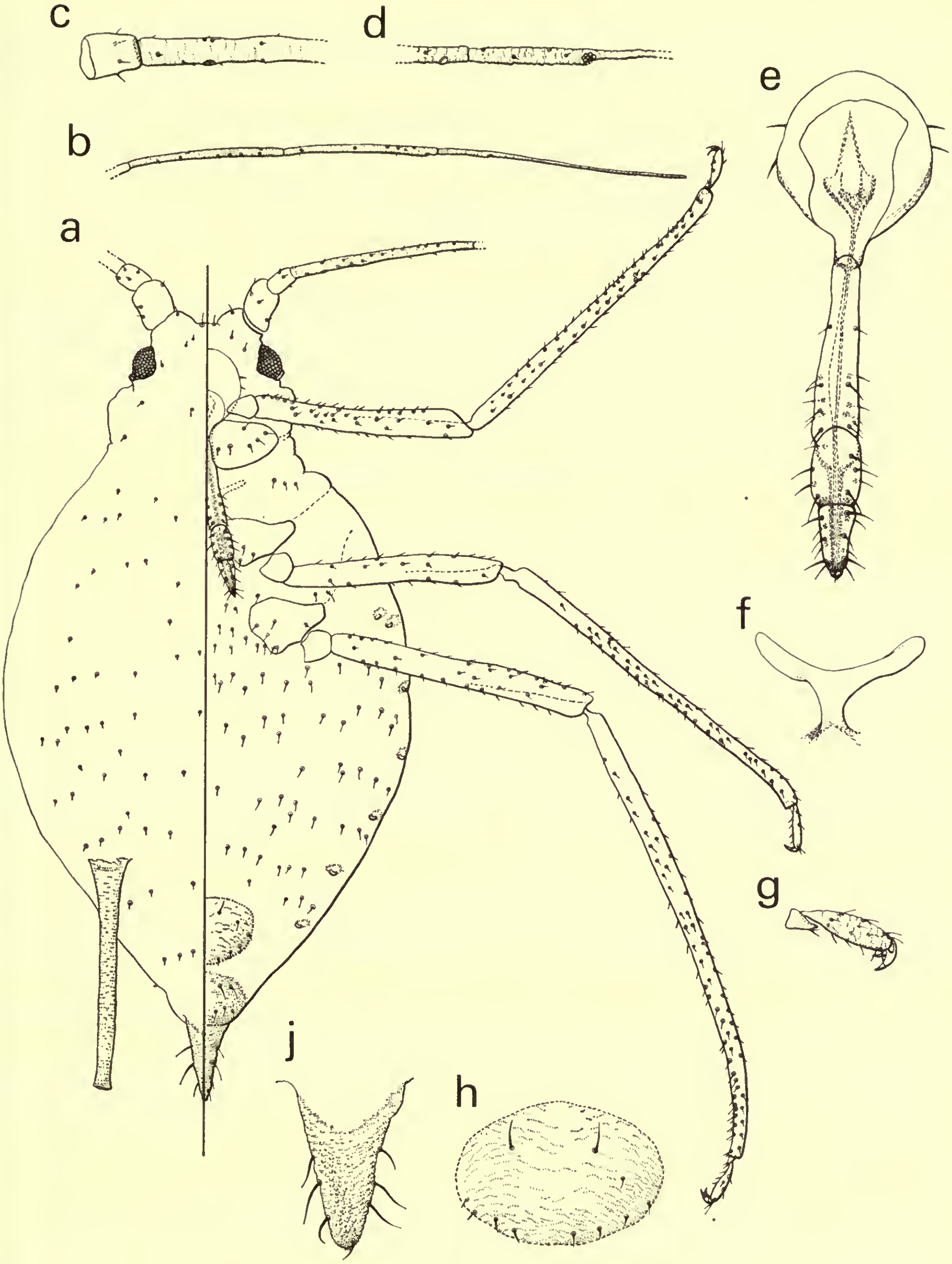

FIG. 2. *Acyrthosiphon astragali*, aptera, a, body; b, antennal segments IV–VI; c, antennal segment II and base III; d, apex of antennal V and base VI; e, rostrum; f, mid-thoracic furca; g, hind tarsus; h, sub-genital plate; j, cauda. a & b ×40, c-j ×80.

SPECIMENS STUDIED. Holotype aptera vivipara, PAKISTAN: Madyar, *Astragalus* sp., 3.i.1963, Commonwealth Institute of Biological Control, Aphid Reg. 317/1963.

Paratypes, 4 apterae and 2 alatae viviparae with the same collection data as the holotype.

Other specimens, one aptera vivipara and one alatoid nymph, PAKISTAN: Alamgang, 17.ii.1963, C.I.B.C.

HOST PLANT. *Astragalus* sp. (Leguminosae).

DISTRIBUTION. Pakistan.

NOTES. The triangular cauda without basal constriction (Text-fig. 2 j) separates *astragali* from the otherwise similar *A. ilka* and *A. bidentis*. *A. kondoi*, which also has an almost unconstricted cauda, differs in that the longest hairs on the eighth abdominal tergite are only 15–20μ long in *kondoi* and are 35–45μ long in *astragali*. The processus terminalis is $3\frac{1}{3}$–$4\frac{1}{5}$ times as long as the base of the sixth antennal segment in *astragali* and $4\frac{3}{4}$–6 times as long in *kondoi*.

Acyrthosiphon (A.) auctus (Walker, 1849)

Aphis aucta Walker, 1849 : xxxiii ; 1852 : 1017.
Acyrthosiphon silenicola Hille Ris Lambers, 1955 : 4–7.
Acyrthosiphon shawi Stroyan, 1957 : 313–316.
Acyrthosiphon aucta (Walker) Heie, 1958 : 214–218.
Acyrthosiphon auctus (Walker); Hille Ris Lambers, 1959: 271; Prior & Stroyan, 1960 : 272; Heie, 1961 : 87; 1964 : 224–225; Doncaster, 1961 : 32–34.

SPECIMENS STUDIED. DENMARK: Thyboren, *Honkenya peploides*, 22.vi.1957, 1 aptera (*O. Heie*). ENGLAND: 3 oviparae, Walker collection slide nos. 113 & 115 (see Doncaster, 1961 : 32–34 & 115). SCOTLAND: Aberdeenshire, Frazerburgh, St. Coombs, *Cakile maritima*, 22.viii.1955, 1 apt. (*M. W. Shaw* coll.), H. L. G. Stroyan leg., paratype of *A. shawi*, B.M. 1957–153.

HOST PLANTS. *Honkenya peploides* and also recorded from *Stellaria media*, *Silene maritima* (Caryophyllaceae), *Cakile maritima* and *Capsella bursapastoris* (Cruciferae).

DISTRIBUTION. Northern England (Newcastle), Scotland, Denmark, Finland, Germany, Iceland & Sweden (Ossiannilsson 1961 : 232; 1969*b* : 54).

BIOLOGY. 'Obviously sandy biotypes as dunes are preferred.' (Heie, 1961 : 78).

NOTES. Authors using the name *Myzus auctus* (Wlk.) were referring to *Myzus certus* (Wlk.) (=*Myzus caryophylacearum* H.R.L.).

Acyrthosiphon (A.) aurlandicus Heikinheimo, 1966

Acyrthosiphon aurlandicus Heikinheimo, 1966 : 388–391.

HOST PLANT. Unknown.

DISTRIBUTION. Norway.

NOTES. Included in the key from the original description only.

Acyrthosiphon (A.) bidenticola Smith, 1960

Acyrthosiphon bidenticola Smith, 1960 : 157–158; Smith, Smith, Martorell & Perez-Escolor, 1964 : 17–18.

Specimens studied. Brazil: Sao Paulo, Camoinas, water trap, 10–12.iii.1967, 1 alata; May/June, 1968, 2 al. (*C. L. Costa*); Puerto Rico: Maricao Forest, 10.iii. 1955, 1 aptera, 1 al., Cayey, *Bidens pilosa*, 19.iv.1960, 2 apt. (*C. F. Smith*), B.M. 1960–693; Venezuela: Maracay, A.R., *Helianthus annuus*, 24.ix.1964, 2 apt., 1 al. (*M. Cermeli*).

Host plants. *Bidens pilosa*, *Helianthus annuus* (Helenieae), *Erechtites valerianaefolia* (Senecioneae), all Compositae.

Distribution. Puerto Rico, Venezuela, Brazil, Cuba (Müller, 1968 : 439).

Acyrthosiphon (A.) bidentis Eastop, 1953

Acyrthosiphon bidentis Eastop, 1953 : 201–202; 1958 : 19–20.

Specimens studied. Morocco: High Atlas, S.W. Imlil El Haj, 'beating bushes', 28.iv.1961, 1 alata; Arend Valley, 'under stones', 29.iv.1961, 1 al. (*P. N. Lawrence*); Kenya: Muguga, *Bidens pilosa*, 1.xi.1952, 1 aptera (holotype), B.M. 1955–756, 1 aptera (paratype); *Sonchus* sp., 11.ix.1953, 6 apt., 3 first instar larvae; 26.xi.1952, 1 al., *Linum grandiflorum*, 22.vii.1953, 16 apt., 4 first instar larvae; *Arachis hypogea*, 13.x.1953, 15 apt., 4 al., 8 first instar larvae; *Torylis africana*, 10.viii.1953, 2 apt.; *Papaver nudicaule*, 8.vii.1953, 1 al., 8.viii.1953, 5 apt.; trap, June 1953, 1 al. (*V. F. E*); 1 vagrant alata, 7.vii.1953 (*B. E. Eastop*); Fort Hall, *Bidens pilosa*, 24.vii. 1952, 1 al. (*F. L. M. Sheffield*); Yemen: San'a District, February 1938, 1 al. (*H. Scott & E. B. Britton*).

Host plants. *Bidens pilosa*, *Sonchus* sp. (Compositae), *Linum grandiflorum* (Linaceae), *Arachis hypogea* (Leguminosae), *Torylis africana* (Umbelliferae), *Papaver nudicaule* (Papaveraceae).

Distribution. Morocco, Kenya, Yemen.

Biology. Usually living on the stalks of the inflorescence. Apparently less specific to host species but more specific to the feeding site on the host than many other *Acyrthosiphon*.

Notes. Very similar to and possibly a synonym of the Southern Russian and Middle Eastern *A. ilka* Mdw. (see p. 44). The single available aptera of *A. ilka* has its siphunculi 17 times as long as their middle diameter and its first antennal segments bear 9 hairs. The siphunculi of *A. bidentis* are usually more slender, 18–22 times as long as their middle diameter in the apterae and the first antennal segments bear 5 to 7 or rarely 8 hairs. *A. astragali* sp. n. (p. 27) also resembles these two species but has a more triangular cauda without a basal constriction.

Acyrthosiphon (A.) brachysiphon Hille Ris Lambers, 1952

Acyrthosiphon brachysiphon Hille Ris Lambers, 1952 : 6—8; 1955 : 4; Heie, 1964 : 225–226; Shaposhnikov, 1964 : 603.

SPECIMENS STUDIED. GREENLAND: Sarqaq, *Vaccinium uliginosum*, 26.vii.1949, 2 apterae (*Chr. Vibe* coll.), D. Hille Ris Lambers leg., B.M. 1963–531.

HOST PLANTS. *Vaccinium uliginosum* (Ericaceae).

DISTRIBUTION. Greenland, Iceland (Prior & Stroyan, 1960 : 271), Sweden (Ossiannilsson, 1959 : 482), Switzerland (Meier, 1958 : 292), Canada, Baffin Is., (Richards, 1963 : 462).

BIOLOGY. According to the original description there are only 3 generations a year in the Arctic, fundatrices in July and apterous males and oviparae in August.

Acyrthosiphon (A.) brevicaudatus Takahashi, 1965

Acyrthosiphon pisi ssp. *brevicaudatus* Takahashi, 1965 : 20–21.

HOST PLANTS. *Pisum* sp., *Trifolium* sp. (Leguminosae).

DISTRIBUTION. Japan, Korea.

NOTES. According to the original description, differing from *pisi* in having a shorter cauda only $\frac{3}{5}$–$\frac{2}{3}$ as long as the siphunculi and only 9 hairs on the first antennal segments.

Acyrthosiphon (A.) brevicornis Hille Ris Lambers, 1960

Acyrthosiphon brevicornis Hille Ris Lambers, 1960 : 1–7.

SPECIMENS STUDIED. SWEDEN: T. Lpm., Abisko, *Dryas* sp., 24.vii.1955, 3 apterae (*F. Ossiannilsson*), B.M. 1956–428; CANADA: Southampton Is., Coral Harbour, *Dryas integrifolia*, 15. VIII. 1959, 1 apt. (*W. R. Richards*), B.M. 1963–621.

HOST PLANTS. *Dryas integrifolia*, *D. octopetala* (Rosaceae).

DISTRIBUTION. Greenland, Sweden (Ossiannilsson, 1959 : 482); Canada, Southampton Is. (Richards, 1963*c* : 462).

NOTES. The similarity to *A. calvulus* is discussed by Heikinheimo (1968 : 86–88).

Acyrthosiphon (A.) calvulus Ossiannilsson, 1958

Acyrthosiphon calvulus Ossiannilsson, 1958 : 66–68; Heikinheimo, 1968 : 86–88; Pettersson 1968 : 188–189.

HOST PLANT. *Poa arctica* (Gramineae).

DISTRIBUTION. Spitzbergen.

NOTES. Similar to *A. brevicornis*, q.v.

Acyrthosiphon (A.) caraganae (Cholodkovsky, 1907)

Siphonophora pisi (Ktlb.) Bogdanov, 1897 : 25, nec Kaltenbach, 1843, teste Mordwilko, 1914 : 152.
Siphonophora ulmariae (Schrank) Cholodkovsky, 1898 & 1902, nec Schrank, 1801, partim, teste Mordwilko, 1914 : 52.
Siphonophora sp., Mordwilko, 1901 : 297.
Macrosiphum ulmariae (Schrank) Schouteden, 1906 : 240, partim, nec Schrank, 1801.
Siphonophora caraganae Cholodkovsky, 1907 : 87–95.
Macrosiphum caraganae (Cholodkovsky) Cholodkovsky, 1909 : 4–5, 10; Opamis, 1928 : 392–393.
Acyrthosiphon caraganae (Chol.) Mordwilko, 1914 : 152–168; Hille Ris Lambers, 1947 : 222–225; Stroyan, 1950 : 91–92; Meier, 1955 : 292–295; Rupais, 1969 : 264–265.
Acyrthosiphon caraganae ssp. *occidentale* Hille Ris Lambers, 1947 : 225.
Metopolophium caraganae (Chol.) Börner, 1952 : 155.
Metopolophium occidentale (H.R.L.) Börner, 1952 : 155–156.
Acyrthosiphon emeri Hille Ris Lambers m.s., in Stroyan, 1955 : 290.

SPECIMENS STUDIED. CZECHOSLOVAKIA: Prague, *Caragana arborescens*, 2.vi.1964, 7 apterae, 1 alata (*J. Holman, P. Stary, V.F.E.*). ENGLAND: Berks, Reading, *Colutea orientalis*, 8.iv.1961, 4 fundatrices; 3.v.1948, 8 apt. (? second generation); 11.v.1949, 5 apt., 7 al.; 28.v.1966, 2 apt., 3 al.; 2.vi.1955, 5 apt.; 10.vi.1950, 15 apt.; 3.vii.1955, 4 apt., 3 al.; 20.ix.1948, 1 ovipara, 1 apterous ♂. Surrey, Kew, *Colutea arborescens*, 28.iv.1961, 2 apt.; 2–12.v.1961, 12 apt., 2 first instar larvae; 1.vi.1961, 12 apt., 4 al., 28 first instar larvae; 8–12.vi.1961, 6 apt., 7 al.; 17.vi.1963, 1 apt., 1 al.; 5.vi.1967, 3 apt., al., 3 first instar larvae; 18.vii.1963, 5 apt., 13.vii.1963, 2 apt., July 1965, 9 apt., 2 first instar larvae, 7.vii.1967, 4 apt., 1 al; 13–16.viii.1962, 4 apt.; 27.ix.1966, 11 apt.; 24.x.1963, 8 oviparae; October 1964, 2 apterae viviparae, 6 oviparae, 5 apterous ♂♂; 1.xi.1963, 1 apt. ♂. London, Chelsea Physic Gardens, *Colutea* sp., July 1955, 2 apt.; *C. orientalis*, 12.x.1955, 6 apt. viviparae, 1 ovipara. Cambridge, Univ. Bot. Gdn, *Coronilla emerus*, 10.vi.1952, 49 apt., 2 al., 7 first instar larvae; Somerset, Merriot, ? *Colutea* sp., 9.ix.1950, 2 apt., 3 first instar larvae (*V.F.E.*). HUNGARY: Baloton föred, *Colutea arborescens*, 31.v.1965, 5 apt., 3 al., 1 first instar larva (*P. Andrasfavy*). NETHERLANDS: Wageningen arboretum, *Caragana* sp., 21.v.1930, 4 apt. (*D. Hille Ris Lambers*), B.M. 1934–70; *Caragana arborescens*, 26.vi.1952, 6 apt. 2 al.; *C. frutex*, 26.vi.1952, 9 apt. (*D.H.R.L. & V.F.E.*). CANADA: Alberta, Waterton National Park, *Caragana* sp., 1 apt., 3 al. (*G. F. Knowlton*). Manitoba, Winnipeg, *Caragana* sp., 9.vi.1961, 1 apt., *Caragana* sp. in glasshouse, 25.x.1961, 1 al. vivip., 1 ovipara; 31.x.1961, 1 al. ♂ (*A. G. Robinson*).

HOST PLANTS. Woody Papilionaceae, *Anthyllis hermanniae* (Meier, 1958 : 295), *Caragana arborescens*, *C. frutex*, *C. pygmaea* (Meier, 1958 : 295), *C. spinosa* (Szelegiewicz, 1963 : 128), *Colutea arborescens*, *C. media* (Meier, 1958 : 295), *C. orientalis*, *Coronilla emerus*, *Hippocrepis comosa* (Meier, 1958 : 295), all Leguminosae.

DISTRIBUTION. Denmark (Heie, 1961 : 87), England, Finland, Germany, Hungary (Szelegiewicz, 1968 : 88), Netherlands, Norway (Ossiannilsson, 1959 : 55), Poland (Szelegiewicz, 1958 : 83), Crimea (Holman, 1961 : 118), Moscow, Leningrad, Latvia (Rupais, 1961 : 128), Sweden (Wahlgren, 1951 : 69), Switzerland (Meier, 1958 : 292), Mongolia (Szelegiewicz, 1963 : 128), Canada (Richards, 1963 : 254).

BIOLOGY. The fundatrices are adult by early April in the Thames valley and alatae occur from the second week in May to early July. Ossiannilsson (1959 : 482) recorded alatae in Sweden from 30.vi. to 22.vii, but Meier (1959 : 294) found alatae in Switzerland in May, June, August and November on different host plants. Males are apterous in England and the Netherlands and alate in Russia, Switzerland and Eastern Canada, which led Hille Ris Lambers (1947 : 225) to regard the Western European specimens as belonging to a distinct subspecies *occidentale*. As some other aphids also tend to produce apterous males in maritime climates and alate males in continental climates (Eastop, 1954 : 84–86), the different male morphs may be environmentally induced. Chromosomes: 2n = 10 (Robinson & Chen, 1969 : 512).

Acyrthosiphon (A.) catharinae Nevsky, 1928

Acyrthosiphon catharinae Nevsky, 1928 : 185–186, 1929 : 78–81; Mordwilko, 1932 : 240; Hille Ris Lambers, 1966 : 116; Narzikulov & Umarov, 1969 : 188–189.

HOST PLANTS. *Rosa damascena, kokanica, maracandica, webbiana* (Rosaceae).

DISTRIBUTION. Central Asia.

NOTES. Hille Ris Lambers (1953 : 63) had the spring forms of *A.* (*Metopolophium*) *alpinus* H.R.L. When found, *A. catharinae* should be recognizable as, according to the original description, the siphunculi are more than half as long as the body and 3 to 5 times as long as the cauda. The processus terminalis is 3½–5 times as long as the base of the sixth antennal segment and the third antennal segment of the alata bears 10 to 12 rhinaria.

Acyrthosiphon (A.) cyparissiae (Koch) s. lat.

A. cyparissiae exists in two colour forms; specimens with black head, antennae and extremities of appendages are *cyparissiae* s. str. and those with a pale head, antennae and only the very apices of the appendages dark are the form *propinquum*.

Acyrthosiphon (A.) cyparissiae (Koch, 1855) s. str.

Siphonophora cyparissiae Koch, 1855 : 174–175; Passerini, 1863 : 134; 1871 : 294; Ferrari, 1872 : 212; Macchiati, 1883 : 220, 275; del Guercio, 1900 : 164.

Acyrthosiphon cyparissiae (Koch) Mordwilko, 1914 : 188–192; Nevsky, 1929 : 81–82; Hille Ris Lambers, 1947 : 225–229.

Macrosiphum sp., van der Goot, 1915 : 87, teste Hille Ris Lambers, 1947 : 226.

Acyrthosiphon (*Mirotarsus*) *cyparissiae* (Koch) Börner, 1939 : 83; Tuatay & Remaudière, 1965 : 269.

Mirotarsus cyparissiae (Koch) Börner, 1952 : 153.

SPECIMENS STUDIED. FRANCE: Drôme, Susse la Rousse, *Euphorbia cyparissias*, 6.iv.1965, 4 apterae, 6 alatae (*F. Leclant*). NETHERLANDS: Wageningen, *E. esula*, 22.ix.1934, 2 apt. viviparae, 2 oviparae; *E. cyparissias*, August 1939, 1 apt. 2 al. (*D. Hille Ris Lambers*); Grebbe, *E. esula*, 17.vi.1954, 30 apt., 1 al. (*D.H.R.L. & J.P. Doncaster*). YUGOSLAVIA: Doboj, 18.ix.1963, 8 apt. (*N. Tanasijevic*); Wurzen Pass, *Euphorbia* ?, 10.viii.1966, 1 apt. (*V.F.E.*).

Acyrthosiphon (A.) cyparissiae f. ***propinquum*** Mordwilko, 1914

Acyrthosiphon cyparissiae ssp. *propinquum* Mordwilko, 1914 : 193–196.
Acyrthosiphon cyparissiae var. *propinquum* Mordwilko, Hille Ris Lambers, 1947 : 226–227.
Mirotarsus cyparissiae ssp. *propinquua* (Mordwilko) Börner, 1952 : 53.

SPECIMENS STUDIED. NETHERLANDS, Lith, *Euphorbia esula*, September 1929, 2 apt. (*D. Hille Ris Lambers*). YUGOSLAVIA: Doboj, 18.ix.1963, 8 apt. (*N. Tanasijevic*).

The form *propinquum* is more common in warmer situations and times of year. Both mixed colonies and specimens intermediate between the two forms occur, for instance the sample of 16 apterae from Doboj in September contained 8 dark *cyparissiae* s.str. and 8 other specimens, 6 of these were pale *propinquum* but 2 had the head and appendages a little darker.

HOST PLANTS. *Euphorbia cyparissias, E. esula, E. seguierana* (=*gerardiana*), Euphorbiaceae.

DISTRIBUTION. Bulgaria (Tashev, 1964 : 183), Czechoslovakia, France, Germany, Hungary, Italy, Netherlands, Poland, Switzerland, Crimea (Holman, 1961 : 118), Bessarabia, European Russia and central Asia, Turkey.

BIOLOGY. Living on the upper sides of higher leaves. Sexuales in the last week of September in the Netherlands (Hille Ris Lambers, 1947 : 228).

NOTES. Because the first tarsal segments bear 5–7 hairs where most other members of *Acyrthosiphon* bear only 3 hairs, Börner, 1939, proposed a new subgenus *Mirotarsus* for *cyparissiae* and used it as a full genus in 1952. Hille Ris Lambers, 1947 : 229, pointed out that *A. cyparissiae* is similar to other *Euphorbia*-feeding species which have only 3 hairs on the first tarsal segments, and did not accept *Mirotarsus* as even subgenerically distinct. There are a few other *Acyrthosiphon* species with five hairs on the first tarsal segments belonging to different species-groups. British records of *cyparissiae* apply to other species. *A. cyparissiae* is one of a number of *Euphorbia*-feeding aphids which appear to be widespread in Continental Europe, the host plants of which occur in Britain although the aphids have never been found here. Del Guercio (1913 : 94) described a variety *cucurbitae* from sugar, cucumbers and melons in Italy. It is unlikely that a variety of *cyparissiae* would live on this range of host plants. *A. vasilijevi* was described from *Cucurbita* (p. 71).

Acyrthosiphon (A.) cyparissiae turkestanicum Nevsky

HOST PLANT. *Euphorbia virgata.*

DISTRIBUTION. Kazakstan.

NOTES. Listed from *Euphorbia virgata* in Kazakstan by Nevsky, 1951 : 47 and by Narzikulov & Umarov, 1969 : 178. A formal description has not been seen.

Acyrthosiphon (A.) dauricum Szelegiewicz, 1963

Acyrthosiphon dauricum Szelegiewicz, 1963 : 129–131; 1964 : 214.

HOST PLANT. Possibly *Saussurea salicifolia* (Compositae) but see Szelegiewicz, 1964 : 214.

DISTRIBUTION. Mongolia.

Acyrthosiphon (A.) emeljanovi Mordwilko, 1914

Acyrthosiphon emeljanovi Mordwilko, 1914 : 171–173; 1915 : 11.

HOST PLANT. Unknown.

DISTRIBUTION. Eastern Siberia.

NOTES. Described from one aptera, with incomplete antennae. The dark distal halves of the siphunculi should assist recognition when it is refound. The proportions of body, siphunculi, cauda and antennae are reminiscent of small specimens of the *pisum* group but the thick cauda bearing 14 hairs should distinguish it. Mordwilko's account (1914) of *Acyrthosiphon* is arranged systematically and *emeljanovi* is placed between *caraganae* and *gossypii*. Similar to *genistae*.

Acyrthosiphon (A.) ericetorum Hille Ris Lambers, 1959

Acyrthosiphon ericetorum Hille Ris Lambers, 1959 : 271–273.

SPECIMENS STUDIED. NETHERLANDS: Oirschot, *Genista anglica*, 9.x.1952, 4 oviparae (*D. Hille Ris Lambers & L. Verhoeven*), B.M. 1963–531. (cotypes).

HOST PLANTS. *Genista anglica* (Leguminosae).

DISTRIBUTION. Netherlands.

NOTES. Described from sexuales only but included in the key to apterae viviparae as the oviparae of *Acyrthosiphon* are similar to the viviparae in many respects.

Acyrthosiphon (A.) euphorbiae euphorbiae Börner, 1940

Acyrthosiphon euphorbiae Börner, 1940 : 4; Hille Ris Lambers, 1947 : 229–231; Narzikulov & Umarov, 1969 : 175–176.

HOST PLANTS. *Euphorbia esula*, *E. palustrae* (original description), *E. platyphylos* (Tuatay & Remaudière, 1965 : 269).

DISTRIBUTION. Czechoslovakia (Pintera, 1957 : 513), Germany (original description), France (Remaudière, 1954 : 235), Sardinia, Turkey, (Tuatay & Remaudière, 1965 : 269), Bulgaria (Tashev, 1964 : 182), Hungary (Szelegiewicz, 1968 : 89). The specimens recorded from Bulgaria (Tashev, 1961 : 158) on *Euphorbia platyphyllos* were later (Tashev, 1962 : 419–422) described as a new species, *A. thracicus*.

NOTES. There is doubt about both the host plant range and geographical distribution of *A. euphorbiae*. According to Tashev, 1962 : 421, there is yet another Southern European member of this group, undescribed but listed as *A. euphorbinus* Hille Ris Lambers.

Acyrthosiphon (A.) euphorbiae neerlandicum Hille Ris Lambers, 1947

Acyrthosiphon euphorbiae ssp. *neerlandicum* Hille Ris Lambers, 1947 : 231.

SPECIMENS STUDIED. NETHERLANDS: Grebbe, *Euphorbia esula*, 8.vii.1961, 4 apterae (*D. Hille Ris Lambers*), B.M. 1963–531. NORWAY: Oslo bot. trädg., *E. polychroma*, 25.vii.1960, 2 apt. (*F. Ossiannilsson*).

BIOLOGY. Living in small colonies on the upper sides of the leaves (Hille Ris Lambers, 1947 : 230).

NOTES. Two Norwegian specimens are somewhat intermediate between the German material of *euphorbiae* and the Dutch specimens of *neerlandicum*.

Acyrthosiphon (A.) evodiae (Takahashi, 1929)

Macrosiphon evodiae Takahashi, 1929 : 92–93; 1931 : 60; Shinji, 1941 : 835.
Acyrthosiphon evodiae (Takahashi) Tao, 1963 : 190.

HOST PLANT. *Evodia triphylla* (Rutaceae).

DISTRIBUTION. Taiwan.

NOTES. When refound, it should be easily recognized. The siphunculi are described as being brown on the basal half, black on the distal half and $\frac{2}{7}$ as long as the body but only $1\frac{1}{5}$–$1\frac{1}{3}$ as long as the elongate yellow cauda, which bears 14 hairs. The antennae and legs are black and the processus terminalis is 4 times as long as the base of the sixth antennal segment.

Acyrthosiphon (A.) fragariaevescae Nevsky, 1951

Acyrthosiphon fragariaevescae Nevsky, 1951 : 47–48.
Acyrthosiphon vescae Nevsky, Narzikulov & Umarov, 1969 : 172.

HOST PLANT. *Fragaria vesca* (Rosaceae).

DISTRIBUTION. Kazakhstan.

NOTES. Much of the description fits a small member of the *pelargonii* group but the base of the sixth antennal segment is 210–220μ long, longer than any known member of that group.

Acyrthosiphon (A.) genistae Mordwilko, 1914

Acyrthosiphon genistae Mordwilko, 1914 : 144–147; 1928 : 191; Shaposhnikov, 1964 : 603.
Acyrthosiphon spartii ssp. *genistae* Mordwilko, Börner, 1952 : 153, 257.

HOST PLANT. *Genista tinctoria* (Leguminosae).

DISTRIBUTION. European Russia.

NOTES. Regarded as a synonym of *pisum* by Meier (1958 : 308) but it seems that while *pisum* feeds on *Genista* in Switzerland, a distinct species with dark siphunculi and fewer hairs on the first antennal segments lives on *Genista* in Russia (Shaposhnikov, 1964 : 603). *A. emeljanovi* Mdw. described from a single damaged aptera from Eastern Siberia is similar.

***Acyrthosiphon (A.) ghanii* sp. n.**

(Text-fig. 3)

Apterae viviparae. Described from 7 specimens with body length 2–2$\frac{2}{5}$ mm. Macerated specimens mostly pale. The distal apices of antennal segments III, IV and V, the area around the primary rhinarium and the distal part of the processus terminalis of VI, the very apices of the tibiae and the tarsi are dusky or dark. The very apices of the femora are also sometimes dusky. The lateral abdominal sclerites of segments 2–5 are dusky, those of segments 2–4 are circular and that on 5 constituting the crescent-shaped ante-siphuncular sclerite. Antennal tubercles only weakly developed for an *Acyrthosiphon*. Antennae about equal in length to the body or a little shorter. Body 4–4$\frac{3}{5}$ as long as the siphunculi. Processus terminalis 2$\frac{1}{2}$–3$\frac{1}{2}$ times as long as the base of the sixth antennal segment. Third antennal segment bearing 4–11 medium-sized rhinaria extending in a row over the distal $\frac{1}{3}$–$\frac{9}{10}$. First antennal segments bearing 6–9 hairs. Longest hairs on third antennal segment 14–18μ long, from nearly $\frac{1}{2}$ to $\frac{2}{3}$ as long as the basal diameter of the segment. Posterior dorsal cephalic hairs similar to the hairs on the third antennal segment. Ultimate rostral segment reaching to or just past the mid coxae, 120–140μ long, $\frac{2}{3}$–$\frac{4}{5}$ as long as the second segment of the hind tarsi and bearing 9–11 accessory hairs. First tarsal segments bearing 3 hairs. The longest hairs on the (posterior margin of) hind femur are 22–28μ long. Dorsal abdominal hairs of the anterior tergites are 13–15μ long and the 4 to 6 hairs on the eighth tergite are up to 26 to 33μ long. Sub-genital plate bearing 2–7 hairs on the anterior half and a row of 9–13 along the posterior margin. Siphunculi imbricated over their whole length, 1$\frac{3}{4}$ to twice as long as the cauda, which bears 8–10 long, fine-pointed hairs.

Alatae viviparae. Described from 2 specimens with body length 2–2$\frac{1}{5}$ mm. Head, thorax, antennal segments I, II, III except for the very base, distal parts of IV and V, distal half of the base of VI and the processus terminalis dark. Lateral abdominal sclerites, including the ante-siphuncular sclerite, dusky. Lateral abdominal sclerites 2–4 with an evidently darker imbricated central area. Antennae a little longer than the body, the processus terminalis 3–3$\frac{1}{2}$ times as long as the base of the sixth antennal segment. Third antennal segment bearing 11–16 rhinaria, IV without rhinaria. Longest hair on the third antennal segment 15μ, $\frac{3}{5}$ as long as the basal diameter of the segment. Ultimate rostral segment 120–130μ long, $\frac{7}{10}$–$\frac{3}{4}$ as long as the second segment of the hind tarsus and bearing about 9 accessory hairs. First tarsal segments bearing 3 hairs, the lateral hairs (31μ long) about twice as long as the 'sense peg' (15μ). Wing venation normal for *Acyrthosiphon*, media of the fore wing twice branched and the hind wing with two oblique veins. Eighth abdominal tergite bearing 4 or 5 hairs about 31μ long. Cauda bearing 9 or 10 long, fine-pointed hairs.

SPECIMENS STUDIED. Holotype aptera vivipara, PAKISTAN: Mingora, *Sonchus oleraceus*, 9.iii.1963 (*M. A. Ghani*), aphid reg. 35/1964.

Paratypes, 6 apterae viviparae and two alatae viviparae with the same data as the holotype.

HOST PLANT. *Sonchus oleraceus* (Compositae).

DISTRIBUTION. Pakistan.

Table 2: Measurements of *Acyrthosiphon ghanii* sp. n. in mm.

	Body length	siphunculi	cauda	Antennal segments				ultimate rostral segment	second segment of hind tarsus	rhinaria on third antennal segment	No. of hairs on		
				III	IV	V	VI				ultimate rostral segment	eighth abdominal tergite	cauda
1.	2.13	.50	.28	.56	.37	.35	.18+.61	.13	.18	6	10	5	10
		.48		.56	.38	.34	.20+.59		.18	8			
2.	2.37	.56	.30	.66	.43	.40	.21+.65	.14	.19	11	9	5	?8
		.54		.67	.43	.40	.20+.69		.18	8			
3.	2.14	.46	.26	.51	.31	.30	.18+.49	.12	.16	4	9	6	9
		.47		.52	.30	.30	.19+.49		.17	4			
4.	2.01	.49	.29	.55	.33	.31	.19+.64	.13	.18	6	11	4	10
		.50		.56	.35	.36	.20+.60		-	6			
5.	2.11	.49	.27	.57	.35	.36	.21+.60	.12	.18	6	10	5	9
		.49		.56	.34	.38	.20+.63		-	4			
6.	2.16	.44	.26	.66	.46	.36	-	.13	.18	11	?9	5	9
		.44		.60	.44	.38	.20+.64		.18	15			
7.	2.05	.45	.27	.62	.44	.43	.20+.68	.12	-	16	?8	4	10
		.46		.64	.46	.42	.20+.68		.18	15			

1 (type) - 5, apterae viviparae, 6 & 7 alatae viviparae, Pakistan, Mingora,

Sonchus oleraceus, 9.ii.1963, M.A. Ghani

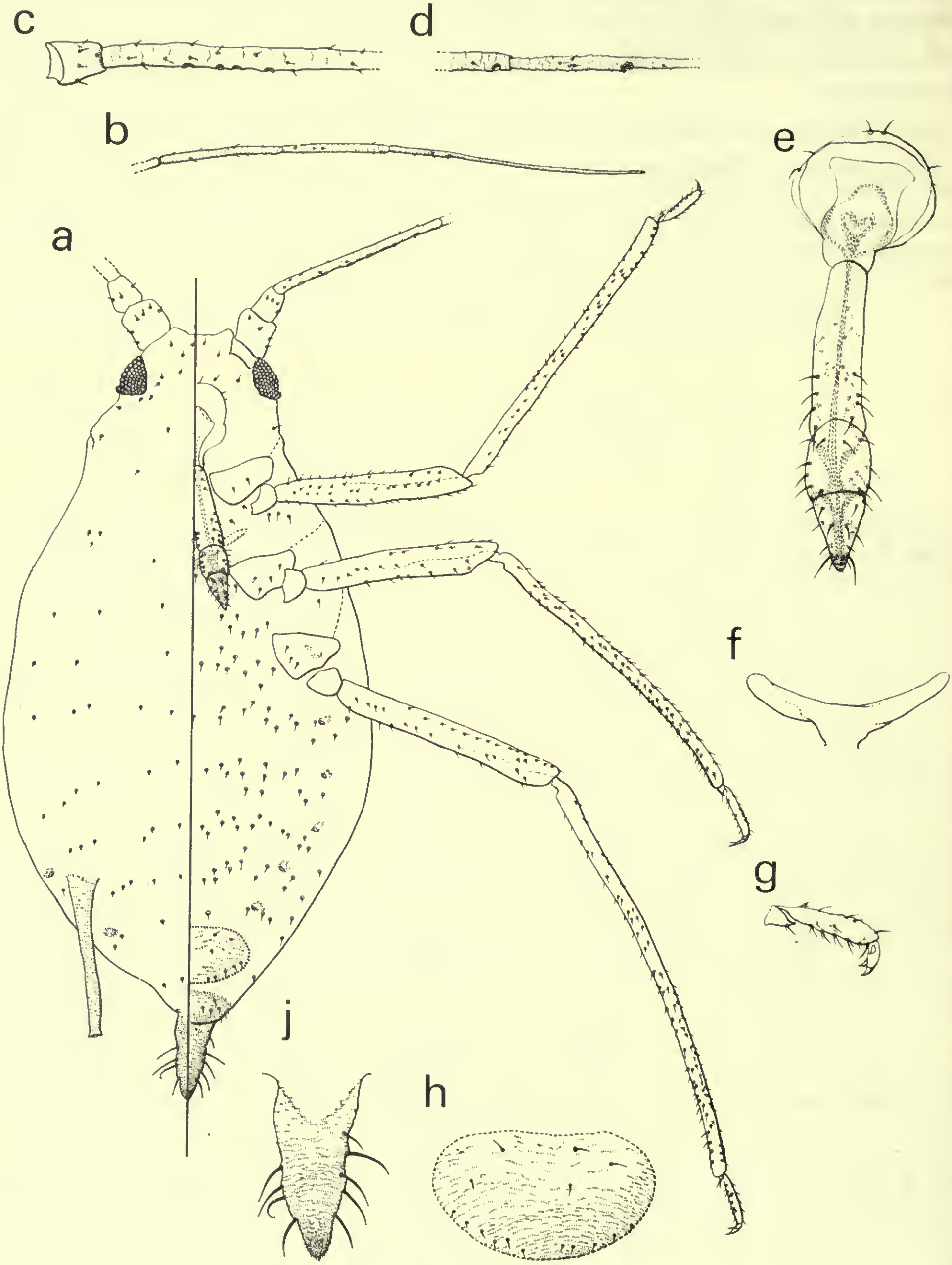

Fig. 3. *Acyrthosiphon ghanii*, aptera, a, body; b, antennal segments IV–VI; c, antennal segment II and base III; d, apex of antennal V and base VI; e, rostrum; f, mid-thoracic furca; g, hind tarsus, h, sub-genital plate; j, cauda. a–& b ×40, c–j ×80.

Acyrthosiphon (A.) gossypii Mordwilko, 1914

(Text-fig. 4)

Acyrthosiphon gossypii ssp. *gossypii* Mordwilko, 1914 : 173–178, addenda 7–8.
Acyrthosiphon gossypii ssp. *paczoskii* Mordwilko, 1914 : 178–180, addenda 8.
Acyrthosiphon dubium Mordwilko, 1914 : 180–181; 1928 : 192.
?*Acyrthosiphon skrjabini* Mordwilko, 1914 : 181–183; 1928 : 192; Narzukulov & Umarov, 1969 : 174–175.
Acyrthosiphon gossypii Mordwilko, Nevsky, 1929 : 83–85; Szelegiewicz, 1963 : 57; Swirski, 1963 : 21; Narzukulov & Umarov, 1969 : 181–186.
?*Macrocaudus phaseoli* Shinji, 1930 : 79–80; 1941 : 791–792.
?*Acyrthosiphon gossypicola* Shinji, 1936 : 148.
Tenuisiphon gossypii (Mordwilko) Mordwilko, 1948 : 215.
?*Tenuisiphon skrjabini* (Mordwilko) Mordwilko, 1948 : 215.
Acyrthosiphon (*Tenuisiphon*) *gossypii* Mordwilko; Shaposhnikov, 1964 : 603.
Acyrthosiphon sesbaniae Kanakaraj David, 1956*a* : 7–9.
Acyrthosiphon sp. Kanakaraj David, 1956*b* : 105.

SPECIMENS STUDIED. EGYPT: Giza, *Vigna unguiculata*, 27.vii.1944, 1 alata (*E. E. Chamberlain* coll.), W. Cottier leg.; Cairo, *Vicia faba*, April 1964, 1 al. (*E. A. El-Kady*); Avou Zaaval, *Vigna ? sinensis*, 5.vii.1965, Min. Agric., 3 apt. IRAN: Shiraz, Faza, cotton, 22.xi.1960; 2 apt. viviparae, 1 al. vivip., 3 oviparae, 2 al. ♂♂ (*E. S. Brown*). IRAQ: Baghdad, Karradab, *Vigna sinensis*, i.x.1920, 1 apt.; no colln. data, 1 apt., 1 al. (*A. A. Hussein*); Abu-Ghraib, *Vicia faba*, 8.xii.1962, 9 apt., 1 al.; *Phaseolus mungo*, 15.x.1962, 3 apt., Al Doori. TURKEY: Nazilli, cotton, 2.viii.1967, 2 apt., F.A.O. ADEN: Giat, Abyan, *Vigna ? sinensis*, 4.xi.1959, 2 apt., 1 al. (*J. H. Proctor*). SUDAN: Darmali, *Vigna ? sinensis*, 22.xi.1918, 5 apt. (*M. W. Bedford*); Nuri, *Vigna catjung*, 21.i.1939, 6 apt. Gureir, 'Egyptian beans', 6.ii.1939, 8 apt., *Vicia faba*, 6.ii.1939, 4 apt., *Dolichos lablab*, 7.iii.1939, 2 apt. (*J. W. Cowland*); Khartoum, 'fasulia bean' (? *Phaseolus* sp.), 31.iv.1934, 1 apt., 5 al. (*H. W. Bedford*); *Vicia faba*, 1959, 4 apt., 4 al. (*A. Khalifa*). INDIA: without further locality, *Sesbania grandiflora*, no date, 3 apt. (*Krishnamurti*). SIKKIM: Mramsha, *Peganum harmala*, 23.iii.1920, 5 apt. (one parasitized) 1 al. (*H. Stevens*).

HOST PLANTS. *Gossypium* sp., *Malva neglecta* (Malvaceae), *Dolichos lablab, Phaseolus mungo, Sesbania grandiflora, Vicia faba, Vigna catjung, V. sinensis, V. ungiuculata* (Leguminosae), *Lepidium perfoliata* (Cruciferae), *Perganum harmala*, (Zygophyllaceae).

DISTRIBUTION. Turkey, India, Sikkim, Israel, Egypt, Sudan, Algeria (Remaudière 1958 : 149), Turkestan, Iraq (Szelegiewicz, 1963 : 57), ? Japan & Korea.

NOTES. As specimens from *Gossypium* tend to have a relatively longer cauda than specimens from Leguminosae, *sesbaniae* may be at least subspecifically distinct. No positive transfer records between Leguminosae and Malvaceae are known but Kanakaraj David (1956) could not transfer specimens from *Sesbania grandiflora* to *S. speciosa*, *Medicago sativa* or *Vigna catjung*. The aphid may exist in a number of populations with individual host plant preferences.

Acyrthosiphon gossypicola is not included in either Shinji's (1941) book on Japanese

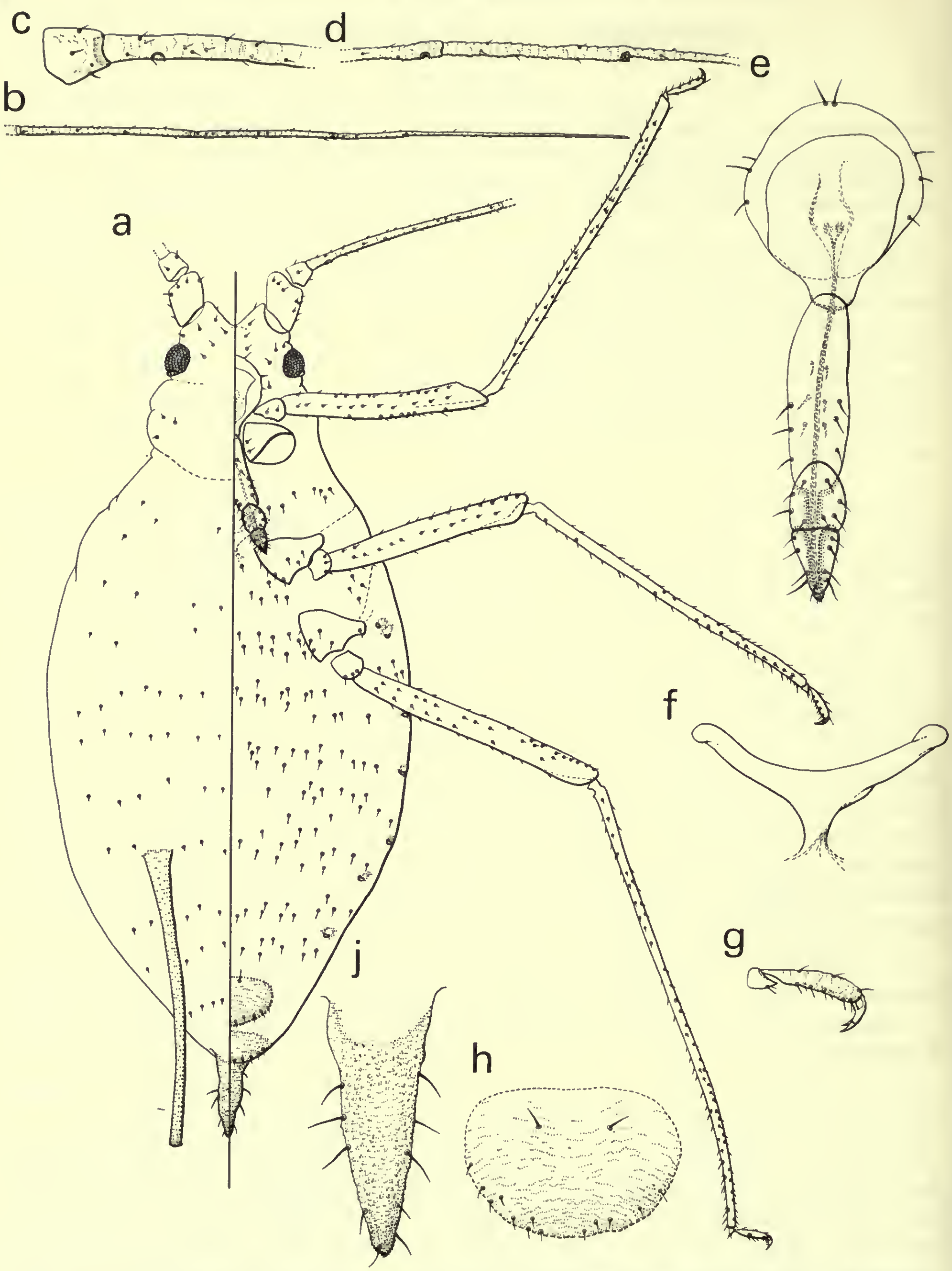

FIG. 4. *Acyrthosiphon gossypii*, aptera, a, body; b, antennal, segments IV–VI; c, antennal segment II and base III; d, apex of antennal V and base VI; e, rostrum; f, mid-thoracic furca; g, hind tarsus; h, sub-genital plate; j, cauda. a & b, ×40, c–j ×80.

aphids or in Paik's (1965) book on Korean aphids. It may be a synonym of *A. gossypii* Mordwilko. Dr M. Miyazaki has kindly provided the following English translation of the original description:—

'*Acyrthosiphon gossypicola* Shinji, n. sp. This species closely resembles *Acyrth. pisi* in various characters but differs therefrom by the following points:—

(1) The aptera of this species is reddish brown in life, whereas *pisi* is green or pale green in life. The colouration is lost in the specimens preserved in alcohol.

(2) The aptera of either species has 2 rhinaria on the 3rd antennal segment, but in the alatae the number and location of the rhinaria are different: i.e. in this species 7–9 rhinaria are distributed on the basal half of the third antennal segment, whereas in *pisi* 10–18 rhinaria are distributed on the basal $\frac{3}{4}$ to the whole length of that segment.

(3) In this species the length of the 3rd–6th antennal segments is in the proportions of 6: 4: 3, whereas in *pisi* these segments are about equal in length or in the proportions of 20: 18: 17.

HOST PLANT. *Gossypium herbaceum* L.

TYPE LOCALITY. Moppo, Korea.

Macrocaudus phaseoli Shinji, 1930, was described from *Phaseolus mungo* var. *subtrilobata*, in Japan. Although Shinji (1941 : 792–796) described what appears to be a *Macrosiphum* as *Macrocaudus clematii*, his original description of *phaseoli*, the type-species of *Macrocaudus* Shinji, 1930, appears to be of an *Acyrthosiphon*. According to the original description, *phaseoli* could be easily recognized when refound, as the aptera has a body length of 2·4 mm, the siphunculi and cauda are about equal in length, about one quarter as long as the body, the base of the sixth antennal segment is 280µ long and the processus terminalis is 4 times as long as the base. The illustration in the original description does not show the long antennal hairs figured in the 1941 : 791 illustration. The photomicrograph (1941 : 791) is of a specimen with only a single siphunculus. *Macrocaudus phaseoli* cannot be *Macrosiphum euphorbiae* without its siphuncular apex as the base of the sixth antennal segment is too long for *euphorbiae* and most other *Macrosiphum* species. The photomicrograph of *phaseoli* suggests that the cauda may be only $\frac{1}{6}$–$\frac{1}{5}$ as long as the body. As the siphunculi of *Acyrthosiphon gossypii* are fragile and are often broken in specimens received for identification it is possible that *Macrocaudus phaseoli* was described from a damaged aptera of *Acyrthosiphon gossypii*. *Phaseolus* is not a usual host for *A. pisum* but it is for *A. gossypii*. Dr M. Miyazaki kindly provided a photo-copy of the original description of *Macrocaudus*.

Acyrthosiphon (A.) hissarica Umarov, 1966

Acyrthosiphon hissarica Umarov, 1966 : 87–88; Narzikulov, 1968 : 20.
Acyrthosiphon (*Metopolophium*) *hissarica* Umarov; Narzikulov & Umarov, 1969 : 163–164.

HOST PLANT. *Cicer soongoricus* (Leguminosae).

DISTRIBUTION. Tadzhikistan.

NOTES. Probably belonging to concept of *Acyrthosiphon* s. str. in the sense of Hille Ris Lambers, 1947.

Acyrthosiphon (A.) ignotus Mordwilko, 1914

(Text-fig. 5)

Acyrthosiphon ignotum Mordwilko, 1914 : 147–149; 1928 : 191; Shaposhnikov, 1964 : 603; Rupais, 1969 : 263.
Metopolophium ignotum (Mordwilko) Börner, 1952 : 56.
Acyrthosiphon spiraeae Rupais, 1961 : 128–129, teste Rupais, 1969 : 358.

SPECIMENS STUDIED. GERMANY: Göttingen Park, *Spiraea vanhoutteni*, 1.vii.1968, 24 apterae (*H. G. W. Gleiss*). NETHERLANDS: Bennekom, *Spiraea thunbergii*, 20.viii.1966, 1 apt. (*D. Hille Ris Lambers & V.F.E.*). SWEDEN: Vrm. Arvika, *S. salicifolia*, 10.vii.1954, 2 apt.; Upl. Stockholm, Berg. tradg., *Sibiraea laevigata*, 19.vii.1958, 6 apt. (*F. Ossiannilsson*).

HOST PLANTS. *Sibiraea laevigata*, *Spiraea alba*, *S.* x *arguta*, *S. bella*, *S. chamaedrifolia*, *S. cinerea*, *S. hypericifolia*, *S. latifolia*, *S. media*, *S. nipponica*, *S. obovata* x *semperflorens*, *S. trichocarpa*, *S.* x *vanhoutteri* (Rosaceae).

DISTRIBUTION. Denmark, Germany (Müller, 1961 : 69), Netherlands, Norway, Sweden (Ossiannilsson, 1969 : 56), U.S.S.R. (Leningrad), Latvia, Mongolia (Szelegiewicz, 1963 : 131).

NOTES. The aphid recorded as *ignotus* from *Sophora alopecuroides* (Leguminosae) in Kazakhstan by Nevsky (1951 : 47) is described as *Acyrthosiphon* (*Metopolophium*) *sophorae* Narzikulov & Umarov, 1969.

Acyrthosiphon (A.) ilka Mordwilko, 1914

Acyrthosiphon ilka Mordwilko, 1914 : 149–152; 1929 : 49.
Aulacorthum ilka (Mordwilko) Börner, 1952 : 155.
Acyrthosiphon (*Metopolophium*) *ilka* Mordwilko; Narzikulov & Umarov, 1969 : 166–169.

SPECIMEN STUDIED. IRAN: Lalekar, 3,100 m.a.m.s.l., *Papaver somniferum*, 26.vi.1955, 1 aptera (*G. Remaudière*).

HOST PLANTS. *Papaver nudicaule*, *P. somniferum*, *Glaucium* sp. (Papaveraceae).

DISTRIBUTION. France, Greece, Turkey (Tuatay & Remaudière, 1965 : 269), Southern Siberia, Oblast, Zabaykalsk.

NOTES. The siphunculi in the original description (aptera of body length 2·7 mm) are figured as being 12–14 times as long as their middle diameter. An aptera (body length 2·5 mm) kindly presented by Dr Remaudière from Iran has the siphunculi 17 times as long as their middle diameter. *A. bidentis* (page 31) described from East Africa has the siphunculi of large apterae (body length 2·6–2·8 mm) 18–22 times as long as their middle diameter. Small East African apterae (body length 1·5–1·6 mm) have the siphunculi only 13–15 times as long as their middle diameter. East African, Yemeni and Moroccan *bidentis* bear 5–8 hairs on the first antennal segments while the single specimen of *ilka* from Iran bears 9 hairs on each first antennal segment. The taxonomic status of *bidentis* and *ilka* is unlikely to be resolved until more material from different places, times of year and host plants is available.

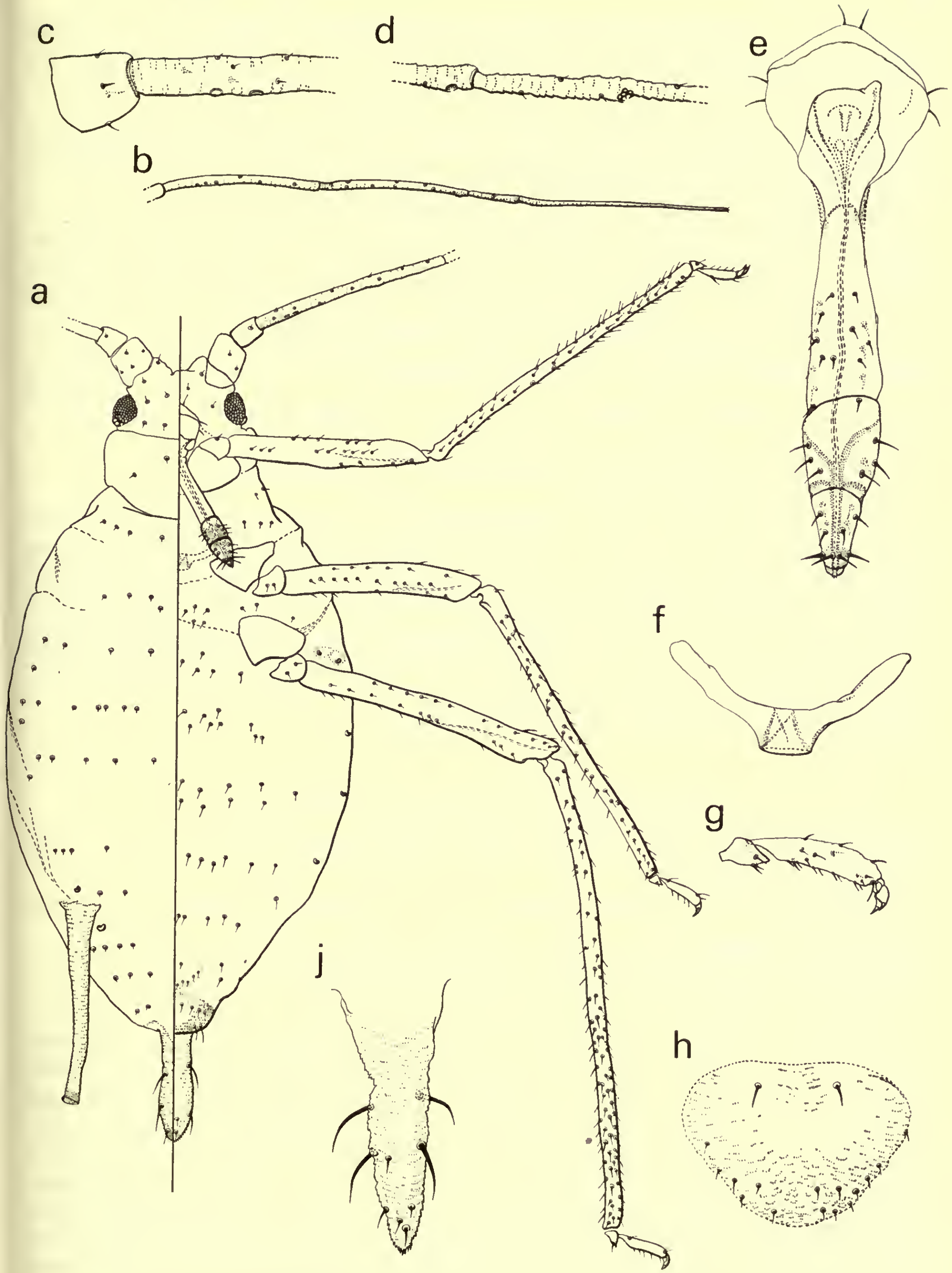

FIG. 5. *Acyrthosiphon ignotus*, aptera, a, body; b, antennal segments IV—VI; c, antennal segment II & base III; d, apex of antennal V and base of VI; e, rostrum; f, mid-thoracic furca; g, hind tarsus; h, sub-genital plate; j, cauda. a & b, ×55, c–j ×110.

Acyrthosiphon (A.) knechteli (Börner, 1950)

Metopolophium knechteli Börner, 1950 : 13; 1952 : 576.
Acyrthosiphon knechteli (Börner) Meier, 1958 : 292; Shaposhnikov, 1964 : 603.

Specimen studied. Sweden: Vstm., Medäker, Näverkärret, *Vaccinium uliginosum*, 4.vii.1954, 1 apt. (*F. Ossiannilsson*).

Host plant. *Vaccinium uliginosum* (Ericaceae).

Distribution. Germany, Poland (Szelegiewicz, 1965 : 39), Sweden, Switzerland.

Acyrthosiphon (A.) kondoi Shinji, 1929

Acyrthosiphon kondoi Shinji, 1938 : 65; Takahashi, 1965 : 19–20.

Specimen studied. Korea: Suwon, clover, 10.vi.1959, 1 apt. (*W. H. Paik*).

Host plants. *Medicago sativa, Trifolium* sp. (Leguminosae).

Distribution. Japan, Korea.

Notes. Some at least of the Oriental records of *A. pisum* are based on *Aulacorthum solani* (Kltb.). Tao, 1963 : 179, had probably not seen genuine *kondoi* when he placed it as a synonym of *Aulacorthum solani*. Takahashi, 1965 : 19–20, redescribes *kondoi* as a valid species of *Acyrthosiphon*. *A. kondoi* is similar to *A. astragali* sp. n. (p. 27) but the eighth abdominal tergite of *astragali* bears hairs 35–45µ long while those on the eighth tergite of *kondoi* are only 15–20µ long. The processus terminalis of *kondoi* is $4\frac{3}{4}$–6 times as long as the base of the sixth antennal segment and only $3\frac{1}{3}$–$4\frac{1}{5}$ times as long in *astragali*.

Acyrthosiphon (A.) loti (Theobald, 1913)

Macrosiphum loti Theobald, 1913*a* : 384; 1913*b* : 139–140; 1926 : 133–135.
Acyrthosiphon loti (Theobald) Mordwilko, 1914 : 185–188; Hille Ris Lambers, 1947 : 231–233; Meier, 1958 : 269–300.
Acyrthosiphon geranicola Hille Ris Lambers, 1935 : 114–115 partim, teste Hille Ris Lambers, 1947 : 231.
Acyrthosiphon anthyllidis Börner, 1950 : 13, teste Meier, 1958 : 296.
Metopolophium gracilipes Börner, 1950 : 13, teste Hille Ris Lambers, 1966 : 103.
Acyrthosiphon loti ssp. *anthyllidis* Börner; Remaudière, 1959 : 37.

Specimens studied. Channel Is.: Guernsey, 15.v.1966, 2 al. (*R. H. LePelley*); Vazon Bay, 3.vi.1951, 1 apt., *Lotus augustifolius*, 6.vi.1951, 1 apt., 1 al.; Sark, *Lotus* sp., 14.vi.1951, 2 al. (*B. E. Eastop*). England: Surrey, Kew Gdns, *Lotus corniculatus*, 24.ix.1960, 1 apt.; 3.x.1962, 1 apt.; *L. hispidus*, 24.ix.1960, 4 apt.; 3.x.1962, 1 apt.; Oxon., Chalgrove, *L. corniculatus*, 29.v.1949, 4 apt. (*V.F.E.*); Suffolk, Walberswick, *L. corniculatus*, 20.vi.1951, 4 apt., 1 al. (*J. P. Doncaster*); Cumberland, Gt. Salkeld, *L. corniculatus*, 14.vi.1912, 1 apt., 1 al. (both labelled type) (*F. V. Theobald*), B.M. 1930–204. Netherlands: Wageningen, *Lotus* sp., 26.vi.1952, 8 apt., 12., 4 first instar larvae (*D. Hille Ris Lambers & V.F.E.*). Scotland:

Banffshire, Ballindalloch, *L. corniculatus*, 2.vi.1954, 9 apt., 2 al. (*G. D. Morrison*); Sutherland, Bettyhill, *L. corniculatus*, 13.vii.1961, 7 apt.; Ben Hope, *L. corniculatus*, 13.vi.1965, 7 apt.; Edinburgh, trap, 2.vii.1943, 1 al. (*J. P. Doncaster*).

HOST PLANTS. *Anthyllis vulneria, Astragalus alpinus, Dorycnium herbaceum, Hippocrepis comosa, Lathyrus* sp., *Lotus corniculatus, L. hispidus, L. uliginosus, Medicago sativa, Phaca frigida* (Leguminosae). See Meier, 1958 : 300, Ossiannilsson, 1959 : 482 and Tuatay & Remaudière, 1965 : 269, for host plant records.

DISTRIBUTION. Austria, Denmark, England, France, Germany, Netherlands, Norway (Tambs-Lyche, 1968 : 5), Poland (Szelegiewicz, 1966 : 450), Sweden, Switzerland and Turkey (Tuatay & Remaudière, 1964 : 269). See Heie, 1961 : 87.

BIOLOGY. Apterous ♂♂ are described from the Netherlands and alate ♂♂ from Switzerland by Meier, 1958 : 299–300, a similar situation to that with *A. caraganae* (see p. 34).

Acyrthosiphon (A.) macrosiphum (Wilson, 1912)

(Text-fig. 6)

Illinoia macrosiphum Wilson, 1912 : 155–156.
Adactynus macrosiphum (Wilson) Hottes, 1934 : 7–8.
Macrosiphum macrosiphum (Wilson) Gillette & Palmer, 1934 : 188; Hottes, 1949 : 45–47; Palmer, 1952 : 314–315.
Acyrthosiphum macrosiphum (Wilson) Leonard. 1968 : 264.

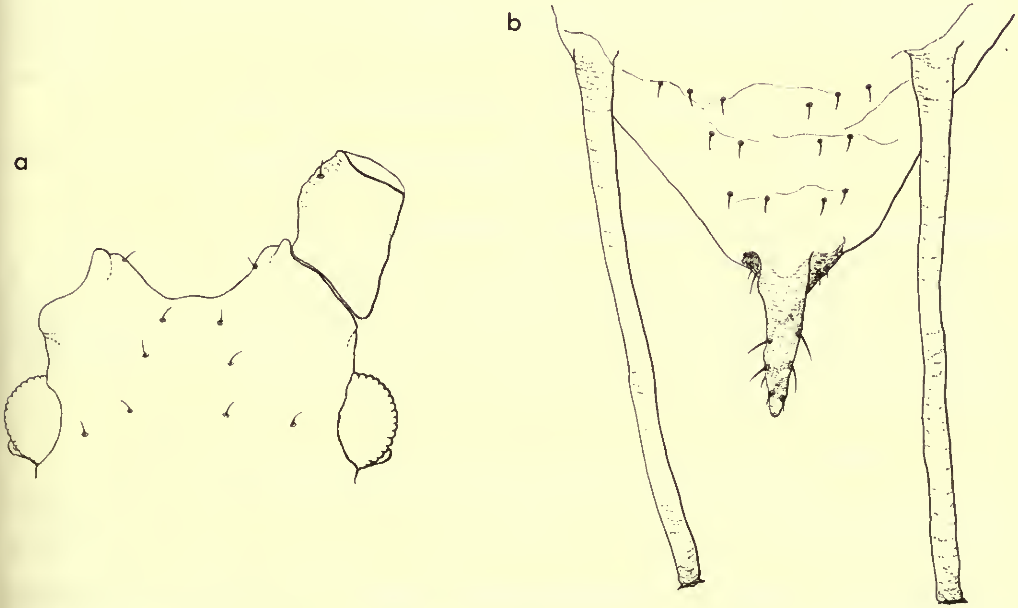

FIG. 6. *Acyrthosiphon macrosiphum*, aptera, a, head; b, apex of abdomen. a × 110, b × 55.

SPECIMENS STUDIED. U.S.A., California, Big Bearlake, *Amelanchier alnifolia*, 21.vii.1940, 3 apt., 1 al. (*R. C. Dickson*); Colorado, Mesa, *Amelanchier* sp., 30.vi.1932, 2 apt., 1 al. (*F. C. Hottes*); Grand Mesa, *A. alnifolia*, 14.ix.1956, 1 apt. vivipara, 2 oviparae, 1 al. ♂ (*F.C.H. & D. Hille Ris Lambers*).

HOST PLANTS. *Amelanchier alnifolia* (Rosaceae). *Sambucus canadensis* (Caprifoliaceae) has also been listed as a host but specimens have not been seen from that plant.

DISTRIBUTION. U.S.A., California, Colorado, Oregon, Utah.

BIOLOGY. Oviparae were found on *Amelanchier* and 'what we supposed to be the (alate) males of this species were collected on wild rose bushes under *Amelanchier alnifolia*', Wilson (1912 : 156).

Acyrthosiphon (A.) moltshanovi Nevsky, 1928

Acyrthosiphon moltshanovi Mordwilko, 1914 : 183–185.
Acyrthosiphon (*Melopolophium*) *moltshanovi* Mordwilko; Narzikulov & Umarov, 1969 : 171.

SPECIMENS STUDIED. INDIA: Keylong, lettuce, 2.ix.1968, 1 apt., 1 larva (*S.S.S. & Khon* coll.), ex S. Kanakaraj David colln, in D. Hille Ris Lambers' collection. PAKISTAN: Bahrain, *Euphorbia helioscopia*, 17.iii.1963, 1 apt., C.I.B.C.

HOST PLANTS. Not known to Mordwilko, 1914 : 183, and the normal host is still uncertain. Some plants in the genera *Lactuca*, *Sonchus* and *Euphorbia* with shiny leaves are often confused and during the dry season in the tropics aphids may exist in small colonies on plants only distantly related to their normal hosts.

DISTRIBUTION. Tadzhikistan, Pakistan, India.

Acyrthosiphon (A.) mordwilkoi Nevsky, 1928

Acyrthosiphon mordwilkoi Nevsky, 1928 : 186; 1929 : 85–86; Narzukulov & Umarov, 1969 : 171.

HOST PLANT. *Linum usitatissimum* (Linaceae).

DISTRIBUTION. Central Asia, Mt. Aslanbob, 2,000 m.a.m.s.l.

NOTES. According to the original description, the siphunculi are about 13 times as long as their middle diameter and 1⅔ to twice as long as the cauda. The processus terminalis is about 4½ times as long as the base of the sixth antennal segment and a little longer than the third antennal segment and the siphunculi.

Acyrthosiphon (A.) navozovi Mordwilko, 1914

Acyrthosiphon navozovi Mordwilko, 1914 : 196–198, 1915 : 11.
Hottesina navozovi (Mordwilko) Börner, 1952 : 151.

HOST PLANT. Described from a single alata collected on an undetermined member of the Umbelliferae.

DISTRIBUTION. Oblast.

NOTES. Suspected of being one of the species with dark appendages that are associated with Umbelliferae and regarded as a distinct genus, *Hottesina* Börner, 1950, by Börner, 1950 : 13. See *A. nigripes* (p. 49).

Acyrthosiphon (A.) nigripes nigripes Hille Ris Lambers, 1935

Acyrthosiphon nigripes Hille Ris Lambers, 1935 : 57; 1947 : 246–247.
Hottesina superba Börner, 1950 : 13.
Hottesina nigripes (Hille Ris Lambers) Börner, 1952 : 151.

SPECIMEN STUDIED. SWITZERLAND: San Salvatore, *Laserpitium siler* 28.ix.1957, 1 aptera (*W. Meier* coll.), D. Hille Ris Lambers leg.

HOST PLANT. *Laserpitium siler* (Umbelliferae).

DISTRIBUTION. Hungary (Szelegiewicz, 1966 : 189), Italy, Switzerland.

BIOLOGY. According to the original description, it lives on the upper sides of the leaves of its host.

NOTES. *A. nigripes* is unusual in that the fourth antennal segment of the adults is longer than the third antennal segment and than the processus terminalis. According to Szelegiewicz (1967 : 443–444) Pintera found an aphid on *Seseli leucospermum* which he identified with *Hottesina superba.* Because of this Szelegiewicz (1966 : 189) disputed Börner's (1952 : 151) contention that *superba* was a synonym of *nigripes*, and recorded *A. nigripes* from *Peucedanum.* Szelegiewicz (1968 : 89) concludes that there are three species or subspecies involved as indicated below, and says (1967 : 443–444) that Pintera is preparing an account of one which lives on *Seseli.*

Acyrthosiphon (A.) nigripes blattnyi Pintera, 1968

Acyrthosiphon superbum (Börner) Pintera, 1957 : 380–383 nec Börner, 1950; Szelegiewicz, 1966 : 189; 1967 : 443–444; 1968 : 89.
Acyrthosiphon nigripes f. *blattnyi* Pintera *in* Szelegiewicz, 1968 : 89.

HOST PLANTS. *Seseli austriaca, S. leucospermum* (Umbelliferae).

DISTRIBUTION. Hungary.

Acyrthosiphon (A.) nigripes peucedani Szelegiewicz, 1967

Acyrthosiphon nigripes Hille Ris Lambers, Szelegiewicz, 1966 : 189 nec Hille Ris Lambers, 1935.
Acyrthosiphon nigripes ssp. *peucedani* Sezlegiewicz, 1967 : 442–443.

HOST PLANT. *Peucedanum officinale* (Umbelliferae).

DISTRIBUTION. Hungary.

NOTES. Presumably described from alatiform apterae as the four specimens are said to bear 11–16 very small rhinaria on the distal one third of the third antennal segment.

Acyrthosiphon (A.) niwanista (Hottes, 1933) comb. n.

Adactynus niwanista Hottes, 1933 : 16–17.
Macrosiphum niwanistum (Hottes) Gillette & Palmer, 1934 : 191; Hottes, 1948 : 29–30; Palmer, 1952 : 318–319.

SPECIMENS STUDIED. U.S.A., Colorado, Skyway, *Mertensia sibirica*, 4.viii.1932, 5 apterous paratypes (*F. C. Hottes*); Rocky Mtn Ntl Park, *Mertensia* sp., 24.viii.1940, 2 apt. viviparae, 1 ovipara, 1 alata vivipara (*G. F. Knowlton*). Grand Mesa, *Mertensia* sp., 17.ix.1956, 2 oviparae, 1 apterous ♂ (*F.C.H. & D. Hille Ris Lambers*).

HOST PLANTS. *Mertensia sibirica* (Boraginaceae), and also recorded from *Polygonatum commutatum* (Hottes, 1948 : 30), *Smilacina* sp. (Palmer, 1952 : 319) (Liliaceae).

DISTRIBUTION. Colorado.

BIOLOGY. The oviparae and apterous males from *Mertensia* in September and October and the apterae viviparae on *Mertensia* in early August preclude host plant alternation as alate males are required for host plant alternation in the Aphidinae.

NOTES. Although it seems unlikely that an aphid would live only on one genus of Boraginaceae and two genera of Liliaceae unless host plant alternation is involved, unusual discontinuous host plant specificity does occur (Stroyan, 1964 : 39–40; Shaw, 1958 : 232). *Macrosiphum mertensiae* Gillette & Palmer (1933 : 361) from *Mertensia* and *Macrosiphum yagasogae* Hottes (1948 : 34–37), from *Polygonatum commutatum* are very similar to one another according to Hottes, 1948 : 36. It would be interesting to know whether *Mertensia* and *Polygonatum* have any unusual constituents in common.

Acyrthosiphon (A.) norvegicum Mordwilko, 1914

Acyrthosiphon norvegicum Mordwilko, 1914 : 143: 144; 1915 : 11.

HOST PLANT. Unknown.

DISTRIBUTION. Norway.

NOTES. The original description fits *A. pisum* better than any other aphid currently known from Norway, but the processus terminalis is said to be only $2\frac{1}{2}$–$2\frac{3}{5}$ as long as the base of the sixth antennal segment. The siphunculi are too long for a member of the *euphorbiae* group, which also occurs in Norway and has a long base to the sixth antennal segment.

Acyrthosiphon (A.) orientalis Mordwilko, 1914

Acyrthosiphon orientale Mordwilko, 1914 : 141–243; 1915 : 10.

HOST PLANT. Unknown.

DISTRIBUTION. Eastern Siberia.

NOTES. According to the original description the length of the body of the aptera is 4½–5 mm (alata 3–3⅗ mm), siphunculi of apterae 1½ mm (alata 1 mm), cauda of aptera 0·95 mm (al. 0·65 mm). The distal antennal segments are not described but the proportions of body, siphunculi and cauda are sufficiently unusual to assist identification when the species is refound. The proportions are suggestive of a large specimen of *A. pisum* with an exceptionally long cauda.

Acyrthosiphon (A.) pamiricum Nevsky, 1929

Acyrthosiphon pamiricum Nevsky, 1929 : 86; Narzikulov & Umarov, 1969 : 174.

HOST PLANTS. Gramineae.

DISTRIBUTION. Pamir.

NOTES. If, as some of the description suggests, *pamiricum* comes in the subgenus *Metopolophium*, then it differs from most other species of *Metopolophium* by the processus terminalis being 5½–6 times as long as the base of the sixth antennal segment and by the siphunculi being 2½–2¾ as long as the cauda. The proportions are similar to those of *soldatovi* (see p. 69).

Acyrthosiphon (A.) papaverinum Nevsky

Acyrthosiphon papaverinum Nevsky, Pek, 1957 : 176, 180; Narzukulov, 1966 : 577; Narzikulov & Umarov, 1969 : 186.

HOST PLANTS. *Papaver somniferum* (Papaveraceae).

DISTRIBUTION. Kirghiz.

NOTES. Apparently not formally described.

Acyrthosiphon (A.) parvus Borner, 1950

Acyrthosiphon parvus Börner, 1950; Meier, 1958 : 300–302.

SPECIMENS STUDIED. CZECHOSLOVAKIA: Prague, *Cytisus capitatus*, 2.vi.1964, 1 aptera, 12 alatae (*P. Stary & V.F.E.*).

HOST PLANTS. *Cytisus austriacus* (Szelegiewicz, 1968 : 89), *C. capitatus*, *C. pilosus*, *C. rhodopeus*, *Sarothamnus scoparius* (Leguminosae).

DISTRIBUTION. Austria, Bulgaria (Tashev, 1961 : 158), Czechoslovakia, Hungary (Szelegiewicz, 1968 : 89), Poland (Szelegiewicz, 1966 : 450), Switzerland.

BIOLOGY. Meier, 1958 : 301 describes fundatrices from *Sarothamnus* in mid-May and Austrian oviparae from Börner's collection, so it seems that *parvus* overwinters as eggs on both *Cytisus* and *Sarothamnus*.

Acyrthosiphon (A.) pelargonii (Kaltenbach, 1843)

This is the complex known as the *Acyrthosiphon malvae* (Mosley) group, since Walker, 1848 : 429, regarded *Aphis pelargonii* Kaltenbach, 1843, as a synonym of *Aphis malvae* Mosley, 1841. This synonymy was accepted on the 'first reviser' principle by Hille Ris Lambers, 1947 : 233–246, and by most subsequent British authors. Stroyan, 1964 : 50–54, summarizes the existing (unsatisfactory) state of knowledge of this group and the following data is arranged according to his system. As *Acyrthosiphon pelargonii* is not known for certain to feed on *Malva*, as the original description of *Aphis malvae* fits *Myzus persicae* better than *Acyrthosiphon*, as *Myzus persicae* is the common aphid on *Malva* in the Thames valley, and as *pelargonii* is a well known and appropriate name for the aphid, it is used here and *malvae* is regarded as a synonym of *Myzus persicae* (Sulzer). Records of *Myzus pelargonii* (Kltb.) usually apply to *Aulacorthum solani* (Kltb.) (see p. 88). It is convenient to recognize the following eight subspecies of *pelargonii* although the real situation is almost certainly more complex.

agrimoniae Börner, 1940, on *Agrimonia*, ♂♂ apterous.
borealis Hille Ris Lambers, 1952, on *Potentilla* in the wild and on *Acaena* and other cultivated Rosaceae, ♂♂ apterous.
geranii Kaltenbach, 1862, on *Geranium* and *Erodium*, ♂♂ apterous.
pelargonii Kaltenbach, 1843, on *Pelargonium* and *Erodium*, without sexuales.
poterii Prior & Stroyan, 1964, on *Poterium*, ♂♂ apterous or alate.
potha Börner, 1950, on *Alchemilla*, sexuales unknown but probably existing.
rogersii Theobald, 1913, on *Fragaria*, ♂♂ apterous or alate.
zerozalphum Knowlton, 1935, on *Erodium*, sexuales unknown, Western North America.
rubi Narzikulov, 1957, on *Rubus* in the Himalayas is similar to the *pelargonii* group (see p. 67).

Acyrthosiphon (A.) p. pelargonii (Kaltenbach, 1843)

?*Aphis malvae* Mosley, 1841 : 684.
Aphis pelargonii Kaltenbach, 1843 : 21–22.
Aphis urticae Schrank, Walker, 1848 : 427, partim.
Aphis malvae Mosley; Walker, 1848 : 429, ? nec Mosley, 1841.
?*Aphis conjuncta* Walker, 1848 : 2220 (see Doncaster, 1961 : 46).
Siphonophora malvae (Mosley) Passerini, 1863 : 137, partim; Buckton, 136, ? nec Mosley, 1841.
Siphonophora pelargonii (Kaltenbach) Henrich, 1910 : 25.
Macrosiphum pelargonii (Kaltenbach) Davis, 1912 : 285–286; Theobald, 1926 : 124–126, partim; Börner, 1932 : 628; Palmer, 1952 : 319–320.
?*Myzus erigeroniella* Theobald, 1926 : 354.
Macrosiphum cornelli Patch, 1926 : 334.
Macrosiphum bosqi Blanchard, 1932 : 21–23; 1939 : 959–960.
Aulacorthum pelargonii (Kaltenbach) Hille Ris Lambers, 1933 : 175; Börner, 1952 : 154; Essig, 1953 : 112.

Acyrthosiphon malvae (Mosley) Hille Ris Lambers, 1947 : 233–238.
Aulacorthum malvae (Mosley) Cottier, 1953 : 238–240, ? nec Mosley, 1841.
Acyrthosiphon pelargonii (Kaltenbach) Eastop, 1958 : 20; 1966 : 424–425; Müller & Schöll, 1958 : 394–395.

SPECIMENS STUDIED. ENGLAND: London, Southgate, *Pelargonium* sp., 2.vi.1847, 3 apterae, 2 alatae (*F. Walker*) slide 616; 8.vi.1847, 2 apt., 1 al. (*F. Walker*) slide 619. South Kensington, *Pelargonium* sp., 20.vi.1963, 38 apt., 25 al. (*A. J. Orian*). Surrey, Kew Gdns, glasshouse, 'Geranium', 5.ii.1937, 5 apt. (*E. O. Essig*). Berks, Wokingham, *Pelargonium* sp., 3 apt., 4 al. (*F. Baranyovits*). Oxford, 5.i.1953, 2 al. Lincs., Spalding, *Pelargonium hederaceum*, 18.iv.1945, 4 apt., 6 al. (*J. P. Doncaster*). NETHERLANDS: Wageningen, *Pelargonium* sp., March 1933, 2 apt. (*D. Hille Ris Lambers*). NEW SOUTH WALES: 1960/1961, 2 al. (*R. D. Hughes*). AUSTRALIAN CAPITAL TERRITORY: Canberra, yellow trap, 12.x.1959, 1 al.; 5–11.xi.1959, 3 al. (*V.F.E.*); August/October 1960, 1 al.; 1961, 1 al. (*R. D. Hughes*). TASMANIA: Grove, colour trap, 30.xii.1960, 1 al.; 6.x.1961, 2 al.; 26.iiii.1962, 1 al.; 23.iv.1962, 1 al.; 21–30.xii.1962, 2 al., *Erodium moschatum*, 30.x.1961, 5 apt. New Town, colour trap, 29.vii.1960, 1 al.; 16.ix.1960, 1 al.; 9.xi.1960, 1 al.; 15–17.viii.1962, 2 al.; 2–29.x.1961, 4 al.; 12–26.xi.1962, 2 al.; Triabunna, *Erodium moschatum*, 2.xi.1961, 8 apt., 2 al. (*E. J. Martyn*). VICTORIA: Melbourne, Brighton beach, 'flying', 28.vi.1959, 1 al., Carlton, yellow traps, 23–25.iii.1959, 3 al.; 26.iv.1959, 2 al.; 18.v.1959, 1 al. (*V.F.E.*). HAWAII: Pokahuloa, 'grass sweepings', 7.v.1948, 1 al. (*F. A. Bianchi*). NEW ZEALAND: Okahune, N.I., 1 al. (*T. R. Harris*), no date, collected prior to 1952. Lincoln, yellow traps, 28.x.–22.xi.1959, 10 al. (*K. P. Lamb*); 29.v.1963, 1 al. (*A. D. Lowe*). U.S.A.: Colorado, Fort Collins, 'Geranium', 23.v.1917, 2 apt., 1 al. (*F. C. Bragg*). New York, Ithaca, *Pelargonium* sp., 24.x.1925, 3 apt. (*E. M. Patch* leg.) (apparently part of the series from which *cornelli* was described).

HOST PLANTS. *Erodium moschatum*, *Pelargonium domesticum*, *P. hederaceum*, *P. odoratissimum* (Geraniaceae).

DISTRIBUTION. Widely distributed by commerce, see Heie, 1960 : 88. Austria, Denmark, England, Netherlands, Poland, Sweden, Switzerland, South Africa (Müller & Schöll, 1959 : 394), Australia, New Zealand, Hawaii, Argentina (as *bosqui* Blanchard, 1932), Peru (Essig, 1953 : 112), Colorado, New York.

BIOLOGY. Apparently completely anholocyclic, the sexuales being unknown. When *pelargonii* lives in the open as in Australia, alatae mostly occur in yellow traps in October and November, and with a smaller peak of activity in March and April. This is typical of many aphids in South Eastern Australia (Hughes *et al.*, 1965 : 830).

NOTES. See Stroyan, 1964 : 50–54 and Müller and Scholl, 1958 : 394–39, 412, for comparisons with other members of the complex. Despite the collection data for *erigeroniella* Theobald, the body 2·55 mm long, the siphunculi 572 & 582μ long, the cauda 317μ long, longest hairs on 8th abdominal tergite 40μ long, the short base of the sixth antennal segment (126 & 127μ), the 10 and 11 hairs on the first antennal segments, the ultimate rostral segment 154μ long, $1\frac{1}{10}$ as long as the second segment of the hind tarsus and bearing 13 accessory hairs suggest *pelargonii* s. str.

Acyrthosiphon (A.) pelargonii agrimoniae (Borner, 1940)

Aulacorthum agrimoniae Börner, 1940 : 4.
Acyrthosiphon malvae ssp. *agrimoniella* (Cockerell) Hille Ris Lambers, 1947 : 238–241, nec Cockerell, 1903.
Aulacorthum agrimoniellum (Cockerell) Börner, 1952 : 154–155, nec Cockerell, 1903.
Acyrthosiphon malvae ssp. *agrimoniae* (Börner) Stroyan, 1964 : 50–51.

SPECIMENS STUDIED. NETHERLANDS: Wageningen, *Agrimonia eupatorium*, 30.ix.1930, 3 apterae (*D. Hille Ris Lambers*), B.M. 1954–417; S. Limberg, Gulpen, *Agrimonia* sp., June 1952, 6 apt., 1 al. (*D.H.R.L. & V.F.E.*), B.M. 1955–363.

HOST PLANTS. *Agrimonia eupatorium*, *A. odorata* (Rosaceae).

DISTRIBUTION. Denmark (Heie, 1961 : 88), England, Germany, Poland (Szelegiewicz, 1964 : 250), Sweden (Wahlgren, 1951 : 71), Turkey (Tuatay & Remaudière, 1965 : 269).

BIOLOGY. Transfers from *Agrimonia* to *Fragaria*; males apterous (Hille Ris Lambers, 1947 : 237).

NOTES. Types in the Deutsches Ent. Inst. 39/87, 39/88, teste Stroyan, 1964 : 51.

Acyrthosiphon (A.) pelargonii borealis Hille Ris Lambers, 1952

Acyrthosiphon pelargonii (Ktlb.) Thomas & Jacob, 1940 : 149, partim, nec Kaltenbach, 1843, teste Stroyan, 1964 : 53.
Acyrthosiphon boreale Hille Ris Lambers, 1952 : 5–6; 1955 : 3–4.
Acyrthosiphon malvae ssp. *borealis* H. R. L.; Stroyan, 1964 : 51–53.
?*Acyrthosiphon malvae* ssp. *potha* (Börner); Ossiannilsson, 1959 : 485 partim.

SPECIMENS STUDIED. ENGLAND: Surrey, Kew Gdns, *Acaena anserinifolia*, 30.v.1967, one specimen, winged on the left side and wingless on the right; *A. macrostemon*, 2.v.1966, 2 apt.; *A. myriophyla*, 30.v.1967, 17 apt., 4 al.; *A. novaezealandica*, 27.ix.1960, 1 apterous ovipariform vivipara; *Potentilla alpestris*, 1.v.1961, 2 apt., 2 al.; *P. blaschkeana*, 30.v.1967, 2 apt., 1 al.; *P. collina*, 30.v.1967, 11 apt.; *P. ornithopoidis*, 24.ix.1960, 1 apt.; *P. recta*, 3.x.1962, 1 apt., 30.v.1967, 3 apt.; *P. villosa*, 30.v.1967, 1 apt. (*V.F.E.*). GREENLAND: Julianahaab, 17.vii.1949, 2 apt. (*Chr. Vibe* coll.), D. Hille Ris Lambers leg., B.M. 1963–531. SCOTLAND: Angus, Glen Doll Lodge, *Potentilla anglica*, 28.v.1959, 2 al.; Sutherland, Stoer-Lochinver Rd., *P. erecta*, 8.vii.1961, 1 apt. (*J. P. Doncaster*). SWEDEN: Upl. Gamla, Upsala, *P. argentea*, 13.viii.1953, 2 apt. (*F. Ossiannilsson*). U.S.A.: Michigan, Midland, *Potentilla* sp., 31.v.1961, 2 apt., 3 al. (*J. O. Pepper*); Pennsylvania, State College, The Rock, *P. recta*, 18.vi.1963, 3 apt., 1 al. (*J. O. Pepper*). CANADA: Quebec, Payne Bay, vagrant alata, 11.viii.1958 (*J. Mason* coll.), W. R. Richards leg.

HOST PLANTS. *Acaena anserinifolia*, *A. macrostemum*, *A. myriophyla*, *A. novaezealandica*, *Potentilla anglica*, *P. anserina*, *P. artica*, *P. argentea*, *P. aurea*, *P. blaschkeana*, *P. collina*, *P. crantzii* (=*alpestris*), *P. ornothopioides*, *P. puberula*, *P. recta*, *P.* ? *sterilis*, *P. villosa* (Rosaceae), *Epilobium latifolium* (Onagraceae), Richards, 1963 : 463. See also the note on the recorded host plants of the ssp. *potha* on p. 56.

DISTRIBUTION. England, Finland, Greenland, Iceland, Hungary (Szelegiewicz, 1968 : 89), Scotland, Sweden (Ossiannilsson, 1959 : 56), Switzerland, ? Wales (Stroyan, 1964 : 51), Quebec, Baffin Is., (Richards, 1963 : 462–463).

BIOLOGY. Apterous ♂♂ (Stroyan, 1964 : 51–52). Alatae viviparae have only been collected in May in Britain.

NOTES. Differs from most other members of the complex in that the processus terminalis is only 4¾–5⅔ as long as the base of the sixth antennal segment while the ultimate rostral segment is 1–1⅛ as long as the second segment of the hind tarsus and bears only 6–8 accessory hairs. It is possible that the American specimens belong to the ssp. *zerozalphum* Knowlton.

Acyrthosiphon (A.) pelargonii geranii (Kaltenbach, 1862)

?*Aphis urticae* Schrank; Kaltenbach, 1843 : 13, partim nec Schrank, 1801.
?*Aphis sodalis* Walker, 1848 : 429 (see Doncaster, 1961 : 123).
Siphonophora pelargonii (Kltb.) Koch, 1855 : 193 nec Kaltenbach, 1843.
Aphis geranii Kaltenbach, 1862 : 16–17; 1874 : 81–82.
Siphonophora malvae (Mosley) Passerini 1863 : 137 partim, ? nec Mosley 1841.
?*Nectarophora geranii* Oestlund, 1887 : 80.
Macrosiphon pelargonii (Ktlb.) Börner, 1932 : 628, partim.
Acyrthosiphon geranicola Hille Ris Lambers, 1935 : 114–115 partim, apterae only.
Acyrthosiphon malvae ssp. *geranii* (Kltb.) Hille Ris Lambers, 1947 : 241–243.
Aulacorthum geranii (Kltb.) Börner, 1952 : 154; Holman, 1961 : 118.

SPECIMENS STUDIED. CHANNEL IS.: Guernsey, St. Peterport, *Geranium robertianum*, 9.vi.1951, 7 apt. (*B. E. Eastop*); Vazon Bay, *G. robertianum*, 21.vii.1955, 3 apt. (*C. A. Prevost*). ENGLAND: Devon, nr. Loddiswell, *G. robertianum*, 23.vi.1959, 2 apt. (*C.A.P.*); Shaldon, *G. robertianum*, 6.vi.1965, 4 apt., 4 al. (*V.F.E.*); Somerset, Bath, *G. robertianum*, 8.viii.1934, 3 apt. (*D. Hille Ris Lambers*). Berks, Reading, *G. pyrenaicum*, 20.v.1950, 3 apt.; *G. pratense*, 30.vi.1950, 8 apt.; *G. sanguinearum*, 30.vi.1950, 3 apt.; Surrey, Kew Gdns, *Erodium cheilanthifolium*, 27.ix.1960, 4 apt.; Hants, Headley, *Geranium robertianum*, 29.v.1950, 7 apt., 2 al. (*V.F.E.*). Essex, Thundersley, *G. robertianum*, 4.vii.1955, 5 apt.; Herts, Harpenden, *G. sanguinearum*, 8.v.1944, 12 apt.; 4.vi.1944, 6 al.; Derbyshire, Middleton-by-Youlgreave, *G. robertianum* 20.vi.1946, 1 apt.; Elton, *G. lucidum*, 20.vi.1946, 1 apt.; Cumberland, Boot, *G. robertianum*, 26.vi.1953, 4 apt., 2 al. (*J. P. Doncaster*). FRANCE: Brittany, La Trinité sur Mer, *Erodium cicutarium* var. *dunense*, 31.vii.–7.viii.1968, 16 apt., 1 alatoid nymph. GERMANY: Wildberg (Black Forest), *G. robertianum*, 27.vii.1969, 8 apt., 2 alatoid nymphs (*V.F.E.*). NETHERLANDS: Limberg, Gulpen, *Geranium robertianum*, 27.vi.1952, 2 apt. (*D.H.R.L. & V.F.E.*). SCOTLAND: Sutherland, Traligill Burn, *G. robertianum*, 10.vii.1961, 6 apt., 2 al. (*J.P.D.*); Kincardine, Maryculter, *G. robertianum*, 20.x.1951, 9 apt. (*G. D. Morison*). WALES: Anglesey, Llanddona, *G. robertianum*, 19.–29.v.1961, 9 apt., 14 al. (*V.F.E.*).

HOST PLANTS. *Erodium cicutarium*, *E. trichomanifolium*, *Geranium dissectum*, *G. lucidum*, *G. molle*, *G. pratense*, *G. pyrenaicum*, *G. robertianum*, *G. sanguineum* (Geraniaceae).

Distribution. Crimea (Holman, 1961 : 118), Denmark, England, Finland, Hungary, Netherlands, Poland, Sweden, Scotland, Wales.

Biology. Heie, 1961 : 89, records an ovipara collected on December 24th in Denmark. The males are apterous according to Hille Ris Lambers, 1947 : 243; alatae viviparae occur in late May and early June in Southern England and Wales and in late June and early July, in Northern England and Scotland.

Notes. American records are based on the ssp. *zerozalphum* which may have a wider host range than *geranii* in Europe although some of the American records may be based on other sub species. The 'specimens studied' indicate that *geranii* has a more Western distribution than most of the other sub species, which is another reason for suspecting that *zerozalphum*, well-known in California, Washington and Utah, is not merely a synonym of *geranii*. The American *zerozalphum* may be an as yet undetected Mediterranean variant of *geranii*.

Acyrthosiphon (A.) pelargonii poterii Prior & Stroyan, 1964

Acyrthosiphon malvae ssp. *poterii* Prior & Stroyan, 1964; Stroyan, 1964 : 53.

Specimens studied. England: Derbyshire, Toddington, *Poterium sanguisorba*, 22.vi.1959, 1 aptera (holotype), 3 apterous paratypes; 15.vi.1963, 5 apt., 1 al. paratypes; 7.x.1959, 1 apt. ♂ paratype; 19.x.1959, 6 paratype oviparae (ex. culture) (*R. N. B. Prior*), B.M. 1970–18. Glos., Cirencester, Chesterton, *P. sanguisorba*, 9.v.1945, 1 apt. (*H. K. Airy Shaw*).

Host plants. *Poterium minor, P. sanguisorba* (Rosaceae).

Distribution. England, Czechoslovakia (Holman, 1965 : 281), Hungary (Szelegiewicz, 1968 : 89).

Biology. The males may be either apterous or alate although the latter are known only from one population according to the original description in which the results of cross-breeding and host transfer experiments are also given.

Acyrthosiphon (A.) pelargonii potha (Börner, 1950)

Metopolophium potha Börner, 1950 : 13; 1952 : 156.
Acyrthosiphon malvae ssp. *potha* (Börner), Ossiannilsson, 1959 : 485 partim; Stroyan, 1964 : 53–54.

Specimens studied. England: London, Chelsea Physic Gdns, *Alchemilla pyrenaica*, 31.v.1960, 1 apt.; Surrey, Kew Gdns, *Alchemilla* sp., 30.v.1967, 1 apt., *A. subcrenata*, 30.v.1967, 3 apt., 2 al. (*V.F.E.*). Cumberland, Wasdale, Pier's Gill, *A. alpina*, 30.viii.1962, 1 apt. Scotland: Perthshire, foot of Ben Lawers, *A. alpina*, 23.vi.1959, 2 apt. (*J. P. Doncaster*). Sweden: Med., Selanger, *A. vulgaris*, 23.vii.1954, 1 apt. (*F. Ossiannilsson*).

Host plants. *Alchemilla alpina, A. pyrenaica, A. subcrenata, A. vulgaris* (Rosaceae).

Distribution. Austria, England, Sweden.

Notes. Types in the Deutsches Ent. Inst., 40/35, 40/36, 40/39, teste Stroyan, 1964 : 53. The names *agrimoniae, boreale* and *potha* are much confused in literature because of the poor state of taxonomic knowledge in the group. Records of *potha* from *Comarum palustre, Dryas* sp., *Geum rivale, Potentilla norvegicum* and *P. reptans* may well apply to *boreale* and from *Agrimonia* to *agrimoniae*.

Acyrthosiphon (A.) pelargonii rogersii (Theobald, 1913)

Macrosiphum rogersii Theobald, 1913 : 126; 1926 : 139–141.
Acyrthosiphon or *Aulacorthum rogersii* (Theobald) Hille Ris Lambers, 1933 : 171.
Acyrthosiphon (?) *rogersii* (Theobald) Massee, 1935 : 174.
Acyrthosiphon malvae ssp. *rogersii* (Theobald) Hille Ris Lambers, 1947 : 243–246; Heie, 1961 : 89.
Aulacorthum rogersii (Theobald) Börner, 1952 : 155.

Specimens studied. Denmark: Jutland, Island of Mors, *Fragaria* sp., 29.v.1958, 1 aptera (*O. Heie*). England: London, Southgate, 'strawberry' 19.v.1847, 1 apt., 2 alatae, 4 alatoid nymphs (*F. Walker*) 362. 28.v.1847, 3 apt., 2 al., 2 al. nymphs (*F. Walker*) 550. Hounslow, strawberry, May, 1912, 1 imm. paratype and one other immature specimen B.M. 1930–204. Kent, East Malling, strawberry 'Royal Sovereign' under glass, 6.iv.1935, 2 apt. (*A. M. Massee*); strawberry, 21.iv.1943, 6 apt. (*G. H. L. Dicker*), June 1938, 3 apt., 1 al. nymph (*A.M.M.*), 3.xi.1952, *Fragaria* sp. (in culture), 3 al. ♂♂ (*G.H.L.D.*); West Malling, 'seedling strawberry', 19.vi.1923, 2 apt. (*A.M.M.*). Sussex, Fernhurst, *Fragaria* sp., 26.iv.1965, 2 apt., 2 al., (*F. Baranyovits*). Scotland: Aberdeen, strawberry, 9.vii.1949, 2 apt., 3 al. (*G. D. Morrison*).

Host plants. *Fragaria vesca* x *viridis* and other cultivars (Rosaceae).

Distribution. Denmark, England, Finland, Germany, Norway, Poland (Szelegiewicz, 1965 : 39), Scotland, Sweden.

Biology. Males apterous, sexuales recorded in October for both Denmark (Heie, 1961 : 89) and Sweden (Ossiannilsson, 1959 : 485).

Notes. The adults Theobald described are not in his collection and were not there when Hille Ris Lambers (1947 : 246) examined the collection.

Acyrthosiphon (A.) pelargonii zerozalphum (Knowlton, 1935)

Macrosiphum zerozalphum Knowlton, 1936 : 194; 1936 : 213; Palmer, 1952 : 333.

Specimens studied. U.S.A.: California, San Fernando, *Erodium moschatum*, 5.iii.1942, 3 apterae, 4 alatae (*R. C. Dickson*). Berkeley, 23.iii.1964, 1 vagrant alata; Temicula, *Erodium* sp., 30.iii.1964, 2 al.; Mirama, *Erodium* sp., 30.iii.1964, 5 apt.; Pala, *Erodium* sp., 30.iii.1964, 6 apt., 2 al., 2 al. nymphs (*R.C.D., O. Heie & V.F.E.*). Utah, Dewey, *Erodium cicutarium*, 28.iv.1927, 3 apterous paratypes

(*G. F. Knowlton*), B.M. 1954–703, Kanab, *E. cicutarium*, 17.iv.1958, 3 apt.; Marriott, *E. cicutarium*, 3.v.1938, 3 apt., 2 al. (*G.F.K.*), St George, 'filaree', 18.v.1944, 1 apt. (*G.F.K.*), *E. cicutarium*, 16.iv.1958, 2 apt., 2 al.; Santa Clara, *E. cicutarium*, 16–17. iv.1958, 20 apt., 2 al., (*G.F.K.*). Virgin, 'sweeps', 17.iv.1958, 7 apt.; Washington Co., *E. cicutarium*, 16.iv.1958, 2 apt. (*G.F.K.*), Willard, 'tunnels of *Pemphredon* wasp', 10.ix.1965, 1 apt. (*G.F.K.*). Washington, Union Gap, *E. cicutarium*, 24.iv. 1946, 1 apt. (*G.F.K.*).

HOST PLANTS. *Erodium cicutarium*, *E. moschatum* (Geraniaceae).

DISTRIBUTION. U.S.A., California, Utah, Washington.

BIOLOGY. All our Californian specimens were collected in March and all our specimens from Utah and Washington in April and May; it seems to be conspicuous early in the year.

Acyrthosiphon (A.) pisum (Harris, 1776)

(Text-fig. 7)

Another species evidently existing as a complex of populations with different biologies and ranges of morphological variation. Almost any two populations may be separated from one another morphologically but only specimens from *Ononis* are both morphologically separable from all other populations and apparently homogeneous enough to be practically recognizable as a distinct subspecies. Specimens from other shrubs such as *Sarothamnus* and *Spartium* are often regarded as constituting a subspecies because they cannot be transferred to herbaceous Leguminosae. This system has been adopted here despite the objections that the material from shrubs is probably not homogeneous and is no more different from specimens from peas than they are from populations from other herbaceous legumes. That two populations from *Sarothamnus* cannot be transferred to peas does not prove that they are subspecifically identical. Some populations may feed and reproduce in the spring and early summer on plants on which they cannot overwinter. Temperature may affect host plant range as well as morphology, as both are the results of physiological activity. Negative results from host plant transference experiments alone are unsatisfactory indicators of taxa. The following three subspecies are accepted here:—

ononis Koch, 1855, on *Ononis*.
pisum Harris 1776, on herbaceous Leguminosae and probably occasionally on shrubs in the early summer. Certainly heterogeneous.
spartii Koch, 1855, on *Cytisus*, *Sarothamnus* & *Spartium*. Probably heterogeneous.

Acyrthosiphon (A.) p. pisum (Harris, 1776)

Aphis pisum Harris, 1776 : 66–67.
Aphis onobrychis Boyer de Fonscolombe, 1841 : 169.
Aphis lathryi Mosley, 1841 : 684; Walker, 1852 : 966.

Aphis pisi Kaltenbach, 1843 : 23–24.
Aphis ulmariae Schrank Walker, 1843 : 421, nec Schrank, 1801.
Aphis basalis Walker, 1848 : 2220.
Siphonophora pisi (Kaltenbach) Koch, 1855 : 190–191; Buckton, 1876 : 134–135; Mordwilko, 1907 : 214, 215; 1909 : 103.
Siphonophora ulmariae (Schrank) partim, Passerini 1863 : 136; Macchiati, 1883 : 231; del Guercio, 1900 : 165; Schouteden, 1900 : 116.
Siphonophora corydalis Oestlund, 1886 : 25.
Nectarophora pisi (Kaltenbach) Oestlund 1887 : 82; Sanderson, 1900 : 14–25; 1901 : 169–186; Essig, 1910 : 336.
Nectarophora destructor Johnson, 1900 : 56–60.
Macrosiphum ulmariae (Schrank) Schouteden, 1901 : 115, partim.
Nectarophora pisi var. *destructor* Johnson, Sanderson, 1901 : 31.
Macrosiphum trifolii Pergande, 1904 : 21.
Macrosiphum pisi (Kaltenbach) Sanborn, 1904 : 79. Chittenden, 1909 : 1–10; Patch, 1911 : 81; Gillette, 1911 : 384; 1927 : 348; Theobald, 1913*a* : 380; 1913*b* : 134; 1926 : 127–133; Davis, 1915 : 1–67; Smith, L. B., 1916 : 32–63; van der Goot, 1917 : 15–17; Drastich, 1927 : 348–351; Harrington, 1945 : 12–22; Palmer, 1952 : 320.
Macrosiphon trifolii Theobald, 1913*a* : 384; 1913*b* : 189.
Acyrthosiphon pisi pisi (Kaltenbach) Mordwilko, 1914 : 83–136.
Acyrthosiphon pisi destructor (Johnson) Mordwilko, 1914 : 136–138.
Acyrthosiphon pisi turanicum Mordwilko, 1914 : 139–140.
Acyrthosiphon pisi ussuriensis Mordwilko, 1914 : 140–141.
?*Acyrthosiphon norvegicum* Mordwilko, 1914 : 143–144.
Macrosiphum theobaldi Davis, 1915 : 4.
?*Macrosiphum* (*Acyrthosiphon*) *genistae* (Mordwilko) Theobald, 1917 : 80 nec Mordwilko, 1914.
Macchiatiella trifolii Del Guercio, 1917 : 210–211.
Macrosiphon onobrychis (Boyer de Fonscolombe) Wilson & Vickery, 1918 : 118; Behlen, 1934 : 48–51.
Illinoia pisi (Kaltenbach) Fluke, 1925 : 612; Campbell, 1926 : 861–881.
Acyrthosiphon pisi (Kaltenbach) Nevsky, 1929 : 86–88; Judenko, 1930 : 163.
Anuraphis (*Macchiatiella*) *trifolii* (Del Guercio) Del Guercio, 1931 : 392–394.
Anuraphis (*Macchiatiella*) *promedicaginis* Del Guercio, 1931 : 495.
Adacytnus pisi (Kaltenbach) Hottes, 1933 : 19.
Acyrthosiphon onobrychidis (Boyer de Fonscolombe) Hille Ris Lambers, 1933 : 171; Knechtel & Manolache, 1940 : 12–16; Essig, 1953 : 110–112.
Acyrthosiphon onobrychis (Boyer de Fonscolombe) Silvestri, 1939 : 524–525; Börner, 1952 : 151–153, partim.
Acyrthosiphon pisum (Harris) Hille Ris Lambers, 1947 : 247–254; Meier, 1957 : 89–92; 1958 : 304–308; 1964 : 1–41; Cartier, 1957 : 37–41; 1959 : 293–294; 1963*a* : 205–213; 1963*b* : 558–560; Heie, 1961 : 89–90; Müller, 1962 : 129–136; Markkula, 1963 : 1–30; Lowe & Taylor, 1964 : 287–295; Sutherland, 1969 : 1385–1410; Wegorek & Hejner, 1969 : 61–75; Narzikulov & Umarov, 1969 : 178–181.
Acyrthosiphon pisum destructor (Johnson) Hille Ris Lambers, 1947 : 254.
Acyrthosiphon destructor (Johnson) Börner, 1952 : 152.
Acyrthosiphon onobrychis ssp. *galeagae* Börner, 1952 : 53.

SPECIMENS STUDIED. AUSTRIA: Carinthia, Ossiach, *Vicia cracca*, 13.viii.1966, 1 aptera; *Vicia* sp., 24.vii.1967, 1 apt.; Hochostewitz, *Medicago* sp., 9.viii.1966, 1 apt. (*V.F.E.*). BULGARIA: Burgas, 9.vi.1964, 1 apt., 2 first instar larvae (*A. Pintera*). CYPRUS: Nicosia, *Lathyrus* sp., 21.v.1937, 3 apt., 1 alata (*H. M. Morris*); Kolochoria, lucerne, 19.iv.1956, 1 apt.; Vatili, lucerne, 19.iv.1956, 1 apt., 1 al.

(*G. P. Georghiou*); Deftera, *Cicer arietinum*, 5.vi.1956 (*S. Pieris*); Amurosios, 23.iv.1956, 1 al., (*G.P.G.*); Lyssi, 24.iv.1965, 7 al. (*H. G. Walker*). CZECHOSLOVAKIA: Vestenice, *Trifolium* sp., 30.v.1964, 3 apt., 1 al. (*J. Holman, P. Stary, V.F.E.*). DENMARK: Lyngby, trap, 5–11,vii.1958, 7 al.; Jutland, Spangberg, 26.vii–1.viii.1958, 2 al. (*O. Heie*). EGYPT: Gezira, *Genista* sp., 6.iv.1924, 6 apt.; Giza, peas, 4.ii.1924, 1 al. (*W. J. Hall*); Cairo, *Vicia faba*, April 1964, 1 al. (*E. A. El-Kady*). ENGLAND: numerous specimens including London, Southgate, 'sweet pea' 2.v.1847, 1 al. & 5 alatoid nymphs (*F. Walker*) 1013; 1.vi.1847, 1 apt., 2 al., 1 alatoid nymph (*F. Walker*) 1014; Pimlico, *Lathyrus pratensis*, 18.iv.1961, 1 apt.; Chelsea, *Pisum* sp., 25.ix.1920, 1 al. & 3 larvae (*W. D. Laing*); Kent, Mereworth, *Vicia faba* (culture), 12.ix.1962, 4 apt., 2 al. (*H. J. B. Lowe*); Downe, *Vicia faba*, 26.vi.1967, 1 apt. (*H. C. Dale*); Berks, Reading, *Trifolium* sp., 5.vi.1949, 1 al., 1 alatoid nymph; Surrey, Esher, 'sweet pea', 10.vii.1922, 1 apt. (*W. E. China*); Kew, *Colutea arborescens*, 12.v.1961, 2 apt.; *Trifolium* sp., October 1969, 2 ovipariform apterae viviparae; Kew Gdns, *Lathyrus latifolius*, 3.x.1962, 1 apt. vivipara, 1 ovipara; *L. roseus*, 24.ix.1960, 3 apt. viviparae, 1 ovipariform vivipara; *Lens nigricans*, 24.ix.1960, 1 apt., 1 al.; *Lotus corniculatus*, 24.ix.1960, 2 apt.; 3.x.1962, 3 apt.; *L. hispidus*, 24.ix.1960, 1 apt.; *L. requienii*, 5.x.1962, 3 apt.; *Medicago carstiensis*, 24.ix.1960, 6 apt.; *M. lupulina*, 24.ix.1960, 2 apt.; *Melilotus officinalis*, 24.ix.1960, 1 slightly ovipariform aptera vivipara; *Onobrychis vicaefolia*, 24.ix.1960, 4 apt.; *Trigonella foenum-graecum*, 24.ix.1960, 1 apt.; *Trifolium hybridum*, 24.ix.1960, 1 apt., 1 al.; *T. pannonicum*, 24.ix.1960, 1 apt., 1 al. (*V.F.E.*); Ham, *Melilotus* sp., 28.v.1966, 3 apt., 2 al. (*L. A. Mound*); Sussex, nr Lewes, *Lathyrus* ? *aphaca*, September 1920, 4 apt. (*K. G. Blair*); Glos., Laurence Weston, clover, 22.vii.1924, 3 apt., 2 al. (*J. V. Pearman*); Hants., Sherfield English, *Vicia hirsuta*, 4.viii.1963, 1 apt. (*K. M. Harris*); Oxon., Oxford, *Vicia faba*, 6.vi.1930, 6 apt. (*R. C. Woodward*); Bucks, Farnham Royal, lucerne, 6.vii.1927, 3 apt., I.B. Ent.; Waddesdon, *Medicago lupulina*, 9.viii.1964, 2 apt., 1 al.; 28.viii.1966, 1 apt. (*V.F.E.*); Herts, Harpenden, *Medicago lupulina*, 26.ix.1949, 2 apt. vivip., 2 immature ? oviparae; lucerne, 24.x.1966, 4 apt. vivip., 4 oviparae; 31.x.1966, 2 apt. vivip., 4 oviparae; 7.xi.1966, 2 apt. vivip., 5 oviparae, 1 al. vivip. (*J. Cockbain*), B.M. 1966–617. *Trifolium* sp., 30.x.1942, 4 ovip., 22.ii.1943 (? in culture) 2 fundatrices; *Vicia faba*, 2.x.1941, 4 alatiform apterae viviparae (*C. Potter*); 2.iv.1943, 1 alatiform aptera, 3 al. (*J. P. Doncaster*); 1.vii.1947, 3 apt. (*V.F.E.*); Sawbridgeworth, garden peas, 3.vii.1944, 9 al. (*W. J. Hall*), B.M. 1954–624; Cambs., Teversham, *Lathyrus pratensis*, 15.x.1950, 3 oviparae, 1 apterous ♂; Cambridge, *L. pratensis*, 15.x.1950, 1 ovipara (*V.F.E.*); *Vicia sativa*, 19.v.1951, 1 apt.; Bourn, *Trifolium repens*, 8.vii.1952, 1 apt., 2 al. (*B. E. Eastop*). Cumberland, Skirwith, *Lathyrus nissolia*, 16.vi.1926, 1 apt., 1 al. (*H. Britten*). FINLAND: Tikkurila, *Vicia faba*, 1.vi.1963, 17 apt., 16 al., 1 first instar larva (*M. Markkula*). FRANCE: Bouches-du-Rhone, 1–17.vii.1960, 1 apt. (*B. M. Goodings*); Brittany, La Trinité sur Mer, sweeping behind sand dunes, 24.vii.–5.viii.1968, 8 apt. (*V.F.E.*). GERMANY: Rostock, 1964, numerous apterae and alatae from cultures on *Lotus uliginosus*, *Medicago sativa*, *Pisum sativum* and *Trifolium pratense* (*F. P. Müller*). ISRAEL: Dagania, *Trifolium* sp., 4.iv.1934, 1 al.; Rehoboth, lucerne, 20.i.1936, 1 apt., 2 al., (*E. Rivnay*). Jerusalem, *Lathyrus odoratus*, 30.v.1946, 2 al., (*E. Swirski*). Italy: Portici, *Medicago sativa*, 1.iii.1934, 2 apt., 2 al., (*F. Silvestri*). Madeira: 1847–48, 1 al. (*T. V. Wollaston*), B.M. 1855–7. Morocco: High Atlas, Asni, 3,500–5,000′, 20–30.iv.1961, 1 apt., 2 al.; Middle Atlas, Ifrane, 15.v.1961, 1 al., (*P. N. Lawrence*). Norway: Fana, trapped, 18.vi.1954, 1 al.; Vollebekk, As, 14.vii.1954, 1 al. (*H. Tambs-Lyche*). Portugal: Algarve, Lagos, yellow legume, June 1963, 4 apt. (*E. R. Speyer*). Scotland: Lanark, pea, 7.viii.1849, 3 apt., 1 al. (*F. Walker*) 1016. Argyllshire, July 1922, 1 al. (*A. Cuthbertson*). Spain: Talavena, 22.v.1969, 1 al. (*F. Baranyovits*). Switzerland: *Medicago sativa*, 5 apt., 4 al.; *Pisum sativum*, 7 apt.; *Trifolium pratense*, 8 apt., 4 al.; *Vicia faba*, 12 apt. (*W. Meier*). Turkey: Ankara, *Medicago sativa*, 19.vi.1962, 4 apt. Wales: Berthymaen, 16.vi.1933, 3 al. (*W. Maldwyn Davies*): Anglesey, Llandonna, 6–8.vi.1962, 6 apt. (*V.F.E.*). Mont., Welshpool, Sept. 1965, 1 al. (*G. A. Smith*). Yugoslavia: Many specimens including, from *Medicago sativa*, Cacak, 25.iv.1960, 3 apt., 1 al.; Skoplje, 26.vi.1962, 3 apt., 1 al., 23–24.ix.1964, 2 apt., Smedederevo, 20.vii.1962, 6 apt., 2 al.; Batajnica, 18.x.1961, 5 apt. vivip., 1 al. vivip., 3 oviparae; Nanske Banja, 9.x.1962, 8 al.; Prokuplje, 10.x.1964, 2 apt., 1 al.; Ljubicevo, 3.xi.1962, 12 oviparae, 4 apterous ♂♂, 3 al. ♂♂; Pozar-Ljubiceva, 3.xi.1961, 6 ovip., 6 apt. ♂♂, 3 al. ♂♂; Arandjelovac, 11.xi.1964, 2 ovip.; Metkovic, 17.xi.1964, 2 ovip.; Uljma-Vrsac, 27.xi.1964, 3 ovip. (*N. Tanasijevic*); from *Medicago* ? *sativa*, Lescepri Bledu, 1.viii.1967, 1 apt. (*V.F.E.*); from *Trifolium pratense*, Pozareva, 19.vii.1962, 3 apt 2 al.; Satornja, 9.vii.1964, 1 apt.; Pohorje, 19.viii.1962, 5 apt. (*N. Tanasijevic*); Wurzen Pass, *T.* ? *pratense*, 10.viii.1966, 1 apt. (*V.F.E.*).

Ethiopia: Dire Dawa, 'horse beans', June 1967, 1 apt. Kenya: Nairobi, *Vicia faba*, 31.xii.1951, 2 apt. (*R. Le Pelley*). Muguga, *Lathyrus* sp., 4.xi.1953, 7 apt., 1 al.; 2.x.1954, 2 apt., 1 al.; *Pisum* sp., 9.ii.1953, 7 apt., 5 al., 8 first instar larvae; trapped,

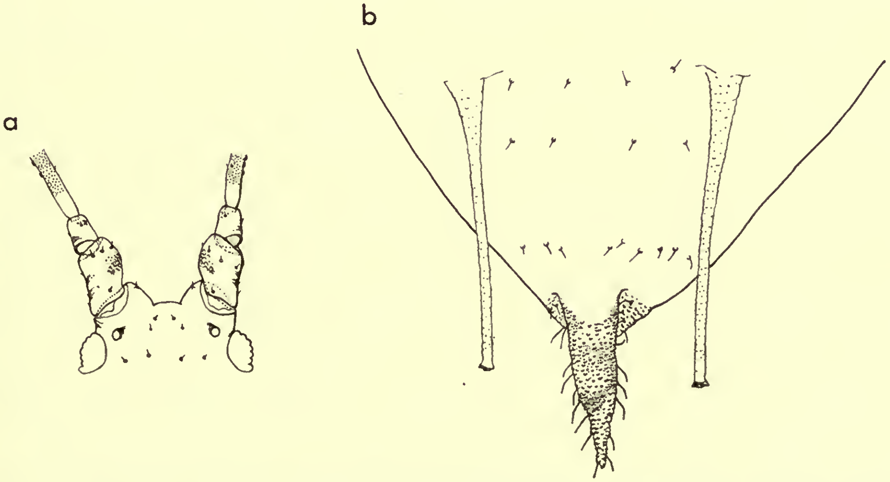

Fig. 7. *Acyrthosiphon pisum*, a, head of alata; b, apex of abdomen of aptera. × 45.

July 1953, 2 al. ♂♂; June 1954, 2 al. vivip., 1 al. ♂. Njoro, 'indigenous vetch', 5.xii.1953, 1 apt., 1 al. (*V.F.E.*). Kisii, coffee, 26.viii.1953, 4 apt., 4 al. (*R. Le Pelley*). RHODESIA: Salisbury, 17.vii.1941, 1 al., 24.vii.1958, 1 al., Sept. 1958, 2 al., 9.x.1958, 1 al. (*C. E. Taylor*); 'from lucerne, bred on peas', 12.i.1958, 6 apt., 1 al.; *Pisum sativum*, 12.iii.1958, 5 apt.; 'sweet pea', 28.x.1958, 2 apt., Fed. Min. Agr. St. SOUTH AFRICA: Transvaal, Nelspruit, trap, 25.v.–2.vi.1962, 1 al. (*R. E. Schwarz*). SUDAN: Khartoum, *Medicago sativa*, 1 apt.; 28.iii.1911, 1 al. (*R. Cottam*). TANZANIA: Arusha, *Vicia faba*, August 1926, 2 apt. (*A. H. Ritchie*). UGANDA: Kigezi, *Pisum* sp., 15.ii.1964, 1 apt., 1 al. (*S. Byakika*). YEMEN: San'a, c. 7,900', 18.ix.1937, 5 apt. (*C. Rathjens*); San'a district, Febr. 1938, 6 apt.; lucerne, 1.ii.1938, 1 apt. (*H. Scott & E. B. Britton*); Febr. 1938, 5 apt. (*E.B.B.*). ZAMBIA: Lusaka, lucerne, 4.x.1963, 2 apt., 2 al., Mt. Makula Res. Stn.

INDIA: Poona, 19.ii.1906, 1 apt., 1 al.; Bombay, *Lathyrus odorata*, 21.ii.1959, 4 apt. (*V.F.E.*); Pantnagar, *Pisum sativum*, 19.xii.1966, 3 apt.; *Vicia faba*, 9.ii.1967, 2 immature; 8.i.–12.i.1967, 1 apt., 2 al., Agric. Univ. U.P.; Jabalpur, Soybean, 16.iii.1968, 2 al., J.H. Agric. Univ.; Patna, 1964, 2 al., Central Potato Research Stn; Jaipur, Rajasthan, pea, 27.iii.1964, 2 apt., 1 al (*B. K. Srivastrava*). Sikkim, Mramcha, 26.iii.1920, 1 al. (*H. Stevens*). West Bengal, pea, 20.iii.1956, 1 apt., 1 al., State Agric. Rest. Inst. NEPAL: Godavari, pea, 5.iv.1966, 2 apt., 4 alatoid nymphs; 'wheat', 5.iv.1966, 1 apt., 1 al., 4 al. nymphs (*G. P. Kafle*); Shreemahal, yellow trap, March 1966, 1 al., May 1966, 1 al. (*K. C. Sharma*). PAKISTAN: Rawalpindi, *Pisum sativum*, 26.ii.1960, 1 apt., 1 al. (*M. A. Ghani*); 4.v.1967, 7 apt., 2 al. (*C.I.B.C.*); *Lathyrus* sp., 21.iii.1961, 3 apt.; Balakot, *Lathyrus odoratus*, 15.v.1963 (*M. A. Ghani*). HAWAII: Kaula Is., trap. 24.xii.1959, 1 al. (*J. L. Gressitt*).

U.S.A.: numerous specimens including Arizona, Yuma alfalfa, 7.–14.iii.1958, 9 apt., 1 al. vivip., 1 al.♂ (*V. Roth & D. M. Tuttle*); sticky board, Dec. 1959, 1 al. vivip. (*D.M.T. & D. Muse*). Arkansas, Madison Co., locust, 3.v.1965, 2 al., 1 larva (*H. Rolston*). California, Half Moon Bay, *Pisum sativum*, 4.vii.1936, 1 apt., 2 al. (*R. C. Dickson*); Blythe, alfalfa, 2.iv.1964, 2 apt., 2 al. (*R.C.D. & V.F.E.*); Colorado, Sulphur Springs, 25.vi.1937, 2 al. (*G. F. Knowlton*); Georgia, Tifton, peas, 27.iv.1964, 1 al. (*R. Davis*); Idaho, Woodruff Co., alfalfa, 24.x.1958, 2 apt., 4 al., Franklin, 26.x.1959, 2 apt., 1 al. vivip., 1 al. ♂ (*G. F. Knowlton*); Kansas, Manhattan, alfalfa, 2.iv.1921, 1 apt., 3 al. (*G. A. Dean*); Minnesota, St. Paul, peas in glasshouse, 8.ii.1961, 8 apt. (*E. A. Elkady*); Nevada, 22 apterae reared on *Vicia faba* in California, Oct. 1968, by *D. L. McLean*, originating from Reno, Nev.; New York, Rochester, *Lathyrus latifolius*, 2.viii.1963, 9 apt. (*M. D. Leonard*); Yonkers, 12 apt., 18 al. reared on *V. faba* in California by *D. L. McLean*, October 1968 but originating from Yonkers; Oregon, Corvallis, 14 apt., 5 al. reared on *V. faba*, in California, October 1968 by *D. L. McLean* but originating from Corvallis; South Dakota, Brookings, suction trap, 28.ix.1966, 1 al. (*J. T. Medler*); Texas, Denton, suction trap, 25.iv.1966 (*J. T. Medler*); Utah, Santa Barbara, alfalfa, 16.iv.1962, 7 apt., 2 al.; Plane City, alfalfa, 9.v.1938, 1 apt., 3 al.; Garfield, 22.v.1953, 2 al.; St. George, 17.iv.1958, 2 al.; Ogden, 2.vi.1956, 2 al., 11.vi.1958, 2 apt., 2 al., 19.vi.1962, 1 al.; Fielding, alfalfa, 26.x.1959, 1 apt., 2 al. vivip., 1 al.♂; Magna, alfalfa, 28.ix.1955, 1 apt., 3 al.; 8.xi.

1956, 1 apt. ♂; Corinne, 23.x.1962, 1 al. ♂; Paradise, 22.x.1962, 1 apt. ♂ (*G. F. Knowlton*); Washington, Prosser, bean, 14.vii.1955, 4 al. (*R. S. Robertson*); Wyoming, Goshen Co., clover, 9.vi.1949, 2 al.; Lone Tree, 10.vii.1956, 1 al. (*F.G.K.*). CANADA: Manitoba, Oakville, 25.vii.1962, 1 al.; Roland, *Melilotus alba*, 31.vii.1962, 1 apt.; Winnipeg, *Lathyrus odoratus*, 13.x.1963, 1 ovipara; *Medicago sativa*, 9.xi.1962, 2 apt. ♂♂ (*A. G. Robinson*); Quebec, St. Jean, artificial diet, 17.x.1966, 6 apt. vivip., 4 ovip., 2 apt. ♂♂ (*J. J. Cartier*).

HOST PLANTS. *Astragalus alpinus*, *Caragana arborescens*, *Glycine soya*, *Hippocrepis comosa*, *Lathyrus* ? *aphaca*, *L. latifolius*, *L. nissolia*, *L. odoratus*, *L. pratensis*, *L. roseus*, *Lens nigricans*, *Lotus corniculatus*, *L. hispidus*, *L. requienii*, *L. tenuifolius*, *L. uliginosus*, *Medicago carstiensis*, *M. falcata*, *M. lupulina*, *M. satica*, *Melilotus officinalis*, *Onobrychis vicaefolia*, *Pisum sativum*, *Trifolium arvense*, *T. hybridum*, *T. dubium*, *T. medium*, *T. pannonicum*, *T. pratense*, *T. repens*, *Trigonella foenum-graecum*, *Vicia cracca*, *V. faba*, *V. hirsuta*, *V. sinensis* (Leguminosae). and *Capsella bursa-pastoris* (Cruciferae). Records from Leguminous shrubs and trees such as *Genista nigricans*, *G. tinctoria*, *Ononis* ssp., *Robinia pseudacacia*, *Sarothamnus scoparius* and *Spartium junceum* probably often but not always apply to other subspecies.

DISTRIBUTION. Albania (Szelegiewicz, 1963 : 816), Austria, Azores, Canary Is., Crimea (Holman, 1961 : 118), Denmark, England, Faroes, Finland (Heie & Heikinheimo, 1964 : 124), Hungary, Iceland, Irak, Israel, Lebanon, Norway (Tambs-Lyche, 1968 : 6), Poland, Rumania, Sweden, Switzerland, Yugoslavia, European Russia to 67 degrees N (Shaposnikov, 1964 : 603), Eritrea, Kenya, South Africa, Tanzania, Yemen, India, Mongolia (Szelegiewicz, 1963 : 131), Central Asia (Nevsky, 1929 : 88), Japan (Takahashi, 1965 : 20), Szechuan, Taiwan (Tao, 1963 : 190), Peru (Essig, 1953 : 112), U.S.A., Canada to about 50 degrees N. Commonwealth Institute of Entomology map A23 (1952) gives the European and American distribution but the Australian record was based on a mis-identification and some of the Asiatic records are suspect.

BIOLOGY. Hibernation as eggs on biennial and perennial Leguminosae. Alatae viviparae occur in early summer, less frequently in mid and late summer and again in the autumn. Both apterous and alate males are produced in the autumn and in warm climates alate males are sometimes produced in the spring, presumably induced by the medium length day in populations that have over-wintered parthenogenetically. *A. pisum* does not thrive at high temperatures. Most of the records from India are between December and May while in Western Europe they are mostly between May and November. Auclair, 1957 : 32–33; 1958 : 330–337; 1959 : 279–286; 1962 : 134–140; 1963 : 439–490; 1965 : 855–875; 1964 : 241–249; Auclair & Cartier, 1960 : 13–16; 1960 : 315–326; 1963 : 1068–1069; Auclair & Maltais, 1950 : 175–176; 1961 : 740–743; Auclair, Maltais & Cartier, 1957 : 457–464; Cartier, 1957 : 37–41; 1963 : 205–213; 1965 : 65–73; 1966 : 378–380; Cartier & Auclair, 1964 : 1240–1243; Fröhlich, 1963 : 55–68; Halfhill, 1967 : 298–299; Kenten, 1955 : 599–624; Lowe & Taylor, 1964 : 287–295; Markkula, 1963 : 1–30; Markkula &

Laurema, 1967 : 77–80; Skotland & Hagedorn, 1955 : 665–666; Sutherland, 1967 : 387–389 & 1969 : 1385–1410, have studied the biology of *A. pisum* experimentally. Barker, 1952 : 162–164; Cook, 1963 : 1–48; Forsythe & Gyrisco, 1963 : 104–107; B. Johnson, 1959 : 367–377; McLean & Kinsey, 1967 : 400–406; 1968 : 730–739 and 1969 : 987–994; and Strong, 1968 : 463–475 have made observations on the biology of *A. pisum.* Host plant resistance has been investigated by Auclair, 1959 : 279–286; 1958*a* : 7–17; Auclair, Maltais & Cartier, 1957 : 456–464; Cartier, 1959 : 293–294; Harrington, 1941 : 461–466; 1945 : 12–22; Harrington, Searls, Brink & Eisenhart, 1943 : 369–387; Maltais, 1937 : 40–45; 1951 : 29–33; Maltais & Auclair, 1957 : 365–370; Ortman, Sorenson, Painter, Harvey & Hackerott, 1960 : 881–887; Searls, 1932 : 46–49; 1933 : 613–619.

Natural enemies and biological control have been investigated by Dunn, 1951 : 21–23; Fluke, 1929 : 1–47; Hagen & Schlingen, 1960 : 5–6; Freeman, 1938 : 2–3; Knowlton, Smith & Harmston, 1938 : 71–80; Mackauer & Finlayson, 1967 : 1051–1082; Mimeur, 1934 : 45; Sharma & Subba Rao, 1959 : 181–188; Drastich & Rozsypal, 1929 : 345–364 and MacLeod, 1953 : 503–505 studied the fungus diseases to which *A. pisum* is susceptible. Maxwell & Painter, 1962*a* : 57–62 & 1962*b* : 229–233 give an account of the honeydew.

NOTES. This aphid was long known as *pisi* Kltb. but there is no advantage in rejecting *pisum* Harris because of its long disuse, as *pisi* was also described as *onobrychis* B. de F. and *lathyri* Mosley, which also antedate *pisi.*

There is an enormous amount of literature concerning *A. pisi,* mostly under the name *Macrosiphum pisi.* The aphid exists as a complex of morphologically and biologically distinct populations variously termed biotypes or races. Since each fertilized egg gives rise to a distinct population which may not breed true for all characters, there is little chance of producing a useful nomenclatural system for these populations, particularly since a new system would be required each year for the sexually reproducing populations at least. There is no point in giving names to taxa unless individuals are recognizable when the taxon is next encountered. Cytogenetics have been investigated by Suomalainen, 1933 : 583–594 and Pagliai, 1965 : 235. Müller, 1962 : 228–239 and Markkula, 1963 : 1–30 conclude that red colouration is caused by a single dominant factor. Chromosome 2n=8 (Colling, 1955 : 208; Sun & Robinson, 1966 : 651).

Cartier, 1957 : 37–41; 1959 : 293–294; 1963a : 205–213; 1963b : 558–560; Harrington, 1945 : 12–22; Hinz, 1963 : 173–176; Lowe & Taylor, 1964 : 287–295; Müller, 1957 : 93–99; 1962 : 129–136; Sohi & Swenson, 1964 : 9–14; Sutherland, 1969 : 1385–1410; Wegorek & Hejna, 1969 : 61–75 have given accounts of biological races of *A. pisum.*

Acyrthosiphon (A.) pisum ononis (Koch, 1855)

Siphonophora ononis Koch, 1855 : 175–176; Ferrari, 1872 : 212; Macchaiati, 1883 : 230; Del Guercio, 1900 : 162.

Macrosiphon ononis (Koch) Schouteden, 1906 : 239.

Acyrthosiphon pisum (Harris) Hille Ris Lambers, 1947 : 247–254, partim.

Acyrthosiphon onobrychis (B. de Fonsc.) Börner, 1952 : 151–153, partim.
Acyrthosiphon (A.) *pisum* ssp. *ononis* (Koch) Meier, 1957 : 90–92; 1958 : 308–311; Ossiannilsson, 1959 : 487; Stroyan, 1964 : 54–55.

Specimens studied. England: Kent, Tankerton, *Ononis spinosa*, 7.viii.1948, 2 apterae (*L. E. Carey*); Surrey, Kew Gdns, *O. spinosa*, 3.x.1962, 1 ovipara, 2 apterous ♂♂ (*V.F.E.*); Lincoln, *O. spinosa*, August 1965; 5 apt., 3 first instar larvae (*L. A. Mound*). France: Brittany, La Trinité sur Mer, *O. spinosa*, 2.viii.1968, 6 apt. (*V.F.E.*). Wales: Anglesey, Llandona, *O. repens*, 30.v.1961, 2 apt., 1 al., 1 first instar larva (*V.F.E.*).

Host plants. *Ononis spinosa* and sometimes *O. repens*. Meier (1958 : 310) quotes F. P. Müller as saying that specimens can be transferred experimentally to *Medicago sativa*, *Melilotus officinalis*, *Trifolium pratense* and *Pisum sativum*. It is not certain that these experiments were done with the ssp. *ononis*; *pisum* s.str. will sometimes colonize shrubs.

Distribution. Belgium, Denmark (Heie, 1961 : 90), England, Germany, Hungary, Italy, Netherlands, Poland (Szelegiewicz, 1962 : 169), Sweden, Switzerland, Wales.

Biology. Apterous males are produced in October (Meier, 1958 : 309).

Acyrthosiphon (A.) pisum spartii (Koch, 1855)

Siphonophora spartii Koch, 1855 : 172–173.
?*Macrosiphum* (*Acyrthosiphon*) *genistae* (Mordwilko) Theobald, 1917 : 80 nec Mordwilko, 1914 : 144–147.
?*Acyrthosiphon genistae* Mordwilko; Gomez-Menor 1963 : 44–48 nec Mordwilko, 1914 : 144–147.
Acyrthosiphon spartii (Koch) Börner, 1952 : 153.
?*Acyrthosiphon spartii* ssp. *nigricantis* Börner, 1952 : 153–257.

Specimens studied. Egypt: Giza, *Robinia pseudacacia*, 25.v.1924, 5 apterae; *Spartium junceum*, 3.vi.1924, 1 alata (*W. J. Hall*). England: London, Southgate, broom, 3.vii.1847, 3 apt. (*F. Walker*), 1015; Middx., Moor Park, *Cytisus* sp., 17.vii. 1958, 11 apt., 15.vii.1962, 2 apt.; Berks, Midgham, *Sarothamnus scoparius*, 15.v.1948, 4 apt.; Reading, *S. scoparius*, 25.vi.1950, 4 apt.; Surrey, Kew, *Cytisus* sp., 25.vi.1961, 3 apt.; Send, *Cytisus* ? *andreanus*, 15.vii.1963, 2 apt. (*D. J. Williams*). Luxembourg: Esche sur Sûr, *Sarothamnus* sp., 29.vii.1966, 10 apt. (*V.F.E.*). Madeira: Carcin, *Cytisus* sp., 20.vi.1929, 1 apt., 4 al. (*J. Balfour Browne*). Netherlands: Bennekom, *S. scoparius*, 15.vi.1954, 22 apt., 3 al. (*D. Hille Ris Lambers & J. P. Doncaster*). Scotland: Aberdeen, *S. scoparius*, 5.x.1927, 7 apt. (*E. V. Laing*). Tasmania: *Cytisus monspessulanus*, 19.v.1960, 19 apt., 5 first instar larvae (*R. D. Hughes*); Bellerive, *Cassia* sp., 2.v.1964, 34 apt., 5 al. vivip., 1 apt. ♂, 5 first instar larvae; Grove, colour trap, 8.ii.1963, 1 al.; New Town, colour trap, 16.i.1961, 1 al.; 6.ii.1963, 1 al., 29.x.1962, 1 al.; 27.xi.1961, 1 al.; 6–13.xii.1961, 2 al.; 18.xii. 1963, 5 al. (*E. J. Martyn*).

Host plants. *Cassia* sp., *Cytisus* sp., *Sarothamnus monspessulanus*, *S. scoparius*, *Spartium junceum*, and perhaps also *Genista* spp., *Robinia pseudacacia* and *Spartocytisus nubigens*.

Distribution. Canary Is., Denmark, (Heie, 1961 : 90), England, Egypt, Germany, Latvia (Rupais, 1965 : 27), Luxembourg, Madeira, Netherlands, Scotland, Sweden, Tasmania.

Biology. Smith (1966*a* : 255–267) says that most eggs had hatched by 27.iii. 1956 and 28.ii.1957 at Silwood Park, Berks and that only a few of the second generation but many of the third generation were alate. Sexuales were produced from the end of September and oviposition continued well into November. He also gives details of the natural enemies. Smith (1966*b* : 213–214) discusses host selection.

Notes. It is not certain that all the specimens listed above are really *spartii* as *pisum* s.str. will probably live on the young growth of some shrubs under some conditions. Similarly *spartii* may not be homogeneous but only a name given to those populations of *pisum* which prefer living on shrubs rather than on herbs.

Acyrthosiphon (A.) primulae (Theobald, 1913)

?*Siphonophora malvae* (Mosley) Passerini, 1863 : 137 partim, nec Mosley, 1841.
Macrosiphum primulae Theobald, 1913 : 91.
Myzus primulae (Theobald) Theobald, 1926 : 338–341.
Acyrthosiphon primulae (Theobald) Eastop, 1951 : 108; Stroyan, 1952 : 256.
Dysaulacothum primulae (Theobald) Börner, 1952 : 143.
Aulacorthum primulae (Theobald) Cottier, 1953 : 240–242.
Acyrthosiphon malvae ssp. *primulae* (Theobald); Ossiannilsson, 1959 : 484.
Acyrthosiphon pelargonii ssp. *primulae* (Theobald); Müller, 1961 : 69.
Microlophium primulae (Theobald) Hille Ris Lambers, 1966 : 17.

Specimens studied. England: London, S. Kensington, 'polyanthus', 9.ii.1944, 2 apt., April 1944, 2 apt., 4 al., 22.v.1944, 10 apt., 10 al. (*M. E. Mosely*); Bedford Park, *Primula* sp., 30.iv.1926, 3 apt., 5.v.1926, 3 apt., 3 al. (*J. Waterston*). Middx., Hendon, *Primula vulgaris*, 17.ii.1920, 1 al., 24.iii.1920, 3 al. (*K. G. Blair*). Kent, Maidstone, *Primula kewensis*, 27.iii.1913, 1 apt., 1 al., both labelled type (*F. V. Theobald*), B.M. 1930/204; East Malling, trapped, 25.v.1965 (*K. R. Bock*). Surrey, Tooting Common, *Primula* sp., 2.ix.1923, 3 apt., 1 al. (*O. G. Heath*). *Primula* 'Emily Arkwright', 27.iv.1928, 1 apt., 3 al., 2 alatoid nymphs (*G. Fox Wilson*). Herts, Sawbridgeworth, 'polyanthus', 21.v.1944, 2 apt., 4 al. (*W. J. Hall*). Harpenden 'polyanthus' 18.v.1952, 1 apt., 3 al. (*J. P. Doncaster*); trap, 4.vii.1967, 1 al. (*J. Palmer*); Whetstone, m/v lamp, 3.vi.1961, 1 al. (*P. H. Ward*). Cambridge, Botanic Gdns, glasshouse, *P. kewensis*, 6–11.iv.1950, 4 apt., 3 al. (*H. L. G. Stroyan*); *P. kewensis* var. *farinosa*, 9.i.1951, 5 apt., 2 al. (*V.F.E.*). Tasmania: New Town, 'polyanthus', 28.iv.1947, 3 apt., 1 al., 1 al. nymph; Grove, *Primula* sp., 22.v.1964, 1 apt. (*E. J. Martyn*). New Zealand: Palmerston North, primrose, 22.ix.1929, 1 apt.; 8.ii.1937, 2 al. (*W. Cottier*).

HOST PLANTS. *Primula kewensis* and perhaps more rarely other *Primula* spp. (Primulaceae).

DISTRIBUTION. England, Germany (Müller, 1961 : 69), Sweden, Tasmania, New Zealand.

NOTES. Hille Ris Lambers (1966 : 17) has placed *primulae* in *Microlophium* Mordw. but it has been included in this account of *Acyrthosiphon* as, if apterae alone are collected, they are difficult to distinguish from *Acyrthosiphon* Mordw. No earlier reference to the combination *Acyrthosiphon primulae* has been found than my 1951 paper on Berkshire aphids. Since I do not remember consciously proposing a new combination, it may have been used before or the information was derived from Dr Hille Ris Lambers or Mr Stroyan.

Acyrthosiphon (A.) pseudodirhodum (Patch, 1919)

Macrosiphum pseudodirhodum Patch, 1919 : 213; 1923 : 309.
Acyrthosiphon brevis Richards, 1963 : 254–256.
Acyrthosiphon pseudodirhodum (Patch) MacGillivray, 1968 : 353–357.

SPECIMENS STUDIED. U.S.A.: Penn., Scotia, *Spiraea* sp., 5.vii.1963, 5 apt. (*J. O. Pepper*). CANADA: Manitoba, Caddy Lake, *Spiraea* sp., 20.vii.1963, 1 apt. (*A. G. Robinson*).

HOST PLANTS. *Spiraea latifolia* and perhaps other *Spiraea* spp., *Rosa* sp. or spp.

DISTRIBUTION. Maine, New York, Pennsylvania, Manitoba, New Brunswick, Nova Scotia, Ontario.

NOTES. According to MacGillivray, 1968 : 356, Griswold, 1927 : 16 and Leonard's 1963 : 363–364 records from rose applied to *Rhodobium porosum* (Sand.) (see p. 79) and Glendenning (1929 : 56) had *Placoaphis siphunculata* Richards, 1961 : 624–625.

Acyrthosiphon (A.) rjabushinskiji Mordwilko, 1914

Acyrthosiphon rjabushinskiji Mordwilko, 1914 : appendix 5; 1919 : 244–246.

HOST PLANT. Unknown.

DISTRIBUTION. Kamchatka.

NOTES. See *soldatovi*, p. 69.

Acyrthosiphon (A.) rubi rubi Narzikulov, 1957

Acyrthosiphon rubi Narzikulov, 1957 : 673–675; Stroyan & Nagaich, 1964 : 61.
Acyrthosiphon (*Metropolophium*) *rubi* Narzikulov, Narzikulov & Umarov, 1969 : 164–166.

HOST PLANTS. *Rubus caesius* var. *turkestanicus* (Rosaceae).

DISTRIBUTION. Tadjikistan.

Acyrthosiphon (A.) rubi elliptici Stroyan & Nagaich, 1964

Acyrthosiphon rubi ssp. *elliptici* Stroyan & Nagaich, 1964 : 59–62.

Specimens studied. India: U.P., Chambatiya dist., 6000′, *Rubus ellipticus*, October/November 1957 (*B. S. Nagaich*), holotype and 3 paratype apterae, H. L. G. Stroyan leg., B.M. 1966–144; New Delhi, *R. ellipticus*, October, 1958, 4 apt., Agricultural Research Institute.

Host plants. *Rubus ellipticus* and perhaps *Fragaria* sp. (Rosaceae).

Distribution. Northern India.

Notes. Similar to *pelargonii* s.lat., of which several of the subspecies live on Rosaceae. Specimens with a strongly sclerotic dorsum collected from strawberry at Galu by Dr Rabinder Kumar are probably this species.

Acyrthosiphon (A.) rubiformosanus (Takahashi, 1927)

Macrosiphum ? rosae (L.); Takahashi, 1923 : 13–14 nec Linnaeus, 1758 : 452.
Macrosiphum rubiformosanum Takahashi, 1927 : 3–4.
Acyrthosiphon (*Microlophium*) *rubiformosanus* (Takahashi) Takahashi, 1965 : 21–23.

Specimens studied. Japan: Osaka, Chihaya, *Rubus* sp., 1.vi.1958, 2 apt. (*R. Takahashi*), B.M. 1962–228.

Host plants. *Rubus* sp. (Rosaceae).

Distribution. Japan, Taiwan.

Notes. Takahahsi (1923 : 14) thought *rubiformosanus* was close to *kamshaticum* Mdw. (see p. 86) and in 1965 : 21 placed it in the subgenus *Microlophium* Mdw. Tao (1963 : 195) thought it might come in *Aulacorthum* Mdw.

Acyrthosiphon (A.) rumicis Narzikulov, 1969

Acyrthosiphon rumicis Narzikulov, *in* Narzikulov & Umarov, 1969 : 193–194.

Host plant. *Rumex paulseniana* (Polygonaceae).

Distribution. Tadzhikistan.

Acyrthosiphon (A.) salviae Nevsky, 1929

Acyrthosiphon salviae Nevsky, 1929 : 88–89; Narzikulov & Umarov, 1969 : 176–177.

Host plant. *Salvia sclarea* (Labiatae).

Distribution. Kazakhstan.

Notes. The original description is similar in some respects to that of *soldatovi* Mdw. (see p. 69). When refound the alatae should be readily recognizable, as the third antennal segment is described as bearing 40–50 rhinaria, an unusually high number for an *Acyrthosiphon*. Narzikulov & Umarov (1969) figure siphunculi with reticulated apices which, together with the long antennal hairs, make it unlikely that *salviae* really belongs in *Acyrthosiphon*.

Acyrthosiphon (A.) scalaris (Richards, 1963) **comb. n.**

Chaetosiphon scalaris Richards, 1963 : 690, 692, 693.

SPECIMENS STUDIED. CANADA: Ontario, Little Current, *Potentilla fructosa*, 12.vii.1961, 1 paratype aptera (*W. R. Richards*), B.M. 1963–621; Manitoba, Stony Mtn, *Potentilla* sp., 27.vii.1965, 1 apt. (*A. G. Robinson*).

HOST PLANT. *Potentilla fructosa* (Rosaceae).

DISTRIBUTION. Manitoba, Ontario.

NOTES. Mr Stroyan pointed out that it would be useful to include this species in a key to *Acyrthosiphon*.

Acyrthosiphon (A.) soldatovi soldatovi Mordwilko, 1914

Acyrthosiphon soldatovi Mordwilko, 1914 : 80, 168–171; Narzikulov, 1957 : 883.

HOST PLANT. *Spiraea hypericifolia*.

DISTRIBUTION. Tadzhikistan.

NOTES. The first of five species to be described from Asiatic Russia and China with a rather unusual combination of proportions. None of these proportions is unusual in itself but they are rare in this combination.

Ratios	Body length / Siphunculi	Siphunculi / Cauda.	Processus terminalis / Base antennal VI	Host Plant	Page No:
hoffmani Tak.	4·0–4·3	2·4	5·6	*Wisteria*	91
pamiricum Nevsky	2·9–3·8	2·6	5·6	Gramineae	51
rjabushinskiji Mdw.	3·4–3·5	2·8	4·6	unknown	67
salviae Nevsky	3·0–3·7	2·7	4·6	*Salvia*	68
soldatovi Mdw.	4·0–4·3	2·4	4·3	*Spiraea*	69

It is possible that *soldatovi* should be placed in the sg. *Metopolophium* Mdw., with *pamiricum* as a synonym or close relative on the secondary host plant.

Acyrthosiphon (A.) soldatovi tadzhikistanica Narzikulov & Umarov, 1969

Acyrthosiphon soldatovi ssp. *tadzhikistanica* Narzikulov & Umarov, 1969 : 193.

HOST PLANT. *Spiraea hypericifolia* (Rosaceae).

DISTRIBUTION. Tadzhikistan.

Acyrthosiphon (A.) spiraeae Narzikulov, 1957

Acyrthosiphon spiraeae Narzikulov, 1957 : 675–676; 1968 : 6.
?*Acyrthosiphon spiraeae* Rupais, 1961 : 128–129, teste Narzikulov & Umarov, 1969 : 169.
Acyrthosiphon (*Metopolophium*) *spiraeae* Narzikulov; Narzikulov & Umarov, 1969 : 169–170.

Host plant. *Spiraea hypericifolia* (Rosaceae).

Distribution. Tadzhikistan.

Notes. Said to be close to *soldatovi* Mdw. and *ignotum* Mdw., which inhabit other species of *Spiraea*, but to differ from them in having shorter antennae, the third segment of the alatae bearing only 14–15 rhinaria, 7–11 in *ignotum* and 22–24 in *soldatovi*. *A. spiraeae* and *fragariaevescae* resemble the *soldatovi* group but the processus terminalis is only $3\frac{1}{4}$–4 times as long as the base of the sixth antennal segment. According to Rupais (1969 : 358) *A. spiraeae* Rupais is a synonym of *ignotus* Mdw.

Acyrthosiphon (A.) spireaellae Umarov, 1964

Acyrthosiphon spireaellae Umarov, 1964 : 67–68; Narzikulov, 1966 : 32; Narzikulov & Umarov, 1969 : 172–174.

Host plant. *Spiraea hyperifolia.*

Distribution. Kazakhstan.

Acyrthosiphon (A.) svalbardicus Heikinheimo, 1968

Acyrthosiphon svalbardicus Heikinheimo, 1968 : 88–90.

Host plant. Unknown.

Distribution. Spitzbergen.

Notes. The short processus terminalis and paired, pigmented, segmentally arranged, spinopleural transverse bands should make identification easy.

Acyrthosiphon (A.) thracicus Tashev, 1962

Acyrthosiphon sp. nr. *euphorbiae* Börner; Tashev, 1961 : 158.
Acyrthosiphon thracicus Tashev, 1962 : 419–422.
?*Acyrthosiphon euphorbiae* (Börner); Tuatay & Remaudière, 1965 : 269 nec Börner, 1940.

Host plant. *Euphorbia platphyllos* (Euphorbiaceae).

Distribution. Bulgaria, Czechoslovakia (Holman, 1965 : 281).

Acyrthosiphon (A.) titovi Mordwilko, 1932

Acyrthosiphon titovi Mordwilko, 1932 : 57; Titov, 1936 : 157 (as sp. n.); Nevsky, 1951 : 48; Narzikulov & Umarov, 1969 : 192.

Host plant. *Papaver somniferum* (Papaveraceae).

DISTRIBUTION. Kazakhistan.

NOTES. I have not seen a description of this species, although the name has occurred in several lists of insects attacking opium poppy. It may be a *nomen nudum.*

Acyrthosiphon (A.) tutigula (Hottes, 1933)

Adactynus tutigula Hottes, 1933 : 17–19.
Kakimia tutigula (Hottes) Gillette & Palmer, 1934 : 167; Hottes, 1949 : 56; Palmer, 1952 : 284.
Acyrthosiphon tutigula (Hottes) Hille Ris Lambers, 1961 : 182.

SPECIMENS STUDIED. U.S.A.: Colorado, Skyway, *Capnoides* sp., 10.ix.1948, 1 apt.; 7.vii.1951, 6 al. (*F. C. Hottes*), B.M. 1959–403.

HOST PLANTS. *Rosa* sp. (Rosaceae) and *Corydalis* (*Capnoides*) sp. (Fumariaceae).

DISTRIBUTION. Colorado.

BIOLOGY. Alternation between *Rosa* and *Corydalis* (Hille Ris Lambers, 1961 182).

NOTES. The five hairs on the first tarsal segments distinguish *tutigula* from most other *Acyrthosiphon.* The short thick cauda is remniscent of that of *chelidonii,* which feeds on the related family Papaveraceae.

Acyrthosiphon (A.) vasilijevi Mordwilko, 1915

Acyrthosiphon vasilijevi Mordwilko, 1915 : 11; Nevsky, 1929 : 92; Narzikulov & Umarov, 1969 : 174.

HOST PLANT. *Cucurbita pepo* (Cucurbitaceae).

DISTRIBUTION. Turkestan (Mordwilko, 1929 : 79).

NOTES. Described as a green aphid living on the leaves of *Cucurbita* and similar to *caraganae* Chol. Del Guercio (1913 : 94) obtained aphids from cucumbers and melons which he attributed to a variety of *A. cyparissiae.*

Acyrthosiphon (A.) wasintae (Hottes, 1933)

Adactynus wasintae Hottes, 1933 : 19.
Macrosiphum wasintae (Hottes) Gillette & Palmer, 1934 : 200; Hottes, 1948 : 31; Palmer, 1952 : 330.

SPECIMENS STUDIED. U.S.A.: Colorado, Skyway (*Daysophora fruticosa*), 4.vii. 1932, 3 apterous paratypes (*F. C. Hottes*), B.M. 1953–83. Mesa, *Dasiophora* sp., 3.x.1947, 6 oviparae (*F. C. Hottes*).

HOST PLANT. *Dasiophora fruticosa* (Rosaceae).

DISTRIBUTION. Colorado.

Acyrthosiphon (Liporrhinus) chelidonii (Kaltenbach, 1843)

Aphis chelidonii Kaltenbach, 1843 : 41–42.
Siphonophora chelidonii (Kaltenbach) Koch, 1855 : 169–170.
Myzus chelidonii (Kaltenbach) Henrich, 1910 : 32–33; Paik, 1965 : 66.
Macrosiphum chelidonii (Kaltenbach) Opmanis, 1928 : 394.
Acyrthosiphon (?) *chelidonii* (Kaltenbach) Mordwilko, 1929 : 50.
Liphorrhinus chelidonii (Kaltenbach) Börner, 1939 : 82–83.
Acyrthosiphon (*Liphorrhinus*) *chelidonii* (Kaltenbach) Hille Ris Lambers, 1947 : 257–260. Shaposhnikov, 1964 : 603.
Aulacorthum chelidonii (Kltb.) Börner, 1952 : 155.

SPECIMENS STUDIED. AUSTRIA: Carinthia, Hochostewitz, *Chelidonium* sp., 9.viii.1966, 1 apt. (*V.F.E.*). CZECHOSLOVAKIA: Trencin, *C. majus*, 30.v.1944, 11 al. (*J. Holman, P. Stary, V.F.E.*). GERMANY: Berlin, *Chelidonium* sp., 10.v.1950, 2 apt. (*K. Heinze*). KOREA: Seoul, *C. sinense*, 20.v.1965, 1 al.; Suwon, 3.v.1967, 1 al. (*W. H. Paik*). NETHERLANDS: St. Pietersburg, *C. majus*, 5.xi.1939, 5 oviparae (*D. Hille Ris Lambers*).

HOST PLANTS. *Chelidonium majus*, *C. sinense* (Papaveraceae).

DISTRIBUTION. Austria, Crimea (Holman, 1961 : 8), Denmark (Heie, 1961 : 87), France (Remaudière, 1954 : 235), Germany, Hungary, Korea, Latvia, Netherlands, Poland, Sweden, Switzerland.

NOTES. Type-species of *Liporrhinus* Börner, 1939. *Xanthomyzus glaucii* Narzikulov, (see p. 85) which lives on *Glaucium* in Tajikistan and the apterae of which are devoid of secondary rhinaria, have siphunculi $\frac{1}{10}$–$\frac{1}{8}$ as long as the body and the processus terminal is only $1\frac{1}{2}$ to twice as long as the base of the sixth antennal segment may be related. British records of *chelidonii* are based on misidentified specimens of *Aulacorthum solani* (Kaltenbach).

Acyrthosiphon (Metopolophium) albidus (Hille Ris Lambers, 1947)

Metopolophium albidum Hille Ris Lambers, 1947 : 278–218; Stroyan, 1950 : 93–94.

SPECIMENS STUDIED. AUSTRIA: Tirol, Kitzbuhel, 18–29.viii.1962, 1 aptera, (*A. H. Hayes*). CZECHOSLOVAKIA: Strazovice, *Arrhenatherum elatius*, 29.v.1964, 1 alata, 1 larva (*J. Holman, P. Stary, V.F.E.*). ENGLAND: London, 18.iv.1961, 1 al., 26.v.1961, 1 al; Kent, Gravesend, trap, 1942, 2 al. (*J. P. Doncaster*); Berks, Reading, *A. elatius*, 2.v.1948, 1 apt. (*V.F.E.*); Gloucs., Cirencester, *A. elatius*, 4.vii.1945, 1 apt. (*H. K. Airy Shaw*); Somerset, Long Ashton, 1964, 6 al. (*A. Stringer*); Surrey, Kew, 1.v.1961, 3 al.; 8.v.1964, 1 al.; 14.v.1966, 1 al.; grass tufts, 4.vi.1961, 3 apt., 1 al.; 30.iv.1966, 7 apt., 1 al.; 28–29.v.1966, 1 apt., 5 al.; 1.iv.1967, 2 apt.; *Arrhenatherum elatius*, 4–5.v.1958, 10 apt., 1 al., 1 alatoid nymph, 6 first instar larvae (*V.F.E.*), Box Hill, 16.v.1960, 1 al. (*J.P.D.*); Bucks, Waddesdon, grass, 17.v.1952, 3 apt., 1 al. (*V.F.E.*); Herts, Harpenden, *Dactylis glomerata*, 5.vi.1943, 3 apt.; trap, 13.v.1944, 2 al. (*J.P.D.*); Whetstone, m/v lamp, 16.vi.1960, 1 al. (*P. H. Ward*); Beds, Cardington, trap, 8.vi.1948, 1 al. (*C. G. Johnson*); Cambridge, Shepreth, *A. elatius*, 20.v.1948, 3 apt., 2 al. (*H. L. G. Stroyan*); Lincs, Spalding, trap, 8.vi.1943, 6 al. (*J.P.D.*). NETHERLANDS: St. Pietersberg, *A. elatius*, 5.xii.1939, 3 apterous cotypes (*D. Hille Ris Lambers*), B.M. 1950–554; Limberg, Gulpen, 26.vi.1952, 4 apt., 1 al. (*D.H.R.L. & V.F.E.*). WALES: Anglesey, Llanddona, *Dactylis glomerata*, 27.v.1961, 1 apt. (*V.F.E.*).

HOST PLANTS. Usually *Arrhenatherum elatius*, occasionally *Dactylis glomerata* (Graminaeae).

DISTRIBUTION. Austria, Czechoslovakia, England, Germany, Italy (Hille Ris Lambers, 1966 : 117), Netherlands, Norway (Tambs-Lyche, 1968 : 6), Poland (Szelegiewicz, 1964 : 262), Sweden (Ossiannilsson, 1959 : 387), Wales.

BIOLOGY. Alate males are recorded from Holland in October, where *albidum* overwinters as an egg. Numerous alatae occur in the third generation, and alatae occur from late April to early June in Southern England.

Acyrthosiphon (Metopolophium) alpinus (Hille Ris Lambers, 1966)

?*Macrosiphum solanifollii* (Ashmead) Fenjves, 1945 : 3–124 nec Ashmead, 1882.
Acyrthosiphon catharinae Nevsky, Hille Ris Lambers, 1953 : 63 nec Nevsky, 1928.
Metopolophium alpinum Hille Ris Lambers, 1966 : 111–117.

SPECIMENS STUDIED. SWITZERLAND: Nante, *Rosa* sp., 7.vi.1953, 1 apt., 2 al., (*W. Meier* coll.), D. Hille Ris Lambers leg., B.M. 1954–417.

HOST PLANTS. *Rosa* sp. (Rosaceae) and *Poa alpina* (Gramineae).

DISTRIBUTION. Austria, Switzerland.

BIOLOGY. Alternation between *Rosa* and *Poa alpina*.

NOTES. Hille Ris Lambers, 1966 : 116 points out 'that there are reasons for considering *Metopolophium* Mordw. a sub-genus of *Acyrthosiphon* Mordv. as Mordwilko (1914) himself did'.

Acyrthosiphon (Metopolophium) arctogenicolens Richards, 1964

Acyrthosiphon (*Metopolophium*) *arctogenicolens* Richards, 1964 : 1027–1029.

HOST PLANT. *Taraxacum arctogenum* (Compositae).

DISTRIBUTION. Canadian Arctic.

NOTES. Differs from *Aülacorthum palustre* H.R.L. in that the head is smooth ventrally (some spinules in *palustre*), the ultimate rostral segment is only $\frac{7}{10}$ as long as the second segment of the hind tarsus ($1\frac{1}{4}$ in *palustre*), the processus terminalis is $3–3\frac{1}{2}$ times as long as the base of the sixth antennal segment (4 in *palustre*) and the siphunculi are $1\frac{1}{2}$ times as long as the cauda ($2–2\frac{1}{2}$ in *palustre*).

Acyrthosiphon (Metopolophium) beiqueti (Hille Ris Lambers, 1960)

Metopolophium beiqueti Hille Ris Lambers, 1960 : 259–260.

HOST PLANT. Unknown, 'presumably Gramineae or Cyperaceae'.

DISTRIBUTION. Quebec.

NOTES. Described from 3 apterae viviparae with cauda bearing about 15–21 rather inconspicuous hairs. 'Recognition of this large species should be easy as no other known *Metopolophium* has such a large number of caudal hairs', Hille Ris Lambers, 1960 : 260. *A.* (*M*). *graminearum* Mordw. (p. 78) is similar.

Acyrthosiphon (Metopolophium) chandrani Kanakaraj David & Narayanan, 1968

Acyrthosiphon (*Metopolophium*) *chandrani* Kanakaraj David & Narayanan, 1968 : 102–103.

HOST PLANTS. *Bromus unioloides*, *Poa annua* (Gramineae).

DISTRIBUTION. Himachal Pradesh.

NOTES. The eighth abdominal tergite bearing only 2 hairs and the third antennal segment bearing 2–7 tuberculate rhinaria distinguish *chanandri* from other *Metopolophium* species.

Acyrthosiphon (Metopolophium) dirhodum (Walker), 1849)

Aphis dirhoda Walker, 1848 : 372, nom. nud., (migration) : 1849 : 43–45 (description).
Siphonophora dirhoda (Walker) Buckton, 1876 : 132–134.
Siphonophora longipennis Buckton, 1876 : 146–148.
Myzus gracilis Buckton, 1876 : 176–177.
Siphonophora caianensis Del Guercio, 1900 : 167.
Macrosiphum dirhodum (Walker) Schouteden, 1906 : 238; Theobald, 1913 : 128; Van der Goot, 1915 : 62–66; Opamis, 1928 : 396; Palmer, 1952 : 302.
Macrosiphum longipennis (Buckton) Theobald), 1913 : 118.
Macrosiphum arundinis Theobald, 1913 : 144.
Macrosiphum graminum Theobald, 1913 : 145.
Acyrthosiphon (*Metopolophium*) *dirhoda* (Walker) Mordwilko, 1914 : 82 ; 1919 : 272–291; Narzikulov & Umarov, 1969 : 154–158.
Acyrthosiphon (*Metopolophium*) *graminum* (Theobald) Mordwilko, 1914 : 82; 1919 : 296–297.
Macrosiphum rosaeollae Theobald, 1915 : 110, 111, 112.
Myzus myrmecophilus Theobald, 1926 : 352–354.
Myzus longipennis (Buckton) Theobald, 1926 : 354–356.
Illinoia dirhoda (Walker) Börner, 1926 : 229.
Metopolophium dirhodum (Walker) Mordwilko, 1929 : 86, 89, 90: Hille Ris Lambers, 1947 : 281–286; 1966 : 117; Doncaster, 1961 : 58–61; Heie, 1961 : 90–91; Rupais, 1969 : 262.
Acyrthosiphon dirhodum (Walker) Nevsky, 1929 : 82–83; Börner, 1938 : 4.
Amphorophora dirhoda (Walker) Börner, 1932 : 626.
Aulacorthum dirhodum (Walker) Börner, 1936 : 4.
Acyrthosiphon dirhoda (Walker) Knechtel & Manolache, 1941 : 551–552.
Macrosiphum (*Goidanichiellum*) *dirhodum* (Walker) Martelli, 1950 : 318–324.

Specimens studied. Denmark: Lyngby, trap, 5–11.vii.1958, 8 alatae (*O. Heie*). England: London, Southgate, *Rosa* sp., 17–22.v.1847, 2 apterae, 8 al. (*F. Walker*) 333, 303, 308, B.M. 1847–61, 1953–565; 15.x.1847, 2 al. (*F. Walker*) 301; *Glyceria fluitans*, 5.vii.1847, 2 al. (*F. Walker*) 306; South Kensington, *Rosa* sp., Oct. 1943, 7 oviparae (*M. E. Mosely*). *Dactylis glomerata*, 1.vi.1923, 1 apt., 4 al. (*F. Laing*); Chelsea Physic Gdn, 25–31.v.1960, *Agrostis canina*, 11 apt., 5 al.; *Aira capillaris*, 1 apt.; *Arrhenatherum elatius*, 1 apt., 3 al.; *Asperella hystrix*, 4 apt.; *Avena desertorum*, 1 apt.; *Bromus madritensis*, 7 apt., 7 al.; *B. unioloides*, 4 apt., 2 al.; *Festuca pratensis*, 2 apt., 1 al., 1 al. nymph; *F. rubra*, 2 apt.; *F. varia*, 4 apt., 2 al.; *Glyceria aquatica* var. *variegata*, 8 apt.; *Hordeum jubatum*, 3 apt., 2 al.; *H. murinum*, 2 apt., 4 al.; *H. vulgare*, 1 apt., 1 al.; *Lagurus ovatus*, 1 apt., 1 alatoid nymph; *Larmarkia aurea*, 10 apt., 6 al.; *Nardus stricta*, 1 apt., 2 al.; *Poa nemoralis*, 6 apt., 1 al.; *Triticum spelta*, 10 apt., 9 al., 6 al. nymphs; *T. trichophorum*, 9 apt., 2 al.; *Bromus inermis*, 3 apt., 2 alatoid nymphs; *Carex secta*, 1 apt., 2 larvae (*V.F.E.*); Kent, St Mary's Marshes, *Rosa canina*, 23.vi.1958, 1 apt. (*J. P. Doncaster & V.F.E.*); Bromley, *Rosa* sp., 16.v.1965, 1 al. (*H. C. Dale*); East Malling, 30.x.1936, 1 al. (*G. H. L. Dicker*). Berks, Reading, *Rosa* sp., 24.iv.1949, 1 apt.; *Phalaris arundinacea*, 25.vi.1949, 2 apt.; *Lolium perenne*, 28.v.1950, 11 apt., 1 alatoid nymph; *Carex* sp., 27.v.1950, 2 al. (*V.F.E.*); Oxon, Washford, *Phalaris arundinaria*, 16.vi.1925, 1 apt.; *Glyceria* sp., 20.vi.1925, 1 apt. (*O. W. Richards*); Surrey, Kew, *Rosa* sp., 10.x.1914, 1 al. (*F. Laing*); *Bromus carinatus*, 23.ii.1958, 4 apt., 8 al., 18 first instar larvae, 1.iii.1958, 5 apt., 1 al.; 16.iii.1958, 3 apt.; 1.iv.1967, 4 apt., 7 al.; 6.iv.1968, 8 apt.; 5.vi.1966, 7 apt., 5 al.; 24.viii.1966, 3 apt., 1 al.; 16.x.1966, 2 apt., 2 al. viviparae, 2 alate males; *Bromus sterilis*, 23.ii.1958, 8 apt., 4 al.; 16.iii.1958, 5 apt., 5 first instar larvae; *Festuca rubra*, 12.viii.1962, 2 apt.; *Glyceria aquatica*, 4.xi.1961, 8 apt., 1 al., 2 al. nymphs, 4 first instar larvae; Beddington, *Glyceria plicata*, June 1968, 7 al., 1 alatoid nymph (*A. Hutson*). Sussex, nr Washington, *Avena sativa*, June 1969, 17 apt., 5 al. (*G. R. Potts*); Herts, Harpenden, *Rosa* sp., 26.iv.1944, 6 apt., 5 apt., 3 al.; 10.v.1944, 3 al.; 18.xi.1945, 1 al. ♂ (*J.P.D.*); *Hordeum vulgare*, 26.ix.1949, 1 apt. (*V.F.E.*); Bucks, Eton, *Phalaris arundinacea*, 17.vi.1950, 4 apt.; Waddesdon, grass, 4.viii.1958, 2 apt., 4 al. (*V.F.E.*); Beds, Woburn Abbey, trap, 1 al.♂ (*J.P.D.*); Cambridge, *Rosa* sp., 2.v.1951, 2 apt., Maddingley, grass, 29.vii.1951, 2 apt., 1 al. (*V.F.E.*); Suffolk, Walberswick, *Bromus sterilis*, 22.vi.1951, 1 apt.; Lincs., Bourne Fen, *Avena sativa*, 15.vii.1942, 2 apt., 2 al.; Twenty, *A. sativa*, 15.vii.1942, 2 apt., 2 al.; Kirton Institute glasshouse, *Poa annua*, 20.ii.1945 (*J.P.D.*); Lancs., Burnage, grass, 15.iv.1923, 1 apt. (*H. Britten*); Cumberland, Great Salkeld, *Rosa* sp., 18.x.1912, 1 al. ♂ (*H. Britten*). Finland: Tikkurila, *Avena sativa* 'sisu', 1.vi.1963, 9 apt., 3 al. (*M. Markkula*). Germany: Bonn, trap, 12–28.x.1961, 3 al. vivip., 3 al. ♂♂ (*E. Haine*). Italy: Bergamo, *Zea mays*, June 1968, 3 al. and larvae (*F. Baranyovits*). Syria: Lebanon, wheat, 2 apt., 1 al. (*A. S. Talhouk*). Morocco: High Atlas, S. Asni, S.W. Imlil, 5–5,500′, 26–28.iv.1961, 7 al. (*P. N. Lawrence*). Norway: Fana, 12.vii.1954, 1 al.; Vollebekk, 3–14.vii.1954, 20 al. (*H. Tambs-Lyche*). Scotland: Midlothian, Boghall Farm, *Avena sativa*, 8.vii.1939, 1 apt., 1 al. (*A. E. Cameron*). Wales: Bethymaen, 16.vi.1933, 3 al. (*W. Maldwyn Davies*); Flint, Holywell, Mostyn, August 1967, 1 al. (*F. Owens*). YUGOSLAVIA: Srpska Crnja, 4.x.1962, 1 al.; Zemun, *Avena sativa*, 14.vi.1962, 1 apt.; Cacak, *Triticum sativum*, 17.vi.1962, 1 al., 1 alatoid nymph (*N. Tanasijevic*).

KENYA: Muguga, 6,850′, *Bromus catharticus*, 31.x.1952, 2 al.; 17.vii.1954, 3 al., 4 first instar larvae; 10.viii.1954, 6 apt., 9 al. (*V.F.E.*). INDIA: Himachal Pradesh, Fagu, *Triticum vulgare*, 11.vi.1966, 1 al. (*Rabinder Kumar*), Central Potato Research Institute colln. ARGENTINA: Mendoza, barley, July/August 1968, 4 apt., 15 al. (*P. A. Mansur*). BOLIVIA: Cochabama, 'cereals', May 1968, 1 apt., 1 al. (*D. Corbett*) coll., T. Lewis leg. U.S.A.: California, Carmel, *Avena* sp., wild oats, 28.iii.1964, 4 apt., 1 alatoid nymph (*R. C. Dickson, O. Heie, V.F.E.*); Colorado, Ft. Collins, oats, 24.vii.1912, 3 apt., 1 al. (*L. C. Bragg*). Indiana, Lafayette, Oct. 1912, 1 al. (*J. J. Davis*); Oregon, Fruitland, wheat, 10.vii.1957, 2 al. (*G.F.K.*); Salem, *Poa trivialis*, 2.i.1963, 1 apt. (*F. P. Lawson*) coll., G. F. Knowlton leg. Utah, Farmington, *Rosa* sp., 23.x.1958, 4 al. vivip., 1 al. ♂; Garden City, 16.x.1958, 2 al. vivip., 4 al. ♂♂; Hooper, wheat, 11.vi.1930, 2 apt.; Hyrum, 3.x.1958, 1 al. vivip.; Lake Point, wheat, 22.vii.1947, 1 apt., 1 al.; Larketown, *Rosa* sp., 16.x.1958, 2 al.; Lahi, wheat, 18.vii.1936, 1 apt., 1 al., 6 alatoid nymphs; Logan, 6.xi.1958, 1 al. vivip., 13.x.1962, 1 al. ♂; Logan Canyon, Bridge Camp, *Rosa* sp., 16.x.1958, 3 al.; Magna, wheat, 9.vii.1949, 1 al., 2 al. nymphs; Meadow, *Rosa fendleri*, 16.x.1958, 1 al.; Ogden, *R. fendleri*, 14.x.1958, 6 al. vivip., 3 oviparae, 1 al. ♂; Providence, 3.x.1958, 1 al.; Provo, 30.x.1953, 1 al., 30.vii.1958, 1 al.; Salt Lake City, 23.x.1954, 1 al. ♂; Scipio, 7.vii.1958, 1 al. (*G. F. Knowlton*); Washington, Prosser, trap, 14.vii.1955, 11 al. (*R. S. Robertson*); Union Gap, *Rosa* sp., 10.iv.1947, 5 apt.; 24.x.1947, 2 oviparae (*G. F. Knowlton*). CANADA: Manitoba, Winnipeg, 12.x.1963, 1 al. ♂; *Rosa* sp., 8.x.1962, 1 al. vivip.; 15.x.1964, 2 oviparae; *Avena sativa*, 15.vii.1957, 1 apt.; *Hordeum vulgare*, 31.viii.1964, 1 apt. (*A. G. Robinson*); New Brunswick, Fredericton, barley, 1961, 11 apt., 2 al. (*G. B. Orlob*); Saskatchewan, Eston, 15.viii.1965, 1 al. (*A. G. Robinson*).

HOST PLANTS. *Rosa* spp. (Rosaceae) and numerous genera of Gramineae, common on *Bromus* spp. and *Phalaris arundinacea*. Robinson and Hsu (1963 : 135) and Eastop (1966 : 427) list host plants.

DISTRIBUTION. Crimea (Holman, 1961 : 118), Czechoslovakia (Pintera, 1957 : 513), Denmark, England, Finland, France (Remaudière, 1951 : 134), Germany, Iceland, (Prior & Stroyan, 1960 : 273), Italy, Latvia (Rupais, 1961 : 129–130), Morocco, Norway, Poland (Szelegiewicz, 1967 : 84), Portugal (Ilharco, 1969 : 30), Rumania, European Russia, Transcaucasia, Central Asia, Scotland, Sweden, Switzerland (Hille Ris Lambers, 1966 : 117), Turkey (Tuatay & Remaudière, 1969 : 268), Wales, Yugoslavia, Kenya, Himalayas, Argentine, Bolivia, U.S.A., Canada.

BIOLOGY. Alternation between *Rosa* spp. and Gramineae and sometimes Cyperaceae. Walker, 1848 : 372 described the host plant alternation. Orlob (1961 : 497) gives references to recent papers on the biology. Chromosomes. 2n=18 (Sun & Robinson, 1966 : 651).

NOTES. Type-species of *Metopolophium* Mordwilko, 1914. It seems likely that some of the 'greenbug' records from Central and South America apply to *A. dirhodum* and not to *Schizaphis graminum* (Rond.).

Acyrthosiphon (Metopolophium) festucae (Theobald, 1917)

?*Aphis suffragans* Walker, 1848 : 2221 (see Doncaster, 1961 : 129–130).
Myzus festucae Theobald, 1917 : 80–81; 1923 : 8–10; 1926 : 335–336; Jary & Austin, 1935 : 9–14; Warburton, 1935 : 499–506; Massee, 1936 : 164–170.
Myzus sp., Lindroth, 1931 : 152 (teste Hille Ris Lambers, 1955 : 7).
Metopolophium festucae (Theobald) Hille Ris Lambers, 1933 : 175; 1947 : 287–290; 1955 : 7; Prior & Stroyan, 1960 : 272–273.

SPECIMENS STUDIED. ENGLAND: 1 alata without data, possibly the specimen described as *Aphis suffragans* by Walker, 1848 (see Doncaster, 1961 : 129–130); Devon, Coombe Martin, Little Hangman, 19.iv.1957, 1 apt. (*C. A. Prevost*); Seale Hayne, trap, 27.v.1943, 4 al. (*J. P. Doncaster*); Sussex, Washington, spring barley, June 1969, 13 apt., 5 al., winter oats, June 1969, 8 apt., 1 al., (*G. R. Potts*); Kent, Wye, *Festuca ovina*, 25.v.1916, 1 alate type (*F. V. Theobald*), B.M. 1930–204; Gravesend, trap, June, 1942, 2 al. (*J.P.D.*); Berks, Reading, grass, 13.v.1961, 4 apt;. Surrey, Kew, grass, 13.v.1961, 3 al., 8.v.1964, 1 al. (*V.F.E.*); London, *Holcus* sp., 24.v.1923, 6 al., 2 alatoid nymphs (*H. Britten*); *Dactylis glomerata* + *Festuca rubra*, 18.iv.1961, 5 apt., *F. rubra*, 18.iv.1961, 16 apt. (*V.F.E.*); Herts, Harpenden, trap, 8.vi.1942, 1 al.; *Dactylis glomerata*, 5–17.vi.1942, 4 apt., 2 al. (*J.P.D.*); Whetstone, m/v light, 4.vi.1961, 1 al. (*P. H. Ward*); Beds, Cardington, trap, 6.vii.1948, 2 al. (*C. G. Johnson*); Salop, Newport, Harper Adams Agric. Coll., winter oats, 13.v.1935, 5 apt., 4 al. (*H. C. F. Newton*); Isle of Man, Chasms, grass, 27.ii.1949, 2 apt., 1 al. nymph (*V.F.E.*); Derby, wheat, 22.v.1949, 4 apt., 6 al.; Leics, Loughborough, oats, 27.v.1935, 1 apt., 3 al.; Notts, Sherwood Forest, Bestwood Park, '*Agrostis vulgaris* & *Anthoxanthum*', 14.vi.1932, 1 apt., 1 alatoid nymph (*A. Roebuck*); Lincs., Spalding, trap, 8.vi.1943, 12 al. (*J.P.D.*); Northumberland, Tynemouth, 24.vii.1948, 1 al. (*R. S. Bagnall*). FRANCE: Brittany, La Trinité sur Mer, 25.vii.1968, 1 al., *Festuca rubra*, 1.viii.1968, 2 apt. (*V.F.E.*). GERMANY: Kehl, 31.vii.1966, 2 apt. (*V.F.E.*). ICELAND: Reykjavik, grass, 25.vii.1947, 2 apt. (*J. L. Cloudsley-Thompson*); nr. Gandar, '? *Festuca* sp.', 28.vii.1958, 4 apt. (*R. N. B. Prior*). NORWAY: Fana, trap, 10–22.vi.1954, 4 al. (*H. Tambs-Lyche*). SCOTLAND: Aberdeen, Dyce, grass, 4.vi.1964, 1 al. (*L. A. Mound*); Donmouth, *Agropyron repens*, 4.ii.1928, 1 apt. (*G. D. Morison*); Argyll, Ardnamuchan Ben, 15.vii.1962, 2 apt. (*J.P.D.*); Kincardine, Cove, grass, 15.v.1928, 4 apt. (*G. D. Morison*); Midlothian, *Phleum pratense*, 11.v.1944, 11 apt., 1 al.; Edinburgh, *Phleum pratense*, 30.v.1944, 10 apt., 6 al. (*A. E. Cameron*). SWEDEN: L. Tjultrask, 16° 5′ E, 66° N, grass, 29–30.viii.1962, 11 apt., 2 al., 3 alatoid nymphs (*British Schoolboys Exploration Society*). WALES: Anglesey, Llandonna, grass, 6–16.vi.1962, 30 apt., 13 al. (*V.F.E.*); Cardiff, 6.ii.1944, 1 al. (*D. R. Arthur*); Aberystwyth, *Festuca rubra*, S 59, 3.vi.1969, 3 apt., 4 al.; *Lolium perenne*, S 23, 3.vi.1929, 16 apt., 11 al. (*J. A'Brook*). YUGOSLAVIA: Wurzen Pass, ? *Festuca* sp., 10.viii.1966, 2 apt., 1 al. (*V.F.E.*). U.S.A.: California, L.A. Co., Calabavar, *Festuca* turf, 1.ii. 1970, 1 al. (*Williams* coll.), R. C. Dickson leg.

Host plants. Gramineae, particularly *Festuca rubra* but also *F. ovina, Dactylis glomerata, Holcus* sp., *Lolium perenne, Phleum pratense,* barley and oats.

Distribution. Czechoslovakia (Pintera, 1957 : 513), Denmark (Heie, 1961 : 91), England, Faroes, Finland (Heikinheimo, 1966a : 107), France (Remaudière, 1959 : 36–37), Germany, Iceland, Netherlands, Norway (Heikinheimo, 1966*b* : 338); Sweden (Ossiannilsson, 1959 : 488), Switzerland (Hille Ris Lambers, 1966 : 117), ? Argentine (Remaudière, 1963 : 347), California.

Biology. Hille Ris Lambers (1947 : 287) describes fundatrices from the Netherlands and mentions (1955 : 7) alate males from Iceland.

Notes. It is possible that two species are confused under this name. Populations with 2–4 accessory hairs on the ultimate rostral segment are described from England and the Netherlands, but 4–7 is a more normal range in Scotland and Iceland (H.R.L., 1955 : 7), *A.* (*M.*) *montanum* is said to differ from *festucae* by bearing 6–10 accessory hairs on the ultimate rostral segment. It is possible that *festucae* is only one of a number of holocyclic or anholocyclic species derived from the host alternating species *montanum.* Müller (1968 : 131–141) records a red holocyclic race from Northern Germany.

Acyrthosiphon (Metopolophium) frisicum (Hille Ris Lambers, 1947)

Metopolophium frisicum Hille Ris Lambers, 1947 : 290–292; Stroyan, 1950 : 94.

Specimens studied. England: Harpenden, trap, 11–12.vii.1948, 1 al. (*C. G. Johnson*); Soil Sample, 1969, 2 apt. (*C. A. Edwards*); Cambs., nr Harston, 'base of meadow herbage', 17.xi.1949, 1 apt., *Poa pratensis,* April 1949 (in culture), 3 al. (*H. L. G. Stroyan*); Cambridge, grass under logs, 27.i.1951, 1 al., 1 larva. Wales: Anglesey, Llandonna, 6–8.vi.1962, 1 al. (*V.F.E.*).

Host plants. *Poa pratensis, P. trivialis* (Gramineae).

Distribution. England, Germany, Netherlands, Norway (Tambs-Lyche, 1968 : 7), Sweden (Ossiannilsson, 1969 : 31).

Biology. Hille Ris Lambers (1947 : 292) describes apterous males from the Netherlands so *frisicum* appears to be holocyclic on *Poa.*

Acyrthosiphon (Metopolophium) graminearum Mordwilko, 1919

Acyrthosiphon (*Metopolophium*) *graminearum* Mordwilko, 1919 : 291–296; 1921 : 43.
Metopolophium graminearum (Mordwilko) Hille Ris Lambers, 1947 : 281; 1966 : 106. Ossiannilsson, 1969 : 31–32.

Host plants. 'Undetermined Gramineae', *Arrhenatherum elatius* according to Mamontova (1959 : 43).

Distribution. Russia (nr Leningrad) and Sweden.

Notes. Originally described from sexuales but Ossiannilsson obtained a single parthenogenetic female from Sweden which may be the same species. It is similar to *beiqueti* H.R.L. (see p. 74) described from Canada.

Acyrthosiphon (Metopolophium) montanus (Hille Ris Lambers, 1966)

Metopolophium graminearum (Mordw.) Börner, 1952 : 157 partim, nec Mordwilko, 1919.
Metopolophium montanum Hille Ris Lambers, 1966 : 106–111.

HOST PLANTS. *Rosa* sp. (Rosaceae) and *Poa alpina* (Gramineae).

DISTRIBUTION. Austria, Switzerland.

BIOLOGY. Alternation between *Rosa* and *Poa alpina.*

NOTES. The apterous exules are said to resemble *festucae* but to differ in the presence of 6–10 accessory hairs on the ultimate rostral segment which bears/only 2–7 in *festucae* (p. 78).

Acyrthosiphon (Metopolophium) sophorae Narzikulov & Umarov, 1969

Acyrthosiphon ignotum Mordwilko, Nevsky 1951 : 47 partim, nec Mordwilko, 1914.
Acyrthosiphon (*Metopolophium*) *sophorae* Narzikulov & Umarov, 1969 : 158–159.

HOST PLANT. *Sophora japonica* (Leguminosae).

DISTRIBUTION. Tadzhikistan.

NOTES. As Narzikulov & Umarov's (1969) concept of *Metopolophium* seems closer to that of Börner (1950 : 13; 1952 : 155–157) than to that of Mordwilko (1914 & 1919) and Hille Ris Lambers (1947) which has been followed here, *sophorae* would probably be placed in *Acyrthosiphon* s.str. in the latter system.

Acyrthosiphon (Metopolophium) tener (Hille Ris Lambers, 1947)

Metopolophium tenerum Hille Ris Lambers, 1947 : 293–296; Stroyan, 1953 : 94–95.

SPECIMENS STUDIED. ENGLAND: Berks, Reading, *Deschampsia flexuosa*, 19.ii. 1950, 13 apt. (*V.F.E.*); Derbys., Stanton Moor, '*Nardus stricta* ?', 21.vi.1946, 3 apt., *Vaccinium myrtillus*, 21.vi.1946, 1 apt., 1 al. (*J. P. Doncaster*); nr. Baslow, Garden's Edge, *V. myrtillus*, 24.vi.1956, 1 apt. (*C. A. Prevost*). NETHERLANDS: Bennekom, *Deschampsia flexuosa*, 26.vi.1952, 1 apt., 1 al. (*D. Hille Ris Lambers & V.F.E.*), 22.vi.1954, 3 apt. (*D.H.R.L. & J.P.D.*). NORWAY: Espeland, Fana, 12.vii.1954, 1 al. (*H. Tambs-Lyche*).

HOST PLANTS. *Deschampsia flexuosa, Festuca ovina, F. rubra* (Gramineae).

DISTRIBUTION. England, Germany, Netherlands, Norway, Sweden, Wales.

BIOLOGY. Holocyclic on *Deschampsia flexuosa* and *Festuca* growing in the shade. Hille Ris Lambers, 1947 : 295 describes alate males but says that as the oviparae are in the progeny of apterae viviparae migration was lost long ago. Small samples have twice been collected from *Vaccinium.*

Acyrthosiphon (Rhodobium) porosus (Sanderson, 1900)

Myzus porosus Sanderson, 1900 : 205; Hottes & Frison, 1931 : 340–343; Mason, 1940 : 18.
Macrosiphon rosaefolium Theobald, 1915 : 109; Takahashi, 1925 : 9.

Aulacorthum viride Van der Goot, 1917 : 31–32.
Aulacorthum pseudorosaefolium Blanchard, 1922 : 199–201; 1939 : 978–979.
Aulacorthum sp. Timberlake, 1923 : 456.
Acyrthosiphon rosaefoliae (Theobald) Takahashi, 1931 : 64.
Acyrthosiphon rosaefolii (Theobald) Tseng & Tao, 1936 : 146.
Macrosiphum zoorosarum Knowlton & Smith, 1936 : 264.
Rhodobium rosaefolium (Theobald) Hille Ris Lambers, 1947 : 301–303.
Rhodobium porosum (Sanderson) Hille Ris Lambers, 1948 : 285; MacGillivray, 1963 : 892–896; Takahashi, 1965 : 24; Ilharco, 1968 : 133–142; Smith et al., 1963 : 82–84.
Metopolophium rosaefolium (Theobald) Börner, 1950 : 156; Börner & Heinze, 1957 : 237.
Acyrthosiphon porosum (Sanderson) Börner & Heinze, 1957 : 235; Russell, 1963 : 84.
Metopolophium zoorosarum (Knowlton & Smith) Börner & Heinze, 1957 : 238.
Acyrthosiphon (*Rhodobium*) *porosum* (Sanderson); Kennedy, Day & Eastop, 1962 : 30.

SPECIMENS STUDIED. Many, including CZECHOSLOVAKIA: Prague, *Rosa* sp., 2.vi.1964, 1 apt., (*V.F.E.*). EGYPT: Giza, *Rosa* sp., 22.xi.1920, 1 apt.; 17–31.iii. 1924, 3 apt., 3 al.; 5.iv.1924, 7 apt.; 16.xi.1924, 2 apt., Gezireh, *Rosa* sp., 4–26.v.1924, 18 apt., 1 al. (*W. J. Hall*). ENGLAND: Herts, Cheshunt, glasshouse, *Rosa* sp., 4.vii.1940, 2 apt. (*E. R. Speyer*). IRAQ: Haidari, *Rosa* sp., 21.iv.1967, 1 al. (*Dept. Agric.*). ISRAEL: Mishmar Hasharon, *Rosa* sp., 5.xii.1946, 1 apt. (*E. Swirskii.*) NETHERLANDS, Aabmeer, glasshouse, *Rosa* sp., November 1939, 2 apt., 1 al. (*D. Hille Ris Lambers*). YUGOSLAVIA: Doboj, *Rosa* sp., 18.ix.1963, 4 apt. (*N. Tanasijevic*). CAMEROON: Bamenda, *Rosa* sp., 20–25.i.1957, 69 apt., 26.i.1957, 5 al., 6–8.ii.1957, 2 apt., 1 al. (*V.F.E.*). ETHIOPIA: Alemaya, *Rosa* sp., 16.viii.1963, 4 apt. (*R. G. Hill*). KENYA: Nairobi, *Rosa* sp., 3.iii.1953, 3 apt., 14.vii.1953, 5 apt. (*V.F.E.*). UGANDA: Kampala, *Rosa* sp., 10.x.1917, 11 apt., 1 al., part of the sample from which the type-series of *rosaefolium* was selected. MAURITIUS: Rose Hill, *Rosa* sp., 15.vii.1962, 8 apt. (*A. J. Orian*). AUSTRALIA: Victoria, Melbourne, *Rosa* sp., 5–12.iv.1959, 16 apt., 7.v.1959, 2 apt. (*V.F.E.*). FIJI: Koronivia, *Rosa* sp., ? 1967, 3 apt. (*Dept. Agric.*). BRAZIL: São Paulo, Campinas, trap, May/June 1968, 1 al. (*C. L. Costa*). CHILE: Santiago, *Rosa* sp., 22.ii.1967, 1 apt. (*J. V. Apablaza*). JAMAICA: Hopedale, *Rosa* sp., 24.xi.1925, 7 apt. (*C. G. Gowdey*). U.S.A.: California, Berkeley, *Rosa* sp., 23.iv.1941, 1 apt., 5 al. (*N. W. Frazier* coll.), E. O. Essig leg. Delaware, *Fragaria* sp., 190?, 2 oviparae ex G. B. Buckton colln.; Kansas, Manhattan, trap, 11.v.1965, 1 al. (*J. T. Medler*); New York, Rochester, *Rosa carolina*, 16.vii.1963, 1 apt. (*M. D. Leonard*); Oregon, nr McMinnville, Peuinie Ridge, *Rosa nukkhans*, 1 al.; Utah, St. George, *Rosa* sp., 16.iv.1962, 1 apt. (*G. F. Knowlton*); Virginia, Norfolk, *Fragaria* sp., 9.ii.1949, 3 apt. (*R. W. Brubaker*). CANADA: Manitoba, Whitemouth Lake, *Rosa* sp., 12.viii.1964, 1 apt. (*A. G. Robinson*); Nova Scotia, Berwick, *Fragaria* sp., 30.v.1963, 2 apt., 19.vi.1963, 4 apt., 26.vii.1962, 4 apt., 24.ix.1963, 6 apt., 5.xi.1963, 1 apt. vivipara, 7 oviparae, 2 al. ♂♂, 19.xi.1963, 1 apt., 3 ovip., 3 al. ♂♂. Cambridge, *Fragaria* sp., 12.v.1963, 1 al., 27.vi.1963, 1 al., 12–17.vii.1962, 2 apt., 3 al., 17.x.1963, 1 al. ♂. Centerville, *Fragaria* sp., 5.vii.1963, 2 apt., 1 al., Kentville, *Fragaria* sp., 2.x.1962, 1 al. ♂; Fort Williams, *Fragaria* sp., 5.vii.1963, 2 al. (*H. Stultz* coll.), M. E. MacGillivray leg.

HOST PLANTS. *Fragaria* and *Rosa* spp. (Rosaceae).

DISTRIBUTION. Czechoslovakia, England and Netherlands in or near glasshouses.

Egypt, Iraq, Israel, Portugal, Spain (Mimeur, 1936 : 39), Yugoslavia, Cameroon, Ethiopia, Kenya, South Africa (Müller & Schöll, 1958; 395), Uganda, Mauritius, India, Taiwan, Java, Australia, Fiji, Argentina, Brazil, Chile, Cuba (Müller, 1968 : 444), Jamaica, Puerto Rico, Venezuela (Cermelli, 1966 : 254), U.S.A., Canada.

BIOLOGY. Living on either *Rosa* or *Fragaria* without regular alternation. Ilharco, 1968 : 133 records attendance by the ant *Iridomyrmex humilis* and suggests that *porosum* is a recent introduction to Portugal.

NOTES. Type of *Rhodobium* Hille Ris Lambers, 1947. Craig & Stultz (1964 : 235, 237–239) give results from some experiments with *porosum* as a virus vector.

Acyrthosiphon (Tlja) lactucae (Passerini, 1860)

Siphonophora lactucae Passerini, 1860 : 34 (with *Aphis lactucae* Schrank, 1801 queried as a synonym), 1863 : 137; Ferrari, 1872 : 213.
Siphonophora lactucae (Schrank) Schouteden, 1906 : 239 (giving the Passerini reference).
Acyrthosiphon scariolae Nevsky, 1929*a* : 197–198; 1929*b* : 89–91.
Macrosiphum lactucarium Börner, 1931 : 11.
Macrosiphon lactucarius Börner; Börner; 1932 : 627.
Tlja lactucae (Passerini) Mordwilko, 1932 : 55.
Acyrthosiphon (*Lactucobium*) *scariolae* Nevsky; Hille Ris Lambers, 1947 : 255–157.
Macrosiphum barri Essig, 1949 : 151–153.
Macrosiphum scariola (Nevsky) Essig, 1949 : 153.
Lactucobium scariolae (Nevsky) Remaudière, 1951 : 134.
Aulacorthum scariolae (Nevsky) Börner, 1952 : 155.
Acyrthosiphon (*Tlja*) *scariolae* (Nevsky) Hille Ris Lambers, 1953 : 174; Stroyan, 1955 : 334; Shaposhnikov, 1964 : 603.
Acyrthosiphon (*Tlja*) *lactucae* (Passerini) Meier, 1958 : 29.
Acyrthosiphon (*Tlja*) *scariolae* ssp. *barri* (Essig) Kennedy et al., 1962 : 53.
Acyrthosiphon barri (Essig) Russell, 1963 : 84.
Tlja scariolae (Nevsky) Tuatay & Remaudière, 1964 : 269.
Acyrthosiphon scarioli (Nevsky); Leonard, 1968 : 265.
Acyrthosiphon (*Metopolophium*) *scariolae* Nevsky, Narzikulov & Umarov, 1969 : 171–172.

SPECIMENS STUDIED. ENGLAND: Essex, Fobbing, *Lactuca scariola*, 16.vii.1948, 2 apt. (*V.F.E.*); Bucks., Iver, lettuce flowers, 20.ix.1949, 12 apt., 1 al. (*L. Broadbent*); Cambridge, *Lactuca saligna*, 8.x.1951, 25 apt. vivip., 3 al. ♂♂, 5 first instar larvae (*V.F.E.*). FRANCE: Marseilles, *Lactuca* sp., 10.x.1952, 3 apt. (*V.F.E.*). IRAQ: Abu Ghraib, *Lactuca scariola*, 9.v.1966, 1 apt.; *Sonchus* sp., 9.v.1967, 4 apt. (*Dept. Agric.*). ISRAEL: Rehovoth, *Lactuca sativa*, 11.iv.1951, 3 al. (*E. Swirski*). YUGOSLAVIA: ? nr. Skoplje, *L. sativa*, 25.vi.1962, 2 al. (*N. Tanasijevic*). U.S.A.: Arizona, Yuma, *Lactuca* ? *sativa*, 17.iv.1959, 6 apt., 9 al. (*D. Muse & D. Tuttle*); Idaho, Parma, *L. sativa*, seed heads, 25.ix.1947, 2 apt., 2 al. (paratypes of *barri*) (*W. E. Barr* coll.), E. O. Essig leg., B.M. 1950–292; Illinois, Rochford, *L. scariola*, 3.vi.1948, 1 al. (*L. L. English* coll.), W. R. Richards leg.; Montana, 9 m. W. of Whitehall, *Sonchus* sp., 24.vii.1958, 5 apt., 2 al. (*R. C. Dickson*); Utah, Bear Canyon, Mt. Nebo, 2.viii.1962, 1 apt.; Bountiful, wild lettuce, 23.x.1958, 5 apt. vivip., 1 ovipara; Fayette, 22.viii. 1958, 5 apt., 2 al.; Magna, 28.ix.1955, 2 apt.; Medon, 28.vii.1958, 12 apt., 1 al.;

Moab, wild lettuce, 12.vii.1951; Moroni, 21.viii.1963, 3 apt., 2 al.; Vernon, wild lettuce, 5.viii.1958, 20 apt., 1 al.; Wellsville Canyon, 3.x.1963, 2 apt. (*G. F. Knowlton*); Washington, Prosser, 14–21.vii.1955, 7 al.; 9–24.viii.1954, 3 al. (*R. S. Robertson*). CANADA: Manitoba, Winnipeg, *Lactuca scariola*, 28.ix.1964, 2 apt. (*A. G. Robinson*).

HOST PLANTS. *Lactuca saligna*, *L. sativa*, *L. serriola* (=*scariola*), *L. virosa* (Compositae).

DISTRIBUTION. Belgium, Bulgaria (Tashev, 1964 : 182), England, France, Germany, Hungary (Szelegiewicz, 1969 : 90), Iraq, Israel, Italy, Poland (Szelegiewicz, 1965 : 39), Portugal (Ilharco, 1969 : 31), Turkey (Tuatay & Remaudière, 1964 : 269), Crimea (Holman, 1961 : 118), Khazakstan, U.S.A., Canada.

BIOLOGY. Apparently holocyclic on *Lactuca* despite the alate males.

NOTES. Type-species of *Tlja* Mordwilko, 1914. Nevsky (1929) gives the siphunculi as 2⅓ times as long as the cauda but in the Western European specimens examined the siphunculi do not exceed twice the length of the cauda. Hille Ris Lambers (1947 : 257) states 'There is no doubt that my specimens belong to Nevsky's species'. *Aulacorthum porrifolii* Börner, 1950, is said in its original description to resemble *scariolae* but to be very short-haired, with the second tarsal segments bearing only 2 dorsal hairs and living on *Hieracium porrifolium*.

UNNAMED SPECIES OF *ACYRTHOSIPHON*

Most of the species originally mentioned without a binominal have subsequently been named and are included in the synonymy of the species concerned. Remaudière, 1963 : 347, records a still unidentified *Acyrthosiphon* from Argentina.

APHIDS OTHER THAN *ACYRTHOSIPHON* INCLUDED IN THE KEYS

Cryptaphis Hille Ris Lambers, 1947

Cryptaphis Hille Ris Lambers, 1947 : 296–297.

The species described by Takahashi, 1961 : 105–108 feeding on dicotyledons in Japan have spinulose heads and are not included in the keys.

Cryptaphis bromi Robinson, 1967

Cryptaphis poae (Hardy) Robinson & Bradley, 1965 : 42 nec Hardy, 1850.
Cryptaphis bromi Robinson, 1967 : 566–569.

SPECIMENS STUDIED. CANADA: Manitoba, Winnipeg, *Bromus inermis*, 17.v.1965, 1 apterous paratype; 24–25.v.1965, 1 apt., 1 al.; 31.v.1965, 1 alate paratype (*A. G. Robinson*), B.M. 1967–297 & 300.

HOST PLANT. *Bromus inermis* (Gramineae).

DISTRIBUTION. Manitoba.

BIOLOGY. Chromosomes. 2n=16 (Robinson & Chen, 1969 : 512).

Cryptaphis poae (Hardy, 1850)

?*Aphis pilosa* Walker, 1849 : liv; 1852 : 1027 (see Doncaster, 1961 : 106).
Aphis poae Hardy, 1850 : 112.
Cryptaphis setiger Hille Ris Lambers, 1947 : 298–300.
Cryptaphis poae (Hardy) Hille Ris Lambers, 1956 : 229; Doncaster, 1961 : 106–107.

SPECIMENS STUDIED. CZECHOSLOVAKIA: Kostelni Lhota, *Festuca ovina*, 1.vi.1964, 2 apt. (*J. Holman, P. Stary, V.F.E.*). ENGLAND: Devon, Seale Hayne, trap, 27.v. 1943, 1 al. (*J. P. Doncaster*); London, Chelsea Physic Gdns, *Koeleria alpina*, 26.v. 1960, 1 apt. (*V.F.E.*); Surrey, Camberley, etiolated grass stems under stone, 10.vi.1959, 1 apt. (*J.P.D.*); Kew Gdns, *Holcus lanatus*, 26.viii.1962, 1 al. & larva, 9.ix.1962, 3 apt., 1 al. (*V.F.E.*); Herts, Harpenden, trap, 27.vii.1947, 1 al., (*C. G. Johnson*); 28.viii.1950, 1 al. (*Singh*); Cambridge, grass, 21.i.1957, 1 apt. (*V.F.E.*). NETHERLANDS: Bennekom, *Holcus* sp. under stone, 1 apt. (*D. Hille Ris Lambers & V.F.E.*); Grass under stones, 17.vi.1964, 2 apt. (*D.H.R.L. & J.P.D.*); Limberg, Gulpen, grass, 2.vi.1952, 1 apt. (*D.H.R.L. & V.F.E.*). WALES: Aber., 1935 ?, 1 al. (*W. Maldwyn Davies*).

HOST PLANTS. *Festuca ovina, Holcus lanatus, H. mollis, Poa trivialis* (Gramineae).

DISTRIBUTION. Austria (Müller, 1961 : 70), Czechoslovakia, England, France (Leclant, 1966 : 129), Netherlands, Norway (Tambs-Lyche, 1968 : 7), Poland (Szelegiewicz, 1965 : 39), Scotland (Stroyan, 1955 : 334), Wales. The Canadian record (Robinson & Bradley, 1965 : 42) applies to *C. bromi* Robinson.

HYALOPTEROIDES Theobald, 1916

Hyalopteroides Theobald, 1916 : 51; Hille Ris Lambers, 1949 : 212–217.
Hayhurstia Mordwilko, 1921 : 45 nec del Guercio, 1917 : 208.

The type-species *H. pallida* Theobald, 1916 = *humilis* Walker, 1852 (see Doncaster, 1961 : 81–82 for detailed synonymy) differs from *Acyrthosiphon* in having very short siphunculi but *H. palmerae* is included in the key as it is intermediate between *H. humilis* and *Metopolophium.*

Hyalopteroides palmerae Hille Ris Lambers, 1949

Hyalopteroides palmerae H. R. L., 1949 : 216–217.

SPECIMENS STUDIED. U.S.A.: Colorado, Fort Collins, *Elymus* sp., 5.viii.1913, 1 aptera, 15.ix.1913, 4 apt. vivip., 1 ovipara (*L. C. Bragg*), B.M. 1930–204.

HOST PLANT. *Elymus* sp. (Gramineae).

DISTRIBUTION. Colorado.

MICROLOPHIUM Mordwilko, 1914

Microlophium Mordwilko, 1914 : 80, 198–236; 1919 : 237–238; Hille Ris Lambers, 1949 : 201–212.

Microlophium was originally described as a subgenus of *Acyrthosiphon* with the result that the following *Urtica*—feeding aphids have been listed under *Acyrthosiphon, urticae* Schrank, 1801 nec L., 1758 = *evansi* Theobald, 1923, *schranki* Gillette & Palmer, 1934; *carnosum* Buckton, 1876; *sibiricum* Mordwilko, 1914; *rjabushinskiji* Mdw., 1914; *kirgiz* Mdw., 1919.

MYZAPHIS van der Goot, 1913

Myzaphis van der Goot, 1913 : 96; 1915 : 181–188; Nevsky, 1929*b* : 149–153; Jacob, 1946 : 110–117; Hille Ris Lambers, 1948 : 281; Heinze, 1960 : 800–804; Richards, 1963 : 682–687.

The palaearctic species are not likely to be confused with *Acyrthosiphon* and the presence of a dorsal abdominal black patch on the alatae suggests that they are not closely related. Richards (1963) describes a species from Ontario in which the alata does not have a dorsal abdominal black patch and specimens without their last antennal segment would resemble *Acyrthosiphon.*

Myzaphis canadensis Richards, 1963

Myzaphis canadensis Richards, 1963 : 864, 866, 687.

HOST PLANT. *Dasiphora fruticosa* (Rosaceae).

DISTRIBUTION. Ontario.

NOTES. The presence of only 2 hairs on the first tarsal segments is characteristic.

SUBACYRTHOSIPHON Hille Ris Lambers, 1947

Subacyrthosiphon H. R. L., 1947 : 260–264.

Acyrthosiphon hoffmani (see p. 91) was transferred to *Subacyrthosiphon* by Tao, 1963 : 177–178, but as no material is available it is not included in the key. From the description it appears to bear longer hairs than most *Acyrthosiphon* species and very much longer hairs than the type and only other species of *Subacyrthosiphon* which is very short-haired.

Subacyrthosiphon cryptobius Hille Ris Lambers, 1947

Subacyrthosiphon cryptobium H. R. L., 1947 : 261–264; Stroyan, 1953 : 92; 1955 : 334.
Metopolophium cryptobium (H. R. L.) Börner, 1952 : 156.

SPECIMENS STUDIED. ENGLAND: Somerset, Winsford, *Trifolium repens*, 23.ix, 1955, 15 apterae, 12.x.1955, 11 oviparae; Bucks, Waddesdon, 6.viii.1952, 1 apt.. *Trifolium repens*, 8.viii.1952, 2 apt., 23.ix.1952, 1 apt. (*V.F.E.*); Beds., Cardington, trap, 21.viii.194?7, 1 alata (*C. G. Johnson*); Salop, Newport, Harper Adams Inst., trap, 4.vi.1946, 1 al. (*J. P. Doncaster*). Norway: Vollebaeck, As, 10.viii.1954, 1 al. (*H. Tambs-Lyche*).

Host plant. *Trifolium repens* (Leguminosae).

Distribution. England, Netherlands, Norway (Tambs-Lyche, 1968 : 6), Sweden (Ossiannilsson, 1959 : 482).

Biology. Holocyclic on *Trifolium repens*, apterous sexuales being produced in the autumn.

VOLUTAPHIS Bärner, 1930

Volutaphis Börner, 1939 : 90.
Silenobium Börner, 1939 : 78–79.

Volutaphis centaureae Börner, 1939, would not be confused with *Acyrthosiphon* as it has distinctly clavate siphunculi but *V. schusteri* resembles *Acyrthosiphon* in general appearance.

Volutaphis schusteri (Borner, 1939)

Silenobium schusteri Börner, 1939 : 78–79; Hille Ris Lambers, 1947 : 265–267.
Volutaphis schusteri (Börner) Börner, 1952 : 116.

Specimens studied. Italy: Ruta-San Rocco, *Melandryum album*, 23.iv.1955, 3 apt., (*H. L. G. Stroyan & D. Hille Ris Lambers*), May 1955, 3 apt., 2 al. (*D.H.R.L.*).

Host plant. *Silene alba* (Caryophyllaceae).

Distribution. Germany, Italy.

SPECIES NOT SEEN BUT WHICH MAY COME IN OR NEAR *ACYRTHOSIPHON*

Macrosiphum purshiae Palmer, 1938

Macrosiphum purshiae Palmer, 1938 : 356; 1952 : 321.

Host plant. *Purshia tridentata* (Rosaceae).

Distribution. Colorado.

Notes. The description reads like that of an unusually long haired *Acyrthosiphon* but as specimens have not been seen it is not formally transferred.

Xanthomyzus glaucii Narzikulov, 1966

Xanthomyzus glaucii Narzikulov, 1966 : 575–578; Narzikluov & Umarov, 1969 : 70–72.

Host plant. *Glaucium fimbrilligerum* (Papaveraceae).

Distribution. Tajikistan.

NOTES. The apterae are without secondary rhinaria, the siphunculi are only $\frac{1}{10}$–$\frac{1}{8}$ as long as the body, the processus terminalis is $1\frac{1}{2}$ to twice as long as the base of the sixth antennal segment. The cauda bears 10 hairs. The description together with the host plant suggests an affinity with *Liporrhinus* (p. 72).

SPECIES NOT SEEN AND PROBABLY NOT BELONGING TO *ACYRTHOSIPHON*

Acyrthosiphon berkemiae Shinji, 1941

Acyrthosiphon berkemiae Shinji, 1941 : 1158–1162.

HOST PLANT. *Berchemia racemosa* (Rhamnaceae).

DISTRIBUTION. Japan.

NOTES. The reticulated apices of the siphunculi figured in the original description are suggestive of *Macrosiphoniella* or *Sitobion* rather than *Acyrthosiphon*.

Acyrthosiphon elaeocarpi Tao, 1963

Acyrthosiphon elaeocarpi Tao, 1963 : 190–192.

HOST PLANT. *Elaeocarpus serratus* (Elaeocarpaceae).

DISTRIBUTION. Taiwan.

NOTES. Probably nearer *Aulacorthum* or *Sinomegoura* than *Acyrthosiphon*. The surface of the head is described as spinulose but otherwise, apart from the paler appendages, the description resembles that of *Acyrthosiphon evodiae* Takahashi. The length given for the siphunculi is probably a misprint as it does not agree with the illustration.

Acyrthosiphon kamtshatkanum Mordwilko, 1914

Acyrthosiphon kamtshatkanum Mordwilko, 1914 : 144; 1915 : 11.
Anameson kamtshaticum (Mordwilko) Mordwilko, 1932 : 240.

HOST PLANT. Unknown.

DISTRIBUTION. Eastern Siberia, Kamchatka.

NOTES. The aptera is described as 3·5 mm long and with the processus terminalis slightly less than twice as long as the base of the sixth antennal segment, about half as long as the third antennal segment and equal in length to the cauda. These proportions separate it from other species currently placed in *Acyrthosiphon* but are reminiscent of oriental aphids from Ericaceae now placed in *Chaetomyzus* Ghosh & Raychaudhuri, 1962, *Ericolophium* Tao, 1963 and *Neoacyrthosiphon* Tao, 1963.

SPECIES NO LONGER INCLUDED IN *ACYRTHOSIPHON*

Only synonyms relevant to the history in *Acyrthosiphon* are quoted.

Amphorophora ampullata Buckton, 1876

Amphorophora ampullata Buckton, 1876 : 187–188; Hille Ris Lambers, 1949 : 231–234.
Acyrthosiphon (*Amphorophora*) *ampullata* (Buckton) Mordwilko, 1914 : 82; 1919 : 247–248.

Amphorophora rubi (Kaltenbach, 1843)

Aphis rubi Kaltenbach, 1843 : 24.
Amphorophora rubi (Kaltenbach) Schouteden, 1906 : 242; Hille Ris Lambers, 1949 : 237–242.
Acyrthosiphon (*Amphorophora*) *rubi* (Kaltenbach) Mordwilko, 1914 : 82; 1919 : 248–263.

Aphis sanguisorbicola Takahashi, 1966

Aphis sanguisorbae Shinji, 1935 ; 740 nec Schrank, 1801.
Acyrthosiphon sanguisorbae (Shinji) Shinji, 1941 : 1162–1164 (teste M. Miyazaki in litt.)
Aphis sanguisorbicola Takahashi, 1966 : 547–548.

Aulacophora formosana (Takahashi, 1923)

Amphorophora formosana Takahashi, 1923 : 30.
Acyrthosiphon formosana (Takahashi) Takahashi, 1931 : 65; Shinji, 1941 : 705–706.
Aulacophora formosana (Takahashi) Tao, 1963 : 175–176.

Aulacorthum cirsicola (Takahashi, 1923)

Macrosiphum cirsicola Takahashi, 1923 : 10–11.
Acyrthosiphon circifoliae Shinji, 1935 : 251; 1941 : 1156–1158.
Acyrthosiphon circicola (Takahashi) Shinji, 1941 : 705).
Aulacorthum cirsicola (Takahashi) Takahashi, 1965 : 113.

Aulacorthum ibotum (Essig & Kuwana, 1918)

Macrosiphum ibotum Essig & Kuwana, 1918 : 46–47; Shinji, 1941 : 858–864.
Aulacorthum ibotum (Essig & Kuwana) Takahashi, 1965 : 111.
Acyrthosiphon ibotum (Essig & Kuwana) Hille Ris Lambers, in Takahashi, 1965 : 113 (footnote).

Aulacorthum kerriae (Shinji, 1930)

Illinoia kerriae Shinji, 1930 : 137–140.
Acyrthosiphon kerriae (Shinji) Shinji, 1935 : 249; 1941 : 709–617.
Aulacorthum kerriae (Shinji) Takahashi, 1965 : 111.

Aulacorthum nipponicum (Essig & Kuwana, 1918)

Macrosiphum nipponicum Essig & Kuwana, 1918 : 48–49.
Macrosiphum paederiae Takahashi, 1921 : 11; 1923 : 15, 73.
Acyrthosiphon paederiae (Takahashi) Takahashi, 1931 : 64; Shinji, 1941 : 706.
Aulacorthum nipponicum (Essig & Kuwana) Takahashi, 1965 : 102–105.

Aulacorthum solani (Kaltenbach, 1843)

(Text-fig. 8)

Aphis solani Kaltenbach, 1843 : 15–16.
?*Siphonophora malvae* (Mosley) Passerini, 1863 : 137 partim nec Mosley, 1841.
Macrosiphum chelidonii (Kaltenbach) Theobald, 1913 : 37 nec Kaltenbach, 1843.
Macrosiphum malvae (Mosley) Theobald, 1913 : 131 partim nec Mosley, 1841.
Aulacorthum pelargonii (Kaltenbach) Mordwilko, 1914 : 52, fig. 36 nec Kaltenbach, 1843.
Acyrthosiphon (*Microlophium*) *ranunculi* Mordwilko, 1914 : 81.
Macrosiphum pelargonii (Kaltenbach) van der Goot, 1915 : 80–82 nec Kaltenbach, 1843.
Acyrthosiphon ranunculinum (Walker) Mordwilko, 1919 : 239–243 nec Walker, 1852.
?*Macrosiphum sobae* Shinji, 1922 : 787 teste Takahashi, 1965 : 113.
Macrosiphum matsumuraeanum Hori, 1926 : 52–83.
Myzus chelidonii (Kaltenbach) Theobald, 1926 : 346–347 nec Kaltenbach, 1843.
Acyrthosiphon pisi (Kaltenbach) Takahashi, 1931 : 63 nec Kaltenbach, 1843, teste Takahashi, 1939 : 26.
?*Acyrthosiphon kuwanai* Takahashi, 1932 : 295–297.
Aulacorthum solani (Kaltenbach) Hille Ris Lambers, 1933 : 174; 1949 : 182–194.
?*Aulacorthum kuwanai* (Takahashi) Takahashi, 1939 : 27; 1965 : 113.
Acyrthosiphon (*Aulacorthum*) *solani* (Kaltenbach) Kennedy et al., 1962 : 52.
Acyrthosiphon solani (Kaltenbach) Russell, 1963 : 84.

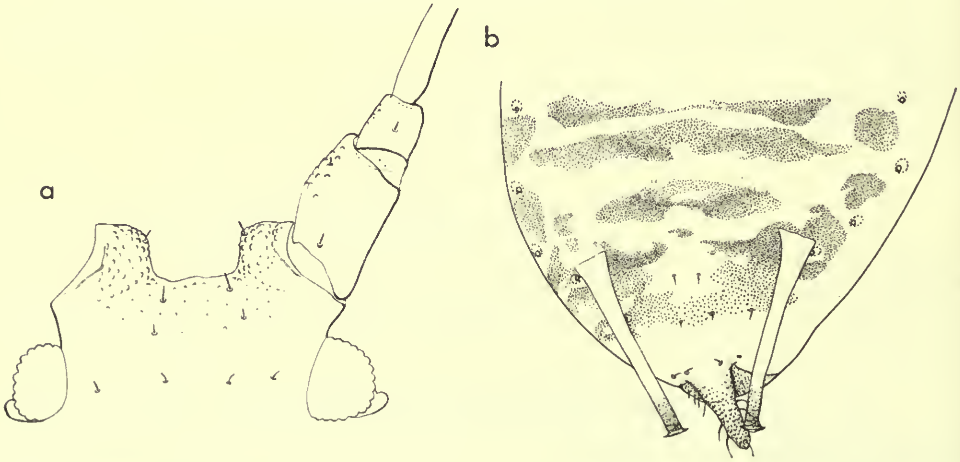

FIG. 8. *Aulacorthum solani*, a, head of aptera; b, apex of abdomen of alata. a × 90, b × 45.

Aulacorthum solani has been misidentified in Asia with *Acyrthosiphon pisum* (Harris). The wide host plant range of *Aulacorthum solani* includes many Leguminosae, the usual hosts of *Acyrthosiphon pisum.* The short cauda will distinguish *solani* from most *Acyrthosiphon* species in addition to the strongly spinulose ventral surface of the head. Because *Aulacorthum solani* frequently occurs on pot plants including *Pelargonium,* it has been identified by some authors with *Aphis pelargonii* Kaltenbach. Gomez-Menor (1963 : 48–51) uses the name *Aulacorthum pelargonii* for an aphid from an unknown host plant resembling *Ulex* in the Canary Islands. Gomez-Menor's alatae have only 11–16 rhinaria on the third antennal segment, which is very few for *pelargonii,* but the base of the sixth antennal segment is 140–148μ long, which is too short (in specimens with body length 2½ mm) for *solani.* The dorsum of the alatae is not pigmented and the processus terminalis is given as 5¼ times as long as the base of the sixth antennal segment, while that of the aptera is given as 3½ times as long. It seems probable that Gomez-Menor's *pelargonii* is different from both Kaltenbach's and Mordwilko's species. Hille Ris Lambers (1949 : 183–185) lists the numerous synonyms of *Aulacorthum solani,* only those relevant to *Acyrthosiphon* are given above.

Aulacorthum symplocois (van der Goot, 1917)

Aulacorthum symplocois van der Goot, 1917 : 28–31.
Acyrthosiphon symplocois (van der Goot) Takahashi, 1936 : 602.
Megoura symplocois (van der Goot) Takahashi, 1950 : 594.

Aulacorthum takahashii (Mason, 1923)

Amphorophora sp., Takahashi, 1923 : 32.
Amphorophora takahashii Mason, 1925 : 67.
Acyrthosiphon takahashii (Mason) Takahashi, 1931 : 65; Shinji, 1941 : 724.
Aulacorthum takahashii (Mason) Tao, 1963 : 178.

Aulacorthum (Perillaphis) perillae (Shinji, 1924)

Macrosiphum perillae Shinji, 1924 : 363.
Macrosiphum perillae Takahashi, 1924 : 25–27.
?*Acyrthosiphon perillae* (Takahashi) Takahashi, 1931 : 64; Shinji, 1941 : 716.
Aulacorthum perillae (Takahashi) Takahashi, 1939 : 117.
Acyrthosiphon perillae (Shinji) Shinji, 1941 : 716–721.
Aulacorthum (*Perillaphis*) *perillae* (Shinji) Takahashi, 1965 : 99–101.

Ericolophium itoe (Takahashi, 1925)

Macrosiphum itoe Takahashi, 1925 : 11–13.
Ericolophium itoe (Takahashi) Tao, 1962 : 187.

See note under *Neoacyrthosiphon taiheisianum* below.

Impatientinum impatiens (Shinji, 1922)

Tuberosiphum impatiens Shinji, 1922 : 789.
Macrosiphum smilaceti Takahashi, 1924 : 101–102; 1937 : 23–24.
Macrosiphum impatiensae Shinji, 1941 : 864–871 (presumed rectification of *impatiens* Shinji, although that reference is not given).
Acyrthosiphon smilaceti (Takahashi) Tao, 1963 : 190.
Impatientinum impatiensae (Shinji) Takahashi, 1964 : 358.
Impatientinum impatiens (Shinji) Takahashi, 1965 : 23–24, 1937.

Metopolophium euryae (Takahashi, 1937)

Macrosiphum euryae Takahashi, 1937 : 7–8.
Metopolophium euryae (Takahashi) Tao, 1963 : 189.

The black siphunculi 2½ times as long as the yellow cauda which bears only 5 hairs, the processus terminalis only 2½ times as long as the base of the sixth antennal segment, the absence of rhinaria from the third antennal segment of the aptera and the presence of a dorsal abdominal black patch make it unlikely that *euryae* really belongs to *Acyrthosiphon*. In the original description it is compared with *Macrosiphum holstii* Takahashi, which has been placed in *Ericolophium* and *Neoacyrthosiphon* (*Pseudoacyrthosiphon*).

Neoacyrthosiphon taiheisianum (Takahashi, 1935)

Macrosiphum taiheisanum Takahashi, 1935 : 504–506.
Acyrthosiphon taiheisanum (Takashashi) Tao, 1963 : 189.
Neoacyrthosiphon taiheisanum (Takahashi) Tao, 1963 : 189.

Ericolophium Tao, (1963 : 187) and *Neoacyrthosiphon* Tao, (1963 : 189) belong to a group of Oriental species resembling *Acyrthosiphon* and associated with *Rhododendron* and related Ericaceae. They differ from *Acyrthosiphon* in that the apterae are devoid of secondary rhinaria, while the third antennal segment of the alate bears 30–110 rhinaria, the body may be variously pigmented or tuberculate and usually bears longer hairs than are usual in *Acyrthosiphon* and the processus terminalis of the described species is only 1½–3½ times as long as the base of the sixth antennal segment. The oldest generic name in the group is *Chaetomyzus* Ghosh & Ray Chaudhuri, 1962 (not *Chaitomyzus* Takahashi, 1960), which having clavate siphunculi and abdominal tubercles least resembles *Acyrthosiphon*. Tao, 1963 : 187–189, Hille Ris Lambers & Basu, 1966 : 17–19 and Ghosh & Ray Chaudhuri, 1969 : 93–96 have contributed to the understanding of this group. There are other undescribed species with both clavate and cylindrical siphunculi with the processus terminalis up to 5 times as long as the base of the sixth antennal segment so the short processus terminalis will not serve to distinguish the group from *Acyrthosiphon*. *Neoacyrthosiphon setosum* Hille Ris Lambers & Basu, 1966 : 17–19, is the only described member of the group not now the type-species of an available generic name. *Neoacyrthosiphon* (*Pseudacyrthosiphon*) *holsti* (Takahashi, 1935) is the type-species of *Pseudacyrthosiphon* Ghosh & Raychaudhuri, 1969.

Sinomegoura citricola (van der Goot, 1917)

Macrosiphoniella citricola van der Goot, 1917 : 34–36.
Tuberosiphum camphorae Shinji, 1922 : 789.
Megoura jacobsoni Mason, 1927 : 88–89.
Sinomegoura citricola (van der Goot) Takahashi, 1960 : 228–229.
Acyrthosiphon citricola (van der Goot) Basu, 1961 : 390; Behura, 1965 : 41.

Sinomegoura photiniae (Takahashi, 1936)

Acyrthosiphon photiniae Takahashi, 1936 : 600–602.
Sinomegoura photiniae (Takahashi) Takahashi, 1960 : 228–229.

Sinomegoura rhododendri (Takahashi, 1937)

Acyrthosiphon rhododendri Takahashi, 1937 : 8–10.
Sinomegoura rhododendri (Takahashi) Takahashi, 1960 : 228.

Subacyrthosiphon hoffmanni (Takahashi, 1937)

Acyrthosiphon hoffmanni Takahashi, 1937 : 56–58.
Subacyrthosiphon hoffmanni (Takahashi) Tao, 1963 : 177–178.

Probably more closely related to *Aulacorthum nipponicum* (Essig & Kuwana) than to the type-species of *Subacyrthosiphon* (see p. 84).

Tubaphis ranunculina (Walker, 1852)

Aphis ranunculina Walker, 1852 : 1046.
Macrosiphum ranunculinum (Walker) Theobald, 1913 : 161.
Myzus ranunculinus (Walker) Theobald, 1926 : 316–318.
Tubaphis ranunculina (Walker) Hille Ris Lambers, 1947 : 312; Doncaster, 1961 : 113–114.

According to Hille Ris Lambers (1949 : 184) Mordwilko found *Aulacorthum solani* on *Ranunculus* and misapplied Walker's name to it (see p. 88).

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HOST PLANT CATALOGUE

Arranged largely according to Engler's system as given in Willis (1966: ii – xlvii)

MONOCOTYLEDONEAE

4. GLUMIFLORAE

1. GRAMINEAE

1. MAYDAE.

Zea mays
Acyrthosiphon (*Metopolophium*) *dirhodum*

7. PHALARIDAE

Phalaris arundinacea
Acyrthosiphon (*M.*) *dirhodum*

8. AGROSTIDEAE

Agrostis canina
Acyrthosiphon (*M.*) *dirhodum*
Agrostis tenuis
Acyrthosiphon (*M.*) *festucae*
Calamagrostis sp.
Acyrthosiphon (*M.*) *dirhodum*
Lagurus ovatus
Acyrthosiphon (*M.*) *dirhodum*

9. AVENEAE

Aira capillaris
Acyrthosiphon (*Metopolophium*) *dirhodum*
Arrhenatherum elatius
Acyrthosiphon (*M.*) *albidum*
A. (*M.*) *dirhodum*
Avena sativa
Acyrthosiphon (*M.*) *dirhodum*
A. (*M.*) *festucae*
Deschampsia caespitosa
Acyrthosiphon (*M.*) *festucae*
Deschampsia flexuosa
Acyrthosiphon (*M.*) *dirhodum*, *tener*
Helicotrichon desertorum
Acyrthosiphon (*M.*) *dirhodum*
Holcus lanatus
Cryptaphis poae
Holcus mollis
Cryptaphis poae
Holcus sp.
Acyrthosiphon (*M.*) *dirhodum*

10. FESTUCAE

Bromus carinatus
Acyrthosiphon (*Metopolophium*) *dirhodum*
Bromus willdenowii (=catharticus)
Acyrthosiphon (*M.*) *dirhodum*
Bromus inermis
Acyrthosiphon (*M.*) *dirhodum*
Cryptaphis bromi
Bromus madritensis
Acyrthosiphon (*M.*) *dirhodum*
Bromus sterilis
Acyrthosiphon (*M.*) *dirhodum*
Bromus unioloides
Acyrthosiphon (*M.*) *chandrani*
A. (*M.*) *dirhodum*
Dactylis glomerata
Acyrthosiphon (*M.*) *albidum*
A. (*M.*) *dirhodum*
Festuca ovina
Acyrthosiphon (*Metopolophium*) *tenerum*
Cryptaphis poae
Festuca pratensis
Acyrthosiphon (*M.*) *dirhodum*
Festuca rubra
Acyrthosiphon (*M.*) *dirhodum*
A. (*M.*) *festucae*
A. (*M.*) *tenerum*
Festuca varia
Acyrthosiphon (*M.*) *dirhodum*

Glyceria maxima (=aquatica)
Acyrthosiphon (M.) dirhodum
Glyceria plicata
Acyrthosiphon (M.) dirhodum
Lamarckia aurea
Acyrthosiphon (M.) dirhodum
Lolium perenne
Acyrthosiphon (M.) dirhodum
A. (M.) festucae
Nardus stricta
Acyrthosiphon (M) dirhodum
Phleum pratense
Acyrthosiphon (M) dirhodum
Poa alpina
Acyrthosiphon (M.) alpinum
A. (M.) montanum
Poa annua
Acyrthosiphon (M.) chandrani
A. (M.) dirhodum
Poa arctica
Acyrthosiphon (A.) calvulus
Poa nemoralis
Acyrthosiphon (Metopolophium) dirhodum
Poa pratensis
Acyrthosiphon (M.) frisicum
Poa trivialis
Acyrthosiphon (M.) dirhodum
A. (M.) frisicum
Cryptaphis poae

12. TRITICEAE

Agropyron repens
Acyrthosiphon (Metopolophium) dirhodum
A. (M.) festucae
Agropyron trichophorum
Acyrthosiphon (M.) dirhodum
Elymus arenarius
Acyrthosiphon (M.) festucae
Elymus sp.
Hyalopteroides palmerae
Hordeum jubatum
Acyrthosiphon (Metopolophium) dirhodum
Hordeum murinum
Acyrthosiphon (M.) dirhodum
Hordeum vulgare (= sativum)
Acyrthosiphon (M.) dirhodum
A. (M.) festucae
Hystrix (= Asperella) hystrix
Acyrthosiphon (M.) dirhodum
A. (M.) festucae
Triticum aestivum (= sativum)
Acyrthosiphon (M.) dirhodum
Triticum spelta
Acyrthosiphon (M.) dirhodum

2. CYPERACEAE

Carex curta (= canescens)
Acyrthosiphon (Metopolophium) dirhodum
Carex ovalis (= leporina)
Acyrthosiphon (M.) festucae

9. LILLIFLORAE

3. LILIACEAE

Polygonatum giganteum (= commutatum)
Acyrthosiphon (A.) niwanista
Polygonatum multiflorum
Acyrthosiphon (Metopolophium) dirhodum
Smilacina sp.
Acyrthosiphon (A.) niwanista

— SMILACACEAE

Smilax china
Impatientinum impatiens
Smilax sp.
Sinomegoura citricola

DICOTYLEDONEAE

ARCHICHLAMYDEAE

12. URTICALES

2. MORACEAE

Ficus spp.
Sinomegoura citricola

3. URTICACEAE

Urtica spp.
Microlophium spp.

16. POLYGONALES

1. POLYGONACEAE

Rumex paulsenianus
Acyrthosiphon (A.) rumicis

17. CENTROSPERMAE

9. CARYOPHYLACEAE

Honkenya peploides
Acyrthosiphon (A.) auctum
Silene alba
Volutaphis schusteri
Silene maritima
Acyrthosiphon (A.) auctus
Stellaria media
Acyrthosiphon (A.) auctus

18. RANALES

17. LAURACEAE

Cinnamon camphora
Sinomegoura citricola
Persea americana
Sinomegoura citricola

19. RHODEALES

1. PAPAVERACEAE

Chelidonium majus
Acyrthosiphon (Liporrhinus) chelidonii
Glaucium fimbrilligerum
Xanthomyzus glaucii
Glaucium sp.
Acyrthosiphon (A.) ilka
Papaver nudicaule
Acyrthosiphon (A.) bidentis
A. (A.) ilka
Papaver somniferum
Acyrthosiphon (A.) ilka
A. (A.) papaverinum
A. (A.) titovi

2. FUMARIACEAE

Corydalis sp.
Acyrthosiphon (A.) tutigula

3. CRUCIFERAE

Cakile maritima
Acyrthosiphon (A.) auctus
Capsella bursa-pastoris
Acyrthosiphon (A.) auctus
A. (A.) pisum
Lepidium perfoliata
Acyrthosiphon (A.) gossypii

21. ROSALES

16. ROSACEAE

I. SPIRAEOIDEAE

Sibiraea laevigata
Acyrthosiphon (A.) ignotus
Spiraea alba, x arguata, bella, chamedrifolia, x cinerea
Acyrthosiphon (A.) ignotus
Spiraea hypericifolia
Acyrthosiphon (A.) ignotus
A. (A.) spiraeae
Spiraea latifolia
Acyrthosiphon (A.) ignotus
A. (A.) pseudodirhodum
Spiraea media, nipponica, obovata, x sempervirens, trichocarpa, x vanhouttei
Acyrthosiphon (A.) ignotus
Spiraea sp.
Acyrthosiphon (A.) soldatovi
A. (A.) spiraeaellae

II. PYROIDEAE (POMOIDEAE)

Amelanchier alnifolia
Acyrthosiphon (A.) macrosiphum
Photinia glabra
Sinomegoura photiniae

III. ROSOIDEAE

1. KERRIEAE

Kerria japonica
Aulacorthum kerriae

2. POTENTILLEAE

a. RUBINAE

Rubus caesius var. turkestanicus
Acyrthosiphon (A.) rubi
Rubus ellipticus
Acyrthosiphon (A.) rubi elliptici
Rubus sp.
Acyrthosiphon (A.) rubiformosanus

b. POTENTILLINAE

Comarum palustre
Acyrthosiphon (A.) pelargonii borealis
A. (A.) p. potha
Dasiophora fruticosa
Acyrthosiphon (A.) scalaris
Dasiophora sp.
Acyrthosiphon (A.) wasintae
Fragaria vesca
Acyrthosiphon (A.) fragariaevescae
Fragaria vesca x viridis
Acyrthosiphon (A.) pelargonii rogersii
Fragaria spp.
Acyrthosiphon (Rhodobium) porosus
Potentilla alpestris, anglica, anserina, artica, argentea,
Acyrthosiphon (A.) pelargonii borealis
Potentilla blashkiana, crantzii
Acyrthosiphon (A.) p. borealis
Potentilla latifolia
Acyrthosiphon (A.) pseudodirhodum
Potentilla norvegica, ornithopioides, puberula
Acyrthosiphon (A.) pelargonii borealis
Potentilla recta, reptans, sterilis, villosa
Acyrthosiphon (A.) p. borealis

c. DRYADINAE

Dryas integrifolia
Acyrthosiphon (*A.*) *brevicornis*
Dryas octopetala
Acyrthosiphon (*A.*) *brevicornis*
Dryas sp.
Acyrthosiphon (*A.*) *pelargonii borealis*/*potha* group.
Geum rivale
Acyrthosiphon (*A.*) *pelargonii borealis*/*potha* group.

3. CERCOCARPEAE

Purshia tridentata
'*Macrosiphum*' *purshiae*

5. SANGUISORBEAE

Agrimonia eupatoria
Acyrthosiphon (*A.*) *pelargonii agrimoniae*
Agrimonia odorata
Acyrthosiphon (*A.*) *pelargonii agrimoniae*
Alchemilla alpina, pyrenaica, subcrenata, vulgaris
Acyrthosiphon (*A.*) *pelargonii potha*
Acaena anserinifolia, macrostemum, microphyllum, myrophilum, novazealandica.
Acyrthosiphon (*A.*) *pelargonii borealis*
Poterium sanguisorba (= minor)
Acyrthosiphon (*A.*) *pelargonii poterii*

6. ROSEAE

Rosa canina
Acyrthosiphon (*Metopolophium*) *dirhodum*
Rosa damascena
Acyrthosiphon (*A.*) *catharinae*
Rosa fendleri, glauca
Acyrthosiphon (*Metopolophium*) *dirhodum*
Rosa kokanica, maracandica
Acyrthosiphon (*A.*) *catharinae*
Rosa pomifera, rugosa
Acyrthosiphon (*Metopolophium*) *dirhodum*
Rosa webbiana
Acyrthosiphon (*A.*) *catharinae*
Rosa spp.
A. (*A.*) *pseudodirhodum*
A. (*A.*) *tutigula*
Acyrthosiphon (*Metopolophium*) *alpinum*
A. (*M.*) *montanum*
Acyrthosiphon (*Rhodobium*) *porosum*

18. LEGUMINOSAE

II. CAESALPINIOIDEAE

Cassia sp.
Acyrthosiphon (*A.*) *pisum spartii*

III. PAPILIONACEAE

1. SOPHOREAE

Sophora japonica
Acyrthosiphon (? *M.*) *sophorae*

3. GENISTEAE

Cytisus austriacus capitatus, pilosus, rhodopeum
Acyrthosiphon (*A.*) *parvus*
Cytisus sp.
Acyrthosiphon (*A.*) *pisum spartii*
Genista anglica
Acyrthosiphon (*A.*) *ericetorum*
Genista nigricans
Acyrthosiphon (*A.*) *pisum spartii*
Genista tinctoria
Acyrthosiphon (*A.*) *pisum spartii*
Sarothamnus monspessulanus
Acyrthosiphon (*A.*) *pisum spartii*
Sarothamnus scoparius
Acyrthosiphon (*A.*) *parvus*
A. (*A.*) *pisum spartii*
Spartium junceum
Acyrthosiphon (*A.*) *pisum spartii*

4. TRIFOLIEAE

Medicago carstiensis, falcata, lupulina
Acyrthosiphon (*A.*) *p. pisum*
Medicago sativa
Acyrthosiphon (*A.*) *kondoi*
A. (*A.*) *loti*
A. (*A.*) *p. pisum*
Melilotus officinalis
Acyrthosiphon (*A.*) *p. pisum*
Ononis repens
Acyrthosiphon (*A.*) *pisum ononis*
Ononis spinosus
Acyrthosiphon (*A.*) *pisum ononis*
Trifolium arvense, dubium, hybridum
Acyrthosiphon (*A.*) *p. pisum*
Trifolium medium pannonicum, pratense
Acyrthosiphon (*A.*) *p. pisum.*

Trifolium repens
Acyrthosiphon (A.) p. pisum
Subacyrthosiphon cryptobium
Trifolium spp.
Acyrthosiphon (A.) brevicaudata
A. (A.) kondoi
Trigonella foenum-graecum
Acyrthosiphon (A.) p. pisum

5. LOTEAE

Anthyllis hermanniae
Acyrthosiphon (A.) caraganae
Anthyllis vulneria
Acyrthosiphon (A.) loti
Dorycnium herbaceum
Acyrthosiphon (A.) loti
Lotus corniculatus
Acyrthosiphon (A.) loti
A. (A.) p. pisum
Lotus hispidus
Acyrthosiphon (A.) loti
A. (A.) p. pisum
Lotus requienii
Acyrthosiphon (A.) p. pisum
Lotus tenuifolius
Acyrthosiphon (A.) p. pisum
Lotus uliginosus
Acyrthosiphon (A.) loti
A. (A.) p. pisum

6. GALEGEAE

Astragalus alpinus
Acyrthosiphon (A.) loti
A. (A.) p. pisum
Astragalus sp.
Acyrthosiphon (A.) astragali
Caragana arborescens, pygmaea, spinosa
Acyrthosiphon (A.) caraganae
Colutea arborescens
Acyrthosiphon (A.) caraganae
A. (A.) pisum ? spartii
Colutea frutex, media, orientalis
Acyrthosiphon (A.) caraganae
Milettia reticulata
Aulacophora formosana
Phaca frigida
Acyrthosiphon (A.) loti
Robinia pseudacacia
Acyrthosiphon (A.) pisum ? spartii
Sesbania grandiflora
Acyrthosiphon (A.) gossypii
Wisteria chinensis
'Subacyrthosiphon' hoffmanni

7. FABEAE (VICEAE)

Cicer soongonicus
Acyrthosiphon (A.) hissarica
Lathyrus alphaca, latifolius, nissolia
Acyrthosiphon (A.) p. pisum
Lathyrus odoratus, pratensis, roseus
Acyrthosiphon (A.) p. pisum
Lathyrus sp.
Acyrthosiphon (A.) loti
Lens nigricans
Acyrthosiphon (A.) p. pisum
Pisum sativum
Acyrthosiphon (A.) p. pisum
Pisum sp.
Acyrthosiphon (A.) brevicaudatus
Vicia cracca
Acyrthosiphon (A.) pisum
Vicia faba
Acyrthosiphon (A.) gossypii
A. (A.) p. pisum
Vicia hirsuta
Acyrthosiphon (A.) p. pisum
Vicia sinensis
Acyrthosiphon (A.) p. pisum

9. PHASEOLEAE

Dolichos lablab
Acyrthosiphon (A.) gossypii
Glycine soya
Acyrthosiphon (A.) p. pisum
Phaseolus mungo
Acyrthosiphon (A.) gossypii
Macrocaudus phaseoli
Vigna catjung, sinensis, ungiculata
Acyrthosiphon (A.) gossypii

10. HEDYSAREAE

Arachis hypogea
Acyrthosiphon (A.) bidentis (experimental only)
Coronilla emerus
Acyrthosiphon (A.) caraganae
Hippocrepis comosa
Acyrthosiphon (A.) caraganae
A. (A.) loti
A. (A.) p. pisum
Onobrychis viscaefolia
Acyrthosiphon (A.) p. pisum
Undetermined Leguminosae
Acyrthosiphon (A.) dubium

23. GERANIALES

1. GERANIACEAE

Erodium cicutarium
Acyrthosiphon (A.) pelargonii geranii
A. (A.) p. zerozalphum

Erodium moschatum
Acyrthosiphon (*A.*) *p. pelargonii*
A. (*A.*) *pelargonii zerozalphum*
Erodium trichomanifolium
Acyrthosiphon (*A.*) *pelargonii geranii*
Geranium dissectum, lucidum, molle, pratense, pyrenaicum, pusillum, robertianum, sanguinium
Acyrthosiphon (*A.*) *pelargonii geranii*
Pelargonium domesticum, hederaceum, odoratissimum
Acyrthosiphon (*A.*) *p. pelargonii*

4. LINACEAE

Linum grandiflorum
Acyrthosiphon (*A.*) *bidentis*
Linum usitatissimum
Acyrthosiphon (*A.*) *mordwilkoi*

7. ZYGOPHYLLACEAE

Peganum harmala
Acyrthosiphon (*A.*) *gossypii*

9. RUTACEAE

Citrus sp.
Sinomegoura citricola
Evodia triphylla
Acyrthosiphon (*A.* ?) *evodiae*
Murraya sp.
Sinomegoura citricola

19. EUPHORBIACEAE

Bridelia sp.
Sinomegoura citricola
Euphorbia cyparissias
Acyrthosiphon (*A.*) *cyparissiae*
A. (*A.*) *euphorbiae neerlandicum*
Euphorbia esula
Acyrthosiphon (*A.*) *cyparissiae*
A. (*A.*) *euphorbiae neerlandicum*
Euphorbia helioscopia
Acyrthosiphon (*A.*) *moltshanovi* (based on one specimen only).
Euphorbia palustris
Acyrthosiphon (*A.*) *e. euphorbiae*
Euphorbia pithyusa ovalifolia
Acyrthosiphon (*A.*) *e. ? euphorbiae*
Euphorbia platyphyllos
Acyrthosiphon (*A.*) *thracicus*
Euphorbia polychroma
Acyrthosiphon (*A.*) *euphorbiae neerlandicum*
Euphorbia seguierana (= gerardiae)
Acyrthosiphon (*A.*) *cyparissiae*
Euphorbia virgatum
Acyrthosiphon (*A.*) *cyparissiae turkestanicum*
Euphorbia sp.
Acyrthosiphon (*A.*) *euphorbinus*

24. SAPINDALES

5. ANACARDIACEAE

Mangifera sp.
Sinomegoura citricola

21. BALSAMINACEAE

Impatiens spp.
Impatientinum spp.

25. RHAMNALES

1. RHAMNACEAE

Berchemia racemosa
'*Acyrthosiphon*' *berkemiae*

2. VITIDACEAE

Vitis sp.
Aulacorthum kuwanai

26. MALVALES

1. ELAEOCARPACEAE

Elaeocarpus serrulatus
'*Acyrthosiphon*' *elaeocarpi*

5. MALVACEAE

Gossypium spp.
Acyrthosiphon (*A.*) *gossypii*
Acyrthosiphon (*A.* ?) *gossypicola*
Malva neglecta
Acyrthosiphon (*A.*) *gossypii*
Malva sp.
Acyrthosiphon (*A.*) *p. pelargonii*

27. PARIETALES

7. THEACEAE

Eurya japonica
Aulacorthum symplocois
Eurya sp.
Aulacorthum euryae
Thea sp.
Sinomegoura citricola

15. BIXACEAE

Bixia sp.
Sinomegoura citricola

29. MYRTIFLORAE

14. MYRTACEAE

Eugenia sp.
Sinomegoura citricola

16. ONAGRACEAE

Epilobium latifolium
Acyrthosiphon (A.) pelargonii borealis

30. UMBELLIFLORAE

2. UMBELLIFERAE

Laserpitium siler
Acyrthosiphon (A.) n. nigripes
Peucedanum officinale
Acyrthosiphon (A.) nigripes peucedani
Seseli austriacum
Acyrthosiphon (A.) nigripes blattnyi
Seseli leucospermum
Acyrthosiphon (A.) nigripes blattnyi
Torylis africana
Acyrthosiphon (A.) bidentis
Undetermined Umbelliferae
Acyrthosiphon (A. ?) navozovi

SYMPETALAE

1. ERICALES

4. ERICACEAE

Pentapterygium serpus
Neoacyrthosiphon (N.) setosum
Pieris japonica
Sinomegoura citricola
Rhododendron formosanum
Neoacyrthosiphon (N.) taiheisianum
Rhododendron lasiostylum
Ericolophium itoe
Rhododendron morii
Neoacyrthosiphon (Pseudoacyrthosiphon) holstii
Rhododendron oldhami
Sinomegoura rhododendri
Vaccinium myrtillus
Acyrthosiphon (Metopolophium) tener
Vaccinium uliginosum
Acyrthosiphon (A.) brachysiphon
A. (A.) knechteli

2. PRIMULALES

3. PRIMULACEAE

Primula kewensis
Acyrthosiphon (A.) primulae

4. EBENALES

3. SYMPLOCACEAE

Symplocos sessilifolia
Aulacorthum symplocois

5. CONTORTAE

1. OLEACEAE

Ligustrum ibota
Aulacorthum ibotum

6. TUBIFLORAE

4. BORAGINACEAE

Mertensia sibirica
Acyrthosiphon (A.) niwanista

6. LABIATAE

Perilla ocymoides
Aulacorthum (Perillaphis) perillae
Salvia sclarea
Acyrthosiphon (A.) salviae

8. RUBIALES

1. RUBIACEAE

Lasianthus sp.
Sinomegoura citricola
Paederia tomentosa
Aulacorthum nipponicum

– NAUCLEACEAE

Nauclea sp.
Sinomegoura citricola

9. CUCURBITALES

1. CUCURBITACEAE

Cucumis melo
Acyrthosiphon (A.) cyparissiae 'var. *cucurbitae*'
Cucumis sativis
Acyrthosiphon (A.) cyparissiae 'var. *cucurbitae*'
Cucurbita pepo
Acyrthosiphon (A.) vasiljevi

10. CAMPANULATAE

6. COMPOSITAE

A. ASTEROIDEAE (TUBULIFLORA)

1. HELIANTHEAE

Bidens pilosa
Acyrthosiphon (A.) bidenticola
Acyrthosiphon (A.) bidentis
Helianthus annuus
Acyrthosiphon (A.) bidenticola

2. ASTEREAE

Aster spp.
Acyrthosiphon (A.) asterifoliae

6. SENECIONEAE

Erechtites valerianaefolia
Acyrthosiphon (*A.*) *bidenticola*
Petasites tricholobus
Aulacorthum cirsicola

10. CYNAREAE

Arctium lappa
Aulacothum cirsicola
Cirsium spicatum
Aulacorthum cirsicola
Saussurea salicifolia
Acyrthosiphon (*A.*) *dauricum* (? true host)

B. LACTUCOIDEAE (LIGULIFLORAE)

Hieracium porrifolium
Aulacorthum porrifolii
Lactuca sativa, serriola (= scariola), virosa
Acyrthosiphon (*Tlja*) *lactucae*
Sonchus oleraceus
Acyrthosiphon (*A.*) *ghanii*
Sonchus sp.
Acyrthosiphon (*A.*) *bidentis*
Taraxacum arctogenum
Acyrthosiphon (*Metopolophium*) *artogenicolens*
Taraxacum officinale
Aulacorthum palustre

UNKNOWN HOST PLANTS

Acyrthosiphon (*A.*) *aurlandicus*
A. (*A.*) *dauricum* (? *Saussurea*)
A. (*A.*) *emeljanovi*
A. (*A.*) *hissarica*)
A. (*A.*) *moltshanovi*
A. (*A.*) *navozovi* (? Umbelliferae)
A. (*A.*) *norvegicum*
A. (*A.*) *orientale*
A. (*A.*) *rjabushinskiji*
A. (*A.*) *svalbardicus* (? Gramineae)
Acyrthosiphon (*Metopolophium*) *beiqueti* (? Gramineae)
'*Acyrthosiphon*' *kamtshakanum*

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V. F. Eastop, M.Sc., Ph. D.
Department of Entomology
British Museum (Natural History)
Cromwell Road
London, S.W.7

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BY

PRABHAT KUMAR
Department of Zoology, University of Lucknow, Lucknow, India

AND

BHUP KISHORE TANDAN
Department of Zoology, University of Lucknow, Lucknow, India

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By P. KUMAR & B. K. TANDAN

CONTENTS

SYNOPSIS

Sixteen species of *Ardeicola* from the Ciconiidae have been described, certain homologous characters of all compared and a key for their identification provided. The four new species are *A. dissourae* from *Dissoura episcopus microscelis*, *A. senegalensis* from *Ephippiorhynchus senegalensis*, *A. asiaticus* from *Xenorhynchus a. asiaticus* and *A. keleri* from *Ibis ibis*.

INTRODUCTION

The genus *Ardeicola* Clay, 1935 includes Ischnocera which live on the back and wings of Ciconiiformes, have an elongated and depressed body (Clay, 1957*b*), and can be diagnosed by the following combination of characters, especially those of the head.

Head. Marginal carina interrupted medially and laterally into pre- and postmarginal carinae. Hyaline margin arises at distal ends of premarginal carinae. Dorsal preantennal suture usually directed posteriorly, sometimes transversely also; a dorsal anterior, and a smaller ventral plate with usually numerous discrete, exceptionally few indistinct, thickenings. Ventral carina interrupted medially and passing anteriorly to fuse with distal end of premarginal carina; pulvinus with lobes attached to flattened, thickened, parallel edges of ventral carinae. Temporal carinae usually absent. Coni better developed in female than in male. Gular plate distinct. Hypopharynx well developed. Usually much sexual dimorphism in antennae. Head setae typical for Ischnocera (see Clay, 1951).

Thorax and abdomen. Pro- and pteronotum either undivided or divided medially. On both 1+1 anterior m, sp, or sh setae. (For explanations to abbreviations see page 158). On prothorax usually 2+2 posterior setae; outer sp or sh, inner sh to lg; rarely only 1+1 (inner) setae. On pteronotum either 5+5, 6+6 or 7+7 posterior setae; of these 1+1 are always trichobothrium-like (here called thoracic trichobothria), and 1+1 are sp and their position relative to each other diagnostic. Abdomen with 8 apparent segments, interpreted thus; apparent 1 as II (actually I + II fused), 2 to 7 as III to VIII; in the male 8 either as IX–XI or its greater anterior portion as IX + X and the posterior smaller portion as XI; in the female 8 always as IX–XI. In the male tergal thickening VI–VIII usually as transverse plates continuous across the segment; of other segments variable. In the female tergal thickening II–VIII as lateral tergites; of IX–XI as a large plate continuous across segment, but falling short of lateral segmental margins. Male genital opening ventral. Setae always present are: 1+1 postero-lateral trichobothria on tergum VIII, here referred to as abdominal trichobothria; anal, 3+3 (Clay, 1951); 2+2 in genital region, referred to as *d*; and in female 1+1 on sternum VIII.

The following characters described fully in the next section are common to species of *Ardeicola* from the Ciconiidae. They clearly indicate a division within the genus above the specific level, here designated as the *ciconiae* group.

1. Position of anterior dorsal setae (Text-fig. 6). 2. Nature of pro- and pteronotum (Text-figs 2, 16). 3. Number, 7+7, and arrangement of postero-lateral pteronotal setae (Text-fig. 18) (especially of telg setae). 4. Number, 1+1, of anterior tc setae on segment II, and 1+1 anterior and 2+2 posterior tergal setae on segment IX-XI (Text-figs 36, 37). 5. The distribution of post-spiracular setae (Text-fig. 17 and fig. 6 in Tandan & Kumar, 1969). 6. Absence of pleural setae on II and their number, 1+1, on III (Text-fig. 16).

REVIEW OF SOME HOMOLOGOUS CHARACTERS IN THE *CICONIAE* GROUP

The sixteen species herein described vary strikingly in the degree of sclerotization thus: poor, *leucosoma;* feeble to moderate, *keleri*, *asiaticus*, *tantali*, *maculatus*, and *loculator* female; heavy (or well sclerotized), the remaining species. The colour pattern is important for separating the otherwise morphologically similar females of *tantali* and the three closely related species (nos 7, 9, 10); it is also important for diagnosing the female of *loculator*. The degree of dimorphism in the length of the two sexes also differs notably (Text-fig. 1).

HEAD AND THORAX. The head varies in shape, but morphologically it is remarkably uniform. The hyaline margin is broad and prominent. The preantennal region is usually slightly longer than the postantennal, the difference being less in the male than in the female. In the male of *lepidus* the preantennal region is slightly shorter than, and in the female longer than or equal to, the postantennal region. In *hopkinsi* the preantennal region is appreciably longer.

The following features of the preantennal region are uniform for the group (Text-figs 2, 4, 6): Length of premarginal carinae; shape of dorsal anterior plate and its modified central area; shape of ventral plate, especially its emarginate posterior margin, and the numerous thickenings on it. Position of dorsal submarginal seta, behind tip of premarginal carina; of anterior dorsal seta, posterior relative to anterior ventral setae 1 and 2, rarely at about the same level as avs 2; of ventral submarginal seta 1 slightly anterior or posterior to ventral submarginal seta 2; of anterior seta 1 slightly anterior or posterior to avs 3. In the male antennal segments II-V, and in the female III-V, are together longer than segments I and II respectively.

Of the eleven well sclerotized species, the dorsal carinae extend to the midline in *loculator* (fig. 10 in Kumar & Tandan, 1968), otherwise these endocarinae are less evident medially (Text-figs 2, 3). The posterior margin of the dorsal anterior plate is usually greatly curved, but in *signatus* and *lepidus* it is much less so, being almost straight (Text-figs 4, 5). Temporal carinae are present only in *loculator* and *ciconiae* males, being well developed in the former, weakly so in the latter species. The gular plate is usually more heavily pigmented than the dorsal cuticle, above or around it. The difference is more marked in *bicolor*, *dissourae*, *senegalensis*, and *castaneus*, but it is perceptible in all others, excepting *leucosoma* and *loculator*. In *leucosoma* and *loculator* female there is no difference,while in *loculator* male the plate

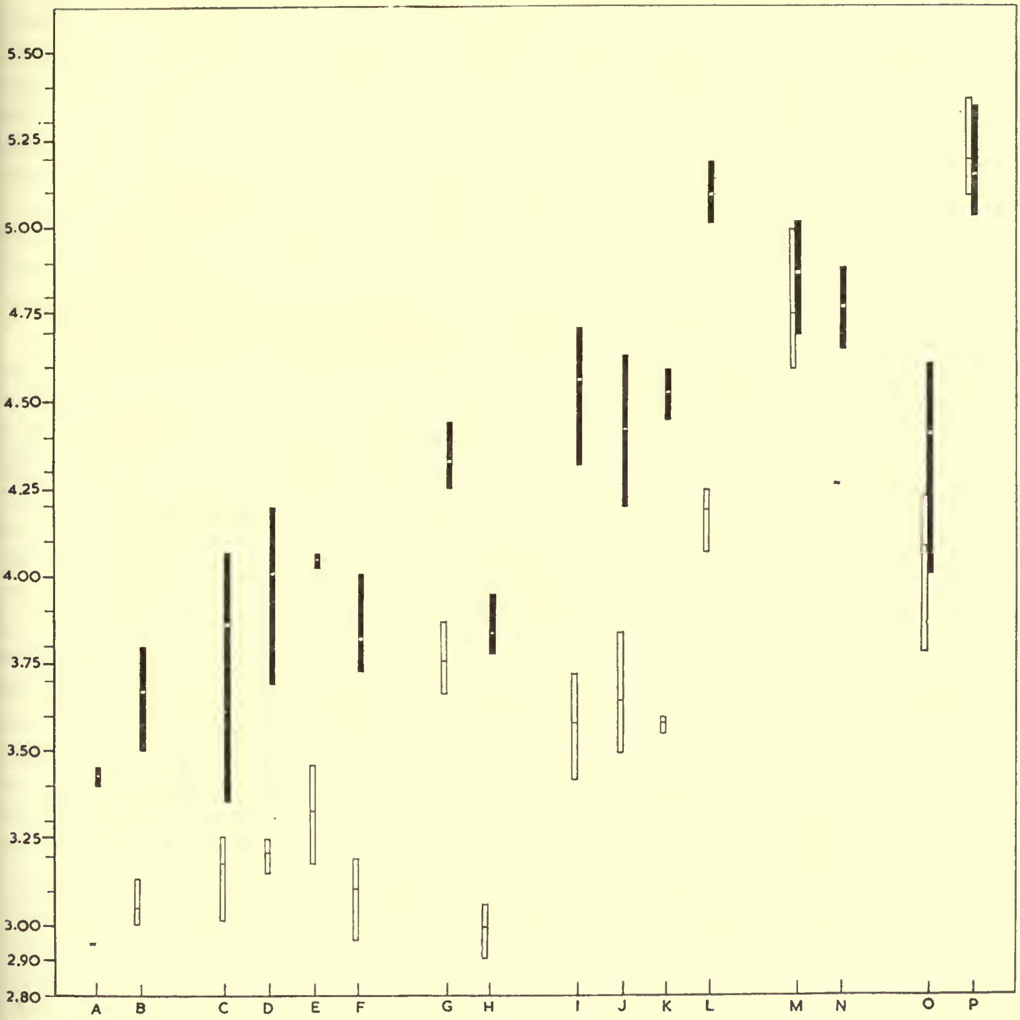


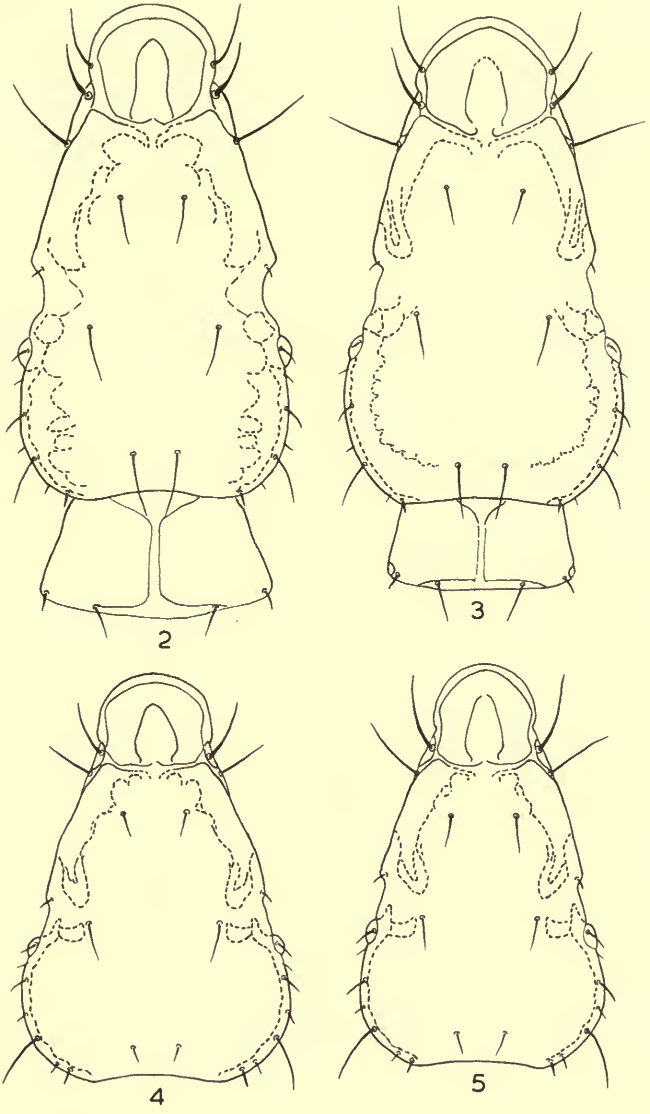
FIG. 1. Dimorphism in length (in millimetres) of males (left-hand side column in white) and females (right-hand side column in black) of *Ardeicola* species of *ciconiae* group. Line across each column represents the average length: (A) *A. signatus*; (B) *A. lepidus*; (C) *A. bicolor*; (D) *A. dissourae* sp. n.; (E) *A. senegalensis* sp. n.; (F) *A. castaneus*; (G) *A. loculator*; (H) *A. leucosoma*; (I) *A. keleri* sp. n.; (J) *A. tantali*; (K) *A. asiaticus* sp. n.; (L) *A. maculatus*; (M) *A. ciconiae*; (N) *A. hopkinsi*; (O) *A. hardayali*; (P) *A. fissomaculatus*.

is markedly less sclerotized. Its pigmentation is almost uniform or noticeably darker anteriorly. Occipital carinae are usually poorly sclerotized, but are well so in *bicolor* and *fissomaculatus* (perhaps in *dissourae* and *hardayali* also).

Coni are poorly developed and hidden in males of eight species, nos 1–6, 11, 12, and just projecting beyond margins of the head in *tantali* and related species (nos 7, 9, 10), *ciconiae, hopkinsi, fissomaculatus* and *hardayali*. In females they are moderately developed and fall slightly short of or reach to the middle of first antennal segment in *bicolor* and the three related species (nos 3, 5, 6) and in *leucosoma, fissomaculatus* and *hardayali*. In nine species they reach beyond the middle of first antennal segment. The outer rounded margin in the male and pointed apex in the female is distinctly thickened in *fissomaculatus;* in other species of identical habitus this character is not determinable as the series are suboptimal. The approximate ratio of antennal segments II-V: I in the male is in *fissomaculatus*, 1·09; *ciconiae*, 1·17; *castaneus, leucosoma* and *hopkinsi*, 1·34–1·38; *senegalensis, dissourae, hardayali, maculatus, tantali, lepidus* (Text-fig. 7) and *asiaticus*, 1·40–1·49; *signatus, keleri*, and *bicolor*, 1·50–1·59; *loculator*, 1·60. In the female (Text-fig. 12) the ratio of segments III-V: II is from 1·82–2·27.

The anterior dorsal seta (ml to lg) is well removed from the preantennal suture and is slightly posterior relative to anterior ventral setae 1 and 2; rarely the ads may be at the same level as avs 2 (Text-fig. 6). Minute second ad setae may also be present in males of *tantali* and related species, nos 7, 9, 10. Dorsal submarginal (lg) is basally stout and subapically on premarginal carina. Postnodal seta is usually ml or ml to lg, but sh to ml in *bicolor* female. Post-temporal seta in the female is sh and falls much short of the occiput. But in the male it shows great variation in length relative to the occiput, as follows : 1. Falls short of it in *loculator* (usually sh or ml also), *leucosoma, hardayali, fissomaculatus* (sh to ml), and *hopkinsi* (ml). 2. Reaches it in *signatus* (ml), *lepidus* (ml to almost lg), *senegalensis* (almost lg), *bicolor* (lg). 3. Crosses it slightly in *signatus*, and *lepidus*. 4. Crosses it well in *dissourae* (lg), *castaneus, bicolor, tantali* and related species (lg). A. *ciconiae* (ml to lg) is the only species in which it may either fall short of the occiput or cross it slightly. Preantennal seta is sp or sh. Preconal is mostly sh to ml in the male and ml to lg in female; also sh in *signatus* male, ml in *dissourae* male, ml to lg in *ciconiae* and almost lg in *maculatus*. Ocular seta is usually sh but sometimes ml; in *ciconiae* male it is ml to almost lg. The alveolus is on the cornea, but close to temporal margin. Of the 6 marginal temporal setae, 1 is always sp or sh and fine, but m in *bicolor;* 2 is usually sh, but is sh to ml in *maculatus* and *ciconiae*, and ml in *fissomaculatus*. In the same species marginal temporal 2 and ocular resemble each other in proportions. Marginal temporals 3 and 5 are much like 1 in proportions; 6 is sp, stouter than 1, 3 and 5. Marginal temporal 4 is usually ml, but sh to ml in *keleri* male, ml to almost lg in *signatus* male, *ciconiae, leucosoma* female, *loculator, tantali*, and *maculatus* and lg in *leucosoma* male. Mandibular seta is usually ml to lg; also sh in *lepidus* male, sh to ml in *hopkinsi, hardayali, fissomaculatus*, ml in *castnaeus, leucosoma* and *loculator* male. The remaining head setae are ml to lg; their lengths are not important.

The thorax shows no striking differences. The pronotum is apparently divided medially; there are 2+2 posterior prothoracic setae in all species except *loculator* which has 1+1 setae only, as the 1+1 (rarely 3 also) outer setae are absent. The outer setae may be slightly thinner in the female than in the male. The pteronotum is medially divided in about its posterior half; a definite medial suture traverses its anterior half also, along which a split often occurs during preparation. On the pteronotum there are normally 7+7 characteristically arranged postero-lateral

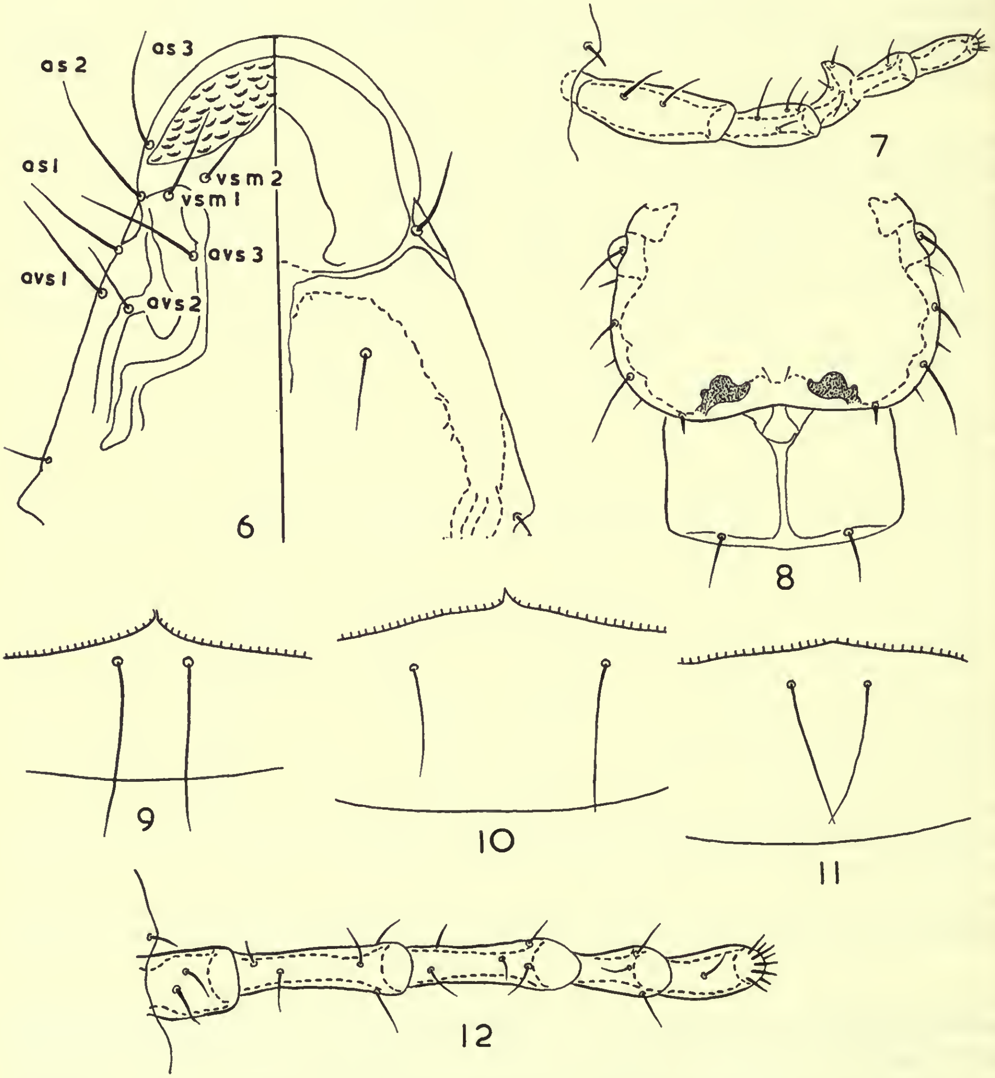


Figs 2–5. Heads of *Ardeicola*: 2, *A. dissourae* sp. n. male; 3, *A. bicolor*, male; 4, *A. lepidus*, female; 5, *A. signatus*, female.

setae (Text-fig. 16); of these 5+5 are lg to elg and have contiguous alveoli which lie in one unsclerotized area; posterior to these are the 1+1 pterothoracic trichobothria, outer relative to the 1+1 thoracic sp setae (Text-figs 16, 30). Meso- and metasternal setae vary in number.

Abdomen. The shape and proportions of the segments are fairly constant in both sexes and this uniformity of the female abdomen is important.

Tergal thickening. In the male tergal thickening of segments II-IV is usually in the form of distinct lateral tergites. Those of II are narrowly separated medially, but diverge characteristically at the level of the 2 anterior tc setae; those of III and IV are medially wide apart. In *loculator* and *leucosoma* central sclerotization, less intense than the lateral tergites, makes the latter of II-IV continuous across the terga. Inner contours of III are not well defined in *lepidus* (Text-fig. 13). Thick-



FIGS 6–12. 6, 7, *A. lepidus*, male, preantennal region of head and antenna; as, anterior seta; avs, anterior ventral seta; vsm, ventral submarginal seta; 8, *A. loculator*, female, postantennal region of head and prothorax; 9–11, Tergocentral setae on segment VIII: 9, *A. dissourae* sp. n.; 10, *A. castaneus*; 11, *A. bicolor*; 12. *A. maculatus*, female, antenna.

ening of III and IV is apparently transversely continuous in *signatus;* in *senegalensis* II and III are less sclerotized centrally and in which no well defined contours of lateral tergites are evident, and the thickening is apparently continuous across (Text-fig. 15). Thickening of V is as distinct lateral tergites in *keleri*, and seems to be so in the three related species also (nos 7–9). In others it is continuous across the segment; and always so in VI-VIII. On some terga, V and VII in *hopkinsi*, V-VIII in *ciconiae, loculator, hardayali*, and only VIII in *fissomaculatus*, contours of lateral tergites are evident. This indicates that in these, and perhaps in other species too, the tergal thickening is primarily as lateral tergites which become continuous across as a result of sclerotization of the central tergum. The anterior margin of tergite V shows much variation and its nature is important. It is either straight in *lepidus* (Text-fig. 13), or slightly emarginate in *ciconiae* to deeply emarginate in *bicolor* and related species (nos 3, 5, 6) (Text-figs 14, 15, 18, 19) and in *loculator* and *hardayali.* Anterior margin of tergal thickening VI-VIII may be straight, medially depressed or emarginate. Maximum curvature in the posterior margin of tergites VI and VII is seen in *loculator* and *hopkinsi* (figs 1, 11 in Kumar & Tandan, 1968). Composite tergum IX-XI is sclerotized all over except for narrow strips antero-laterally (*hardayali, fissomaculatus*), or a strip posteriorly (*fissomaculatus*) (figs 2, 3 in Tandan & Kumar, 1969). The anterior margin of tergite IX-XI is usually more or less straight, but is curved slightly in *hopkinsi* (fig. 5 in Kumar & Tandan, 1968) and *castaneus*, more in *hardayali* (fig. 2 in Tandan & Kumar, 1969), considerably in *ciconiae* or it is noticeably raised medially in *loculator* and *senegalensis* (Text-fig. 33) or depressed medially in *lepidus* and *fissomaculatus* (fig. 3 in Tandan & Kumar, 1969).

In the female, tergal thickening of segments II-VII is as lateral tergites, different in shape from those of the male; those of III in *lepidus* (Text-fig. 16) may, and of II in *senegalensis*, have indistinct contours. The tergum between and posterior to the lateral tergites is either unhardened or relatively less intensely hardened.

In some females (*a* type) of *bicolor* the tergum between lateral tergites IV-VIII and posterior to III-VIII is pigmented, but in others not (*b* type). In yet others (*c* type) the extent of central and posterior pigmentation differs, and such females can be arranged in a series which has at one end individuals more extensively pigmented in these portions and at the other those much less so. The former are closer to the *a* type, the latter to the *b* type of females described above.

In other species there is considerable variation in the extent of these areas of pigmentation. Apparently these are absent in *signatus*, and only the posterior one is present in *lepidus*. In *ciconiae* the central pigmentation is evident along the inner margins of lateral tergites III-VII or VIII; the posterior on II-VIII, showing progressive decrease posteriorly. *A. hardayali* is like *ciconiae*, but may lack completely the central pigmentation, and the posterior one is less intense. *A. fissomaculatus* has central pigmentation of tergum II only, the posterior one being as in *hardayali*.

The anterior margin of tergite IX-XI is (apparently) almost straight in *signatus;* it is medially slightly depressed in *lepidus, bicolor, hopkinsi, leucosoma*, or medially slightly emarginate *hardayali* and *fissomaculatus*. Its lateral margins are usually curved, being considerably so in *hardayali* and *fissomaculatus*.

Sternal thickening. In both sexes sternal thickening of segments III-VIII is in the form of lateral plates, which increase in size progressively posteriorly; that of II is usually not apparent, rarely so as faint, narrow, lateral plates. Lateral sternites VIII continue posteriorly and either merge to form the subgenital plate or remain as lateral plates. In the male the terminal sternum which forms the margin of the genital opening is never thickened.

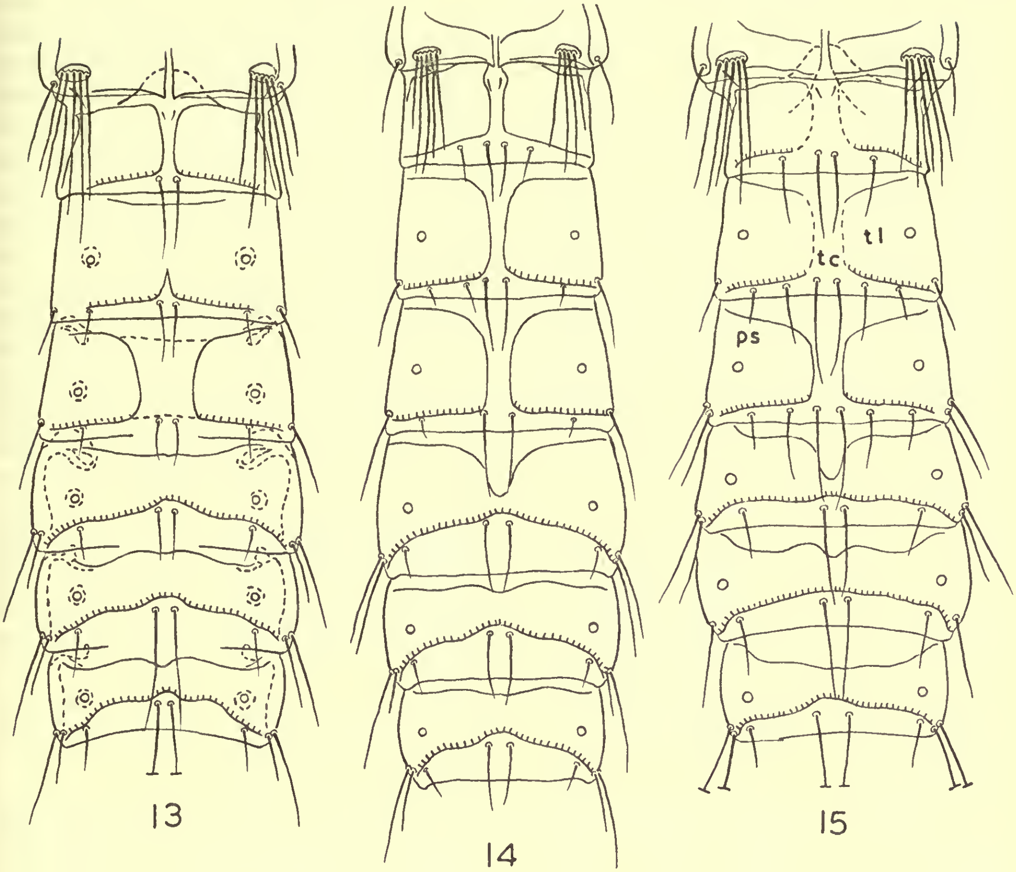
External genitalia. Male. The basal apodeme, parameres and mesosome of *signatus* and *lepidus* are essentially similar (Text-figs 48, 49); so are those of *bicolor, dissourae, senegalensis* and *castaneus* (Text-figs 50–53). The shape of the sclerotized portion of the basal apodeme is characteristic, being wider anteriorly. A distinct waist is present in these species (Text-fig. 31), as also in most others, but is less evident in *lepidus* (Text-fig. 32). The mesosome and its sclerites are short and differ in shape and proportions. The parameres are short and curved (Text-fig. 52) or almost straight (Text-fig. 50); their apical portion is membranous, and differs in proportions. In *loculator* the parameres are much as in the foregoing species, but much larger (fig. 15 in Kumar & Tandan, 1968). The mesosome is also large, its sclerotization extensive and the median ventral sclerite thereof, called for convenience lower endomere (see Clay, 1956, for terminology), is fairly long. The basal apodeme is narrow anteriorly. The apodeme of *leucosoma* is much as in *lepidus* in shape; its mesosome is long and narrow, as in *maculatus*, and related species (nos 8–10), and the posterior portion is distinctive. In *maculatus, tantali, keleri* and *asiaticus* the three main components are extremely alike, differing mainly in size (Table VII) and proportions (Text-figs 54–57). The basal apodeme of these species is much as in *bicolor* and related species, but the mesosome is much longer and so is the lower endomere, which is more heavily sclerotized also. The parameres are also relatively long (Table VII). In the thirteen foregoing species, unlike the three following ones, the paramere has a distinct hook on its inner margin near or slightly anterior to the tip (Text-figs 52, 55).

The genitalia of *hardayali* and *fissomaculatus* are similar, differing mainly in proportions (figs 20–23 in Tandan & Kumar, 1969). Their characteristic parameres and mesosome differ from the corresponding parts of the thirteen foregoing species, but the basal apodeme is narrow anteriorly, as in *loculator*.

In all the fifteen foregoing species the outer articulation of the parameres with the basal apodeme is quite distinct. But in *ciconiae* the anteriorly slightly narrow basal apodeme merges imperceptibly into the parameres (fig. 43 in Clay & Hopkins, 1950). Its mesome and parameres are extremely long and distinctive.

Female. The female genitalia do not show sharp, clear-cut differences. There are narrow supra-vulval sclerites and larger and fainter inner genital sclerites; definitions of these terms are given in Clay (1957*a* and 1962 : 162) and Dhanda (1961 : 658). In four species only, *tantali* and related forms, which are feebly sclerotized species, there is a ring-like sclerotized spermathecal calyx; but *leucosoma*, which too is feebly sclerotized, lacks a sclerotized calyx.

Chaetotaxy. Tergal. Setae always present are; on II, 2 anterior tc, usually sh otherwise ml to lg; on IX-XI, 2 anterior and somewhat lateral and 4 posterior (2 tl + 2 tc), variable in length. On II-VIII 2 central setae are always present;



FIGS 13–15. Male, pterothorax and abdomen: 13, *A. lepidus*; 14, *A. bicolor*; 15, *A. senegalensis* sp. n.

lateral setae when present vary in number. The relative lengths of tc and tl setae on VIII and of the tc setae relative to the anterior margin of tergite IX-XI and the 2 anterior tergal setae on latter are important characters, especially for the male. Unfortunately they, and the number of central and lateral setae on tergum VIII, could not be studied in all the species and in both the sexes of the same species as either the series were in poor state or the setae were broken or twisted.

In *lepidus* and *signatus* the 2 tc on VIII are much longer than the tl setae and respectively reach or extend slightly (Text-fig. 16) or well beyond the 2 anterior setae on tergite IX-XI. In *bicolor, dissourae* and *castaneus* the tc and tl setae are equal or the tc are rather shorter also. In *bicolor* the tc setae usually reach the anterior margin of this tergite (Text-fig. 11) and fall well short of the anterior setae. In male of *dissourae* the tc setae cross the anterior margin slightly or rather more (Text-fig. 9). In the female of *dissourae* and in both sexes of *castaneus* (Text-fig. 10) the condition is as in *bicolor*. In the male of *senegalensis* (Text-fig. 33) the condition is much as in *lepidus*, but in the female the tc are only slightly longer than the tl setae, and although the former cross the anterior margin of tergite IX-XI, they fall rather short of the anterior setae. In *loculator* the tc and tl setae are equal or the tc are slightly longer in the female. In the male the tc setae reach to or cross slightly this margin and fall well short of the anterior setae, but in the female these are longer and fall only slightly short of the anterior setae (Text-fig. 17). In *leucosoma* the tc are slightly longer than the tl setae (fig. 12 in Kumar & Tandan, 1968), but in their posterior extension resemble the male of *loculator*. In *tantali* and related species (nos 7, 9, 10) the tc are slightly shorter than the tl setae or both are equal; in male of *asiaticus* however, the tc are slightly longer also. In *maculatus* and *asiaticus* the tc setae extend considerably beyond the anterior margin of tergite IX-XI to fall much (Text-fig. 35) or slightly (Text-fig. 37) short of the anterior setae. In *tantali* and *keleri* (Text-fig. 36) the condition is as in the male of *dissourae*. In *fissomaculatus* the tc and tl setae are almost equal, but vary much in *hardayali*. In both species the tc setae either fall short of or just cross the anterior margin of tergite IX-XI, and fall well short of the anterior setae. In the male of *ciconiae* the tc are slightly shorter than the tl setae or both are equal; in the female the tc are rather longer. In *hopkinsi* also the tc setae are (seemingly) longer. While in *ciconiae* the tc setae reach to or even cross the anterior margin of this tergite, they fall well short of the anterior setae; and in *hopkinsi* the tc (partially broken in male, completely in female) setae cross the margin considerably in the male to (seemingly) reach the anterior setae (fig. 5 in Kumar & Tandan, 1968).

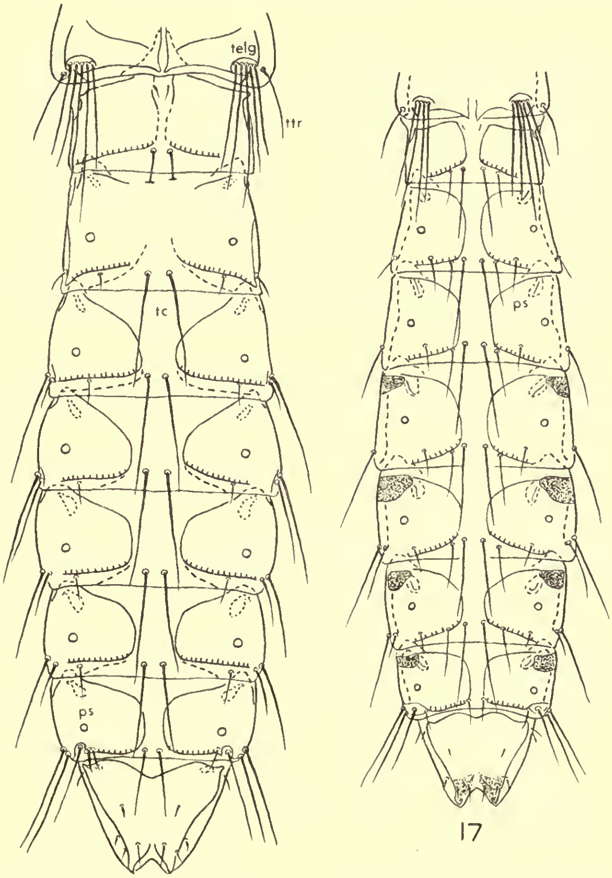
Of much taxonomic significance for the males of some species is the distance between and the proportions of the 2 central setae on tergum VIII (Table IV; Text-figs 9–11).

The definitive position of the tergal trichobothria on segment VIII is not always determinable in poorly or feebly sclerotized species, and in some well sclerotized species it is as follows:- Male. (1) In a notch of tergite: *lepidus*, *senegalensis* (probably) and *loculator* (Text-fig. 20). (2) As 1, but posterior to notch, less intense secondary sclerotization present: *fissomaculatus* (Text-fig. 23) and *hardayali*. (3) On tergite: *bicolor* (Text-fig. 22), *dissourae*, *castaneus*; probably *senegalensis*, *leucosoma*, *keleri* and *maculatus*; in *ciconiae* (Text-fig. 21) and *hopkinsi* well on tergite. Female. Always below tergite, on less intense (secondary) sclerotization. (1) In a notch: *lepidus*, *bicolor* (Text-fig. 27), *dissourae*, *loculator* (Text-fig. 25), *ciconiae* (Text-fig. 26) and *hardayali*. (2) Surrounded by sclerotization (no notch evident): *senegalensis*, *castaneus*, probably *leucosoma*, *keleri*, *fissomaculatus* (Text-fig. 24) and *hardayali*.

The 1+1 characteristic post-spiracular setae are mostly present on terga III-VII, but in *hardayali* and *fissomaculatus* on terga II-VII. Their length varies and there are no contiguous sensilli.

Pleural. On II, absent and on III, 1+1, extremely constant. On IV-V or VI the number varies greatly; on VI or VII-VIII the common number is 4+4. Absence of any great differences in the proportions and position of the pleural setae on IV and V in the female has much significance.

Sternal. This is relatively less variable. In the male sterna II and III normally have 2 sl + 2 sc setae, variable in length. Their proportions relative to each other, more especially of those on II, are important characters. Sternum IV (fig. 9 in Kumar & Tandan, 1968) has only 2 sc setae in 14 species, (nos 1–13, 15) but in *bicolor* and *leucosoma* these may be absent also. In *hardayali* and *hopkinsi* sl setae are also present on sternum IV. The sc are m or sh and usually difficult to locate, but are ml to lg in *ciconiae* (Text-fig. 28) and ml and fine in *signatus*. The sl are m in *hardayali* and lg in *hopkinsi*, (fig. 1 in Kumar & Tandan, 1968). On sternum V also 2 sc setae are present in all species, usually m or sh, as on IV, but ml in *signatus* and ml to lg in *lepidus*, and in both fine. In *hopkinsi* (lg) sl setae are also present on V, while in *ciconiae* (ml to lg) and *fissomaculatus* (m or sh) setae outer to sc setae are not strictly sl in position. Besides these normal ones, additional sp or sh setae may also be present on sterna III-V, but these have no taxonomic significance. Sternum VIII has normally 2 central lg setae in 11 species, but in the remaining 5 their number is more, thus: *signatus*, 4; *lepidus*, 5–6; *ciconiae*, 5–8 (Text-fig. 28); *fissomaculatus* 4–6; *hopkinsi*, 3 (fig. 6 in Kumar & Tandan, 1968).

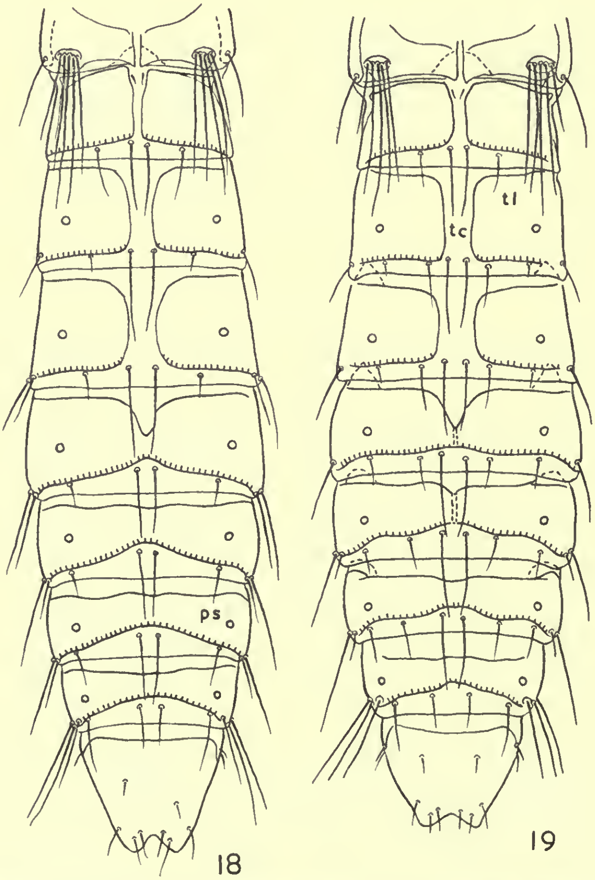


FIGS 16, 17. Female, pterothorax and abdomen: 16, *A. lepidus*; 17, *A. loculator*.

In the females of nine species the normal count of setae on sterna II and III is the same as in their males, but it differs in *signatus*, *lepidus*, *castaneus*, *ciconiae*, *hopkinsi*, *hardayali* and *fissomaculatus*. In these seven species sterna II and III either tend to or have more than 4 setae. This difference in number from the male count deserves emphasis for even striking differences have been observed in the sternal chaetotaxy of *Ardeicola* from the Threskiornithidae and these have proved to have much evolutionary significance. Sterna IV and V are like those of their males, excepting *ciconiae* in which the number and size differ. Sternum VIII always has 2 central lg setae.

In both the sexes the number varies on sterna VI and VII, but the length is usually ml to lg.

The position of the 3+3 anal setae each side relative to each other is important, unlike their proportions which differ slightly only. In the male anal seta *a* is ventral and usually the most anterior; *p* is most dorsal and both these tend to be directed posteriorly. Seta *m*, between *a* and *p*, is associated with the invagination forming



FIGS 18, 19. Male, pterothorax and abdomen: 18, *A. dissourae* sp. n., 19, *A. castaneus*.

the external genitalia and is directed more towards the midline. Except in three species, the alveolus of *m* is either slightly outer to that of *p* or the alveoli of both are in line (Text-fig. 45). In *hardayali* and *fissomaculatus* (Text-figs 46, 47), *p* is inwards and *m* is always outer. In all foregoing species the distance between *m* and *p* differs. Lastly, and only, in *ciconiae* (Text-fig. 44) *m* is inner relative to *p*. In the female of *lepidus* (Text-fig. 39) and *signatus* the alveoli of the three, inner, middle and outer, anal setae are in a straight line. In all other species the position of anal setae *i* and *o* relative to each other is more or less constant, as is also that of anal seta *m* relative to *o*; however, the position of *m* relative to seta *i* varies considerably. Seta *m* is anterior to seta *i* in *hardayali* (Text-fig. 42), but is either at same level or even slightly posterior to the latter in *ciconiae* (Text-fig. 43). Both these conditions are present in *fissomaculatus*. In all other species seta *m* is always posterior to *i*, although the difference in their levels differs (Text-figs 38, 40, 41).

In both sexes the position of the 2 setae *d* of each side relative to each other also shows slight but significant differences (Text-figs. 38–47). Further, the two groups, setae *d* and anal setae, of each side, show significant differences in position relative to each other.

On the terminal segment in the male there are each side 2–6 (total 3–11) anterior and submarginal setae. On the basis of their proportions and position these are distinguishable into three types, referred to as *a*, *p* and *v* (Text-figs 33, 36). Setae *a*, 1+1, are present in 12 species, dorsally, on or off or on edge of tergite IX-XI, ml to lg, slightly shorter and thinner than *v*. Species lacking *a* are *lepidus*, *signatus* and *castaneus*; in *dissourae a* may be present or absent. Setae *v*, 1–4 each side (total 2–8), lg, are ventro-lateral or ventral. Setae *p*, 1+1, are lateral, between *a* and *v*. These are always much shorter and finer than *v*, usually than *a* also, and unlike both are 'glassy' translucent in appearance. The proportions of *a* and *p* are taxonomically important.

In the female and present in the same position there are 1–6 each side (total 3–11) setae (Text-fig. 59). Setae *a*, 1+1, are present in all species, sh and fine, off tergite or on its edge. Setae *p*, 1+1, and *v*, 1–4 each side (total 2–7). Usually *p* and *v* are sp, but *p* may be sh also

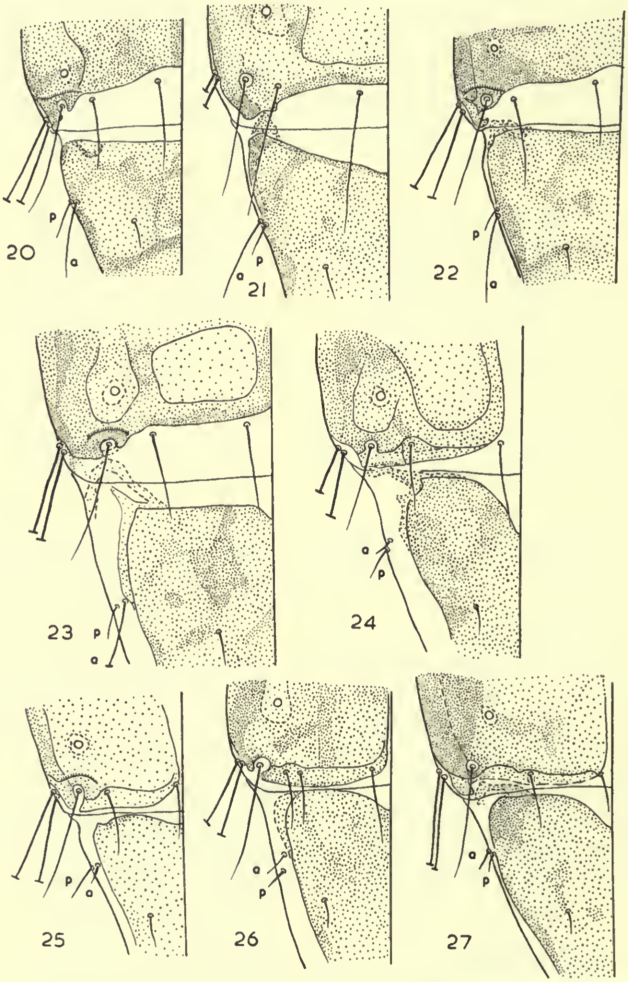
Further, posterior to these setae there are marginal and submarginal setae, usually lg in the male and sp in female. Their number is usually in the male 2–7 each side (total 4–13), exceptionally 0–1 (1–2), and in the female 3–10 (6–16) exceptionally 1–3 (4).

The species can be diagnosed by a combination of the above characters, which may therefore be considered as of specific value. Perhaps none of them is free from individual variation, which may range from slight to considerable, especially in the relative position of setae *a*, *v* and p (Text-figs 20–27, 33, 59).

The *ARDEICOLA* species of the Ciconiidae

For those homologous setae present on thorax and abdomen of all species, described as constant in the previous sections, only the length, position and deviation in number from norm have been given: the latter is expressed as one out of five, but abbreviated 1/5 for example. The 2 setae of the marginal row closest to the midline on terga II-VIII, the composite tergum IX-XI, as also on sterna II-V and sternum VIII, are distinctive and differ strikingly in shape and proportions from the lateral setae, if the latter are present. Hence following Kéler (1938: 419), the terms tergocentral, tergolateral, sternocentral and sternolateral have been used. Explanations of abbreviations used in describing the length and position of important setae in the text and figures are given on page 158.

It was not always possible to count all the setae of the number of specimens given. In such cases the sign of interrogation (?) has been used indicating that the presence or absence of the seta(e) in question remain open. No figure has been given



FIGS 20–27. Abdominal trichobothrium. 20–23, Male: 20, *A. loculator*; 21, *A. ciconiae*; 22, *A. bicolor*; 23, *A. fissomaculatus*. 24–27, Female: 24, *A. fissomaculatus*; 25, *A. loculator*; 26, *A. ciconiae*; 27, *A. bicolor*.

when the count was constant, there being no individual variation. Figures in parantheses denote the number of specimens, and x̄ denotes the mean. Measurements have usually been corrected to two decimal places. All characters discussed in the previous section have been omitted from this section. If a character agrees in the two sexes, it has been omitted from the description of the female.

Five species, *leucosoma*, *loculator* male, *hopkinsi*, *fissomaculatus* and *hardayali*, have been recently described fully (Kumar & Tandan, 1968; Tandan & Kumar, 1969) and only that information necessary for comparison with other species, and not given earlier, has been included here.

Neotypes have been designated for two species described by Nitzsch and one by Giebel; these species were based on specimens in the Nitzsch collection. It is now known that, with the exception of the material belonging to the *Goniodes*-complex and the Trichodectidae, the collection was destroyed during the 1939–1945 War.

1. ***Ardeicola lepidus*** (Nitzsch, 1866)

(Text-figs 4, 6, 7, 13, 16, 30, 39, 49; Tables I, IV)

Lipeurus lepidus Nitzsch, 1866 : 383. Host: *Anastomus coromandelicus*.

This species is closely related to *signatus* and is distinguished from it in both sexes by its larger size, wider head, proportions of the dorsal anterior plate and higher C.I., and in the male by the details of the genitalia (Text-fig. 49). There is considerable difference in the shape of the female abdominal segments IV–VII and their lateral tergites.

CHAETOTAXY. MALE (4). Inner pronotal ml to almost lg. Tergal: II, ant. tc sh to almost ml. Post. II–VII, 2 tc; VIII, 4 tl + 2 tc (2), 3+2 (1), 3+? (1); IX–XI, ant. sh, post. tl sh to ml and tc sh, tc and tl equal or tc slightly shorter; *b*, ml on tergite. Post-spiracular: III, 0+1 (1/4); III, IV, sh; V, VI, ml; VII, ml to almost lg. Pleural: IV, 4 (3), 5 (1); V, 4+4; VI, 4+4 (3), 4+3 (1); VII, 4+5 (1/4); VIII, 3+3 (1/4); *p*, sh; *v*, 2+2; marginal and submarginal, 5–7 (total 11–13). Meso- and meta-sternal, 4–5 and 4, respectively. Sternal: II, all lg, sl slightly longer than sc; III, normal (2), 4 sl + 2 sc (1), sl ml, sc sh and wide apart; VI, 8–11; VII, 10 (3); *d*, ml to lg.

FEMALE (5). Tergal: As in male but on VII, 3 tc (1); VIII, 2 tl + 2 tc (3), 4+2 (1); IX–XI, 3 tl + 2 tc (1/5), tc and tl equal or tc slightly longer; *b*, sh well away from or near edge of tergite. Post-spiracular as in male, but on VI, VII almost lg. Pleural: III, 1+? (1/5); IV, 2–4, total 5–8, x̄ 6·50 (4); V, 3–6, total 7–9, x̄ 8·60 (5); VI, 3–5, total 6–10, x̄ 8·00 (5); VII, 3+4 (1/4); *v*, 1+1 (3), 2+1 (1); marginal and submarginal, 8–10 (total 17–19). Meso- and meta-sternal 4 and 4–5 respectively. Sternal: II, all lg, 9 (1), 10 (1), 2 are sc rest sl; III, 2 sc sh (2), 2 sl + 2 sc + 1 sl (1) all sh, 9 (1) sh to ml, fine; VI, 9–10; VII, 12–14; between VII and VIII, 2–6 sh; *d*, sh to ml, 1+2 (1/4). Sp setae on or near margin of vulva, 14–15 (4 central, 5–6 (total 10–11) lateral); on sub-genital plate, 4 or more sp setae.

MATERIAL EXAMINED.

NEOTYPE ♂ of *Lipeurus lepidus* Nitzsch, from the type-host *Anastomus oscitans* (Boddaert), by present designation, slide no. 19804a, INDIA: Moirang, Manipur, 18.i.1952 (*R. Meinertzhagen*), BMNH.

Neoparatypes. 24 ♂ (4 dissected), 27 ♀ (1 dissected), same data as neotype (slide nos 4821, 9078, 19104) or from INDIA: Unao, U.P., 1949 (*B. K. Tandan*) slide no. 65), BMNH.

Table 1. Measurement in millimetres of *Ardeicola* species, mounted in Canada balsam

		Male			Female					
		lepidus (4)		*signatus*(1)	*lepidus* (4)		*signatus* (2)		*loculator* (2)	
		Range	Mean		Range	Mean	Range	Mean	Range	Mean
Head	L	0.73-0.76	0.75	0.73	0.76-0.83	0.80	0.80, 0.82	0.810	0.93, 0.94	0.935
	L_1	0.35-0.37	0.36	0.37	0.39-0.43	0.40	0.43, 0.46	0.445	0.48, 0.51	0.495
	L_2	0.36-0.41	0.39	0.36	0.37-0.41	0.40	0.37, 0.36	0.365	0.43, 0.44	0.435
	B	0.46-0.48	0.47	0.42	0.51-0.60	0 54	0.46, 0.47	0.465	0.58, 0.59	0.585
Prothorax	L	0.18-0.21	0.19	0.14	0.19-0.21	0,20	0.15, 0.14	0.145	0.19, 0.21	0.200
	B	0,35-0.39	0.36	0.33	0.39-0.43	0.42	0 36, 0.37	0.365	0.41, 0.43	0.420
Pterothorax	L	0.40-0.42	0.41	0.35	0.37-0.42	0.40	0.36, 0.37	0.365	0.41, 0.44	0.425
	B	0.48-0.53	0.50	0.44	0.60-0.65	0.62	0.47, 0.46	0.465	0.57, 0.62	0.595
Abdomen	L	1.66-1.74	1.69	1.73	2.16-2.37	2.25	2.09, 2.13	2.110	2.70, 2.84	2.770
	B	0.50-0.57	0.53	0.50	0.66-0.71	0.69	0.61, 0.54	0.575	0.76, 0.82	0.790
	T.l.	3.00-3.13	3.07	2.95	3.50-3.79	3.67	3.40, 3.46	3.430	4.25, 4.44	4.345
	C.l.	0.61-0.64	0.62	0.57	0.62-0.73	0.67	0.57, 0.58	0.575	0.61, 0.62	0.615

L, length; L_1, length of preantennal region; L_2, length of postantennal region; B, breadth; T. l., total length; C. l., head index.

2. *Ardeicola signatus* (Piaget, 1880)

(Text-figs 5, 29, 48; Tables I, IV)

Lipeurus signatus Piaget, 1880 : 310, pl. 25, fig. 7. Host: *Anastomus lamelligerus*.

The available specimens of *signatus*, which include the original Piaget material also, are of suboptimal quality and unfit for a critical study, hence the setal count of many was not possible to determine. Its difference from *lepidus* are given under the latter species.

CHAETOTAXY. MALE (1). Inner pronotal ml. Tergal: II, ant. tc ml. Post. On II–VII, IX–XI, and post-spiracular as in *lepidus*, but latter on VI, 1+2 and lg, VIII, 3 tl + 2 tc. Pleural: IV, 4; V, 4+3; VI, 8; *p*, 1+0 ml; *v*,2+2; marginal and submarginal, 5+5. Meso- and meta-sternal, 4 and 4 or 5, respectively. Sternal: II, all lg, sc and sl almost equal in length; III, sl ml, sc sh; VI, 10; VII, 11; *d*, ml to lg.

FEMALE (2). Inner pronotal slightly longer than in male. Tergal: II, ant. tc ml to lg. Post. II–VII as in *lepidus*; VIII, 3 and 4 tl + 2 tc; IX–XI, ant. 1 + 0 (1/2), post., ml all asymmetrical, tl very slightly longer than tc; *a*, 0+1 (1/2); *b*, sh. Post-spiracular: III, ml; IV, ml to almost lg; V, almost lg; VI, almost lg to lg; VII, lg. Pleural: IV, 8, 7; V, 7, 9; VI; 8, 9; VII, 5+5, 5+3; VIII, 4+2 (1/2); *p*, 1+0 (1); *v*, 4, 2; marginal and submarginal, 7+4, 8+7. Meso- and meta-sternal, 3, 5 and 4, respectively. Sternal: II, 8 (1) all lg; III, 5 sh fine; VI, 11; VII, 11, 12; between VII and VIII, 2 lg; *d*, ml to lg. Sp setae on or near margin of vulva, 19 (6 central, 6–7 (total 13) lateral); on sub-genital plate, 9–10 sp setae.

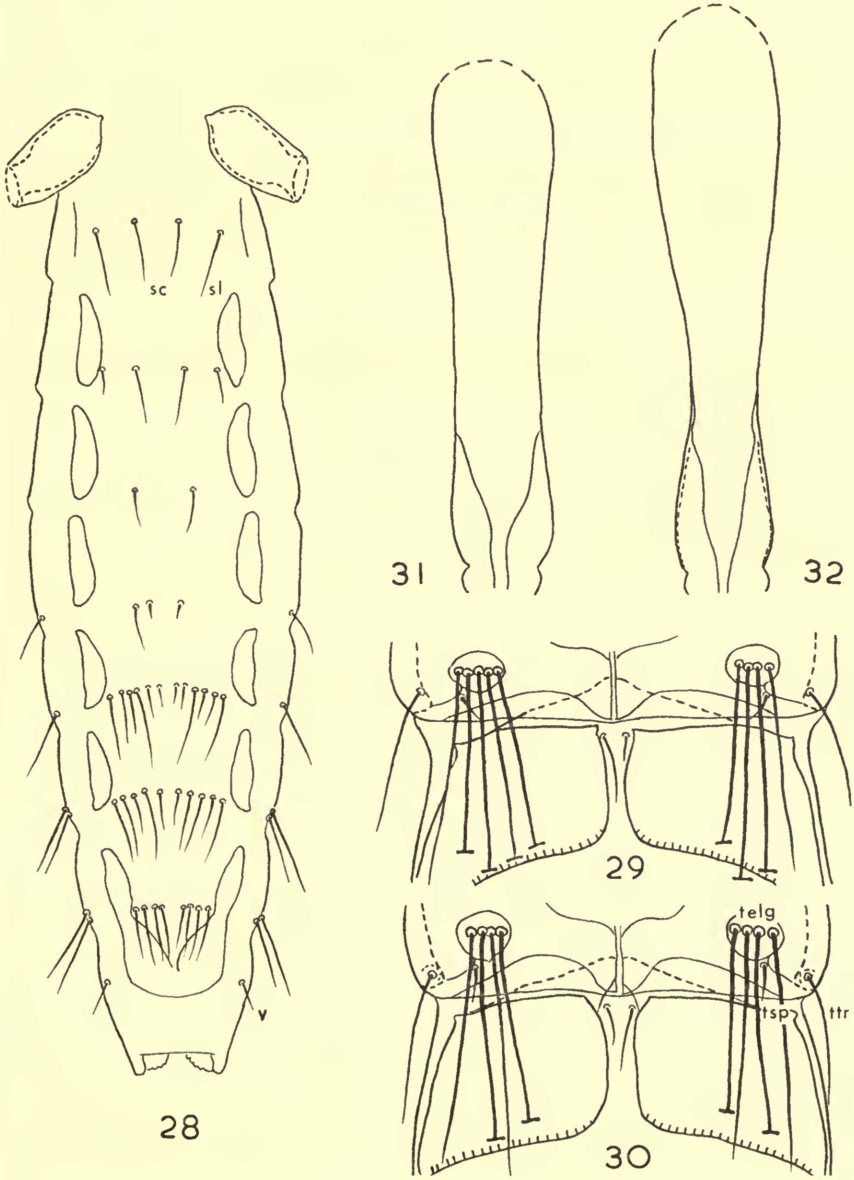
In the female most of the head and thoracic setae are longer than the same ones in the male, and those of both sexes are slightly longer than in *lepidus*.

MATERIAL EXAMINED.

Piaget's syntypes: 2 ♂, 3 ♀ (no locality) from *Anastomus lammelligerus*.

LECTOTYPE ♂ of *Lipeurus signatus* Piaget, by present designation, slide no. 915, BMNH.

Paralectotypes. 1 ♂, 3 ♀, slides nos 915, 914, BMNH.



FIGS 28–32. 28–30, *A. ciconiae*: 28, Male, abdomen, ventral (anal setae and setae in genital region not shown); 29, 30, posterior pteronotal setae and abdominal segment II, male: 31, 32, Basal apodeme: 31, *A. signatus*; 32, *A. lepidus*.

Other material. From *Anastomus l. lamelligerus* Temminck, Kenya: 1 ♂, 2 ♀, iv. 1936 (*R. Meinertzhagen*, 7608), BMNH.

The four species to follow (3–6) are closely related. This is indicated by their general habitus, shape of tergites, especially the deep incision in the anterior margin of tergite V in the male and of the slight to greater emargination in the anterior margin of tergite IX-XI in the female, and the basically similar male external genitalia.

Ardeicola bicolor is more closely related to *dissourae* and both are readily separated from *senegalensis* and *castaneus* by the tergal chaetotaxy.

3. ***Ardeicola dissourae*** **sp. n.**

(Text-figs 2, 9, 18, 45, 50; Tables II, IV)

Type-host: *Dissoura episcopus microscelis* (G. R. Gray).

The species on the African subspecies of *D. episcopus* is not *castaneus* (Piaget) but a new form here described.

A. dissourae is distinguished from *bicolor* by its slightly larger average size (Text-fig. 1) and shape of head and terminalia; in the male by the relatively narrow and shallow incision in the anterior margin of tergite V, the 2 considerably thicker and somewhat longer tc setae on VIII (Text-figs 9 and 11) and details of the mesosome; and in the female by the wider genital opening, the less pronounced curvature of the vulva and the general shape of supra-vulval sclerites.

Chaetotaxy. Male (6). Inner pronotal almost lg to lg. Telg setae, 5+6 (1/6). Tergal: II, ant. tc sh. Post. II, 2 tl + 2 tc (3), 1+2 (2), 1 tl (1) as setae short?; III, 2 tc (5) and ? (1); IV–VII, 2 tc (on V adjoining the tc 1 m also in 1 male); VIII, 2 tl + 2 tc (4) and 2 + 1 (2) as 1 tc ?; the 2 tc close together (Table IV) as in *bicolor*, but thicker and longer; IX–XI, ant. sh, post. ml or tc lg also and slightly longer than tl; *a*, almost lg to lg, 1+1 (1), 0+1 (1), 0 (3); *b*, ml to almost lg, well on tergite. Post-spiracular: on II, 1+0 (1/6); III, IV, sh; V, sh to ml; VI, ml; VII, lg. Pleural: IV, 3–4, total 6–7, $\bar{x}$ 6·16 (6), 3+3 (5/6); V, 3–4, total 6–8, $\bar{x}$ 6·50 (6), 3+3 (4/6); VI, 3–4, total 6–8, $\bar{x}$ 7·66 (6), 4+4 (5/6); *p*, normally sh or ml also; *v*, 2–4; marginal and submarginal, 1–2 (total 2–4). Mesosternal, 2 (3), 3 (2); metasternal, 1+1. Sternal: II, all lg, normal (5), sl longer than sc; III, sl usually sh fine or ml to lg also, sc sh to almost ml; VI, 5–7; VII, 6–8; *d*, ml to lg.

Female (10). Inner pronotal sh to almost ml. Tergal: II, 2 tl + 2 tc (6), and 2+0 (1), 1+0 (1), 1+1 (1) as seate short ?; III–V (10) and VI, VII (9), 2 tc; VIII, 2 tl + 2 tc (8), 3+2 (1), 2+? (1); IX–XI, ant. sh, post. sh to ml, tl longer than tc; *b*, sh off tergite or near its edge. Post-spiracular: III (1/10), VII (1/10), 1+0; in same female, III, IV, 0, and V, 1+0; III, sh to almost ml; IV, V, sh to ml; VI, ml to lg; VII, lg. Pleural: IV, 2–4, total 5–8, $\bar{x}$ 6·80 (10); V, 3–6, total 6–11, $\bar{x}$ 7·20 (10), 4+4 (3/10); VI, 4+4 (9), total 7–8, $\bar{x}$ 7·90 (10); VII, 3+4 (2/10); *p*, 0+1 (1/10); *v*, 2–4 (7), 0–1 (2); marginal and submarginal, 1–5 (total 4–9). Mesosternal, 2 (4), 3 (5), 4 (1); metasternal, 2 (5), 3 (2); on both 1+1 (3). Sternal: II, sl much longer than sc, 3 sl + 2 sc (1) as 1 extra ml sl on one side; III, sl ml to lg, sc sh to ml; VI, VII, 6–8; between VII and VIII, 1–3 sh; *d*, ml to lg. Sp setae on or near margin of vulva, 17–21 (4–8 central, 5–8 (total 10–13) lateral); on sub-genital plate, 4–6 sp setae.

Width of genital opening 0·232–0·245 mm, $\bar{x}$ 0·238 (7); curvature of vulval margin less pronounced.

Material examined.

Holotype ♂, from *Dissoura episcopus microscelis* (G. R. Gray), slide no. 4814a, Sudan (*R. Meinertzhagen*), BMNH.

Paratypes. Some data as holotype, 5 ♂ (1 dissected), 10 ♀, BMNH.

Table II. Measurements in millimetres of Ardeicola species mounted in Canada balsam

		Male						Female			
		dissourae (6)			senegalensis (6)			dissourae (10)		senegalensis	
		Range	Mean	Holotype	Range	Mean	Holotype	Range	Mean	Paratypes	Mean
Head	L	0.75-0.77	0.76	0.76	0.84-0.87	0.86	0.86	0.79-0.87	0.83	0.89, 0.90	0.895
	L_1	0.37-0.41	0.40	0.41	0.43-0.46	0.44	0.45	0.41-0.46	0.43	0.47, 0.48	0.475
	L_2	0.35-0.37	0.36	0.35	0.41-0.43	0.42	0.41	0.37-0.41	0.40	0.42, 0.42	0.420
	B	0.43-0.44	0.43	0.44	0.50-0.53	0.51	0.51	0.46-0.50	0.47	0.54, 0.55	0.545
Frothorax	L	0.17-0.18	0.17	0.18	0.19-0.22	0.21	0.19	0.17-0.19	0.18	0.21, 0.20	0.205
	B	0.32-0.33	0.32	0.33	0.40-0.41	0.40	0.40	0.32-0.39	0.36	0.41, 0.43	0.420
Pterothorax	L	0.40-0.41	0.40	0.41	0.39-0.41	0.40	0.39	0.37-0.44	0.41	0.43, 0.42	0.425
	B	0.43-0.46	0.44	0.43	0.53-0.57	0.54	0.53	0.50-0.57	0.53	0.58, 0.59	0.585
Abdomen	L	1.77-1.88	1.83	1.88	1.73-1.99	1.87	1.87	2.28-2.72	2.48	2.49, 2.53	2.510
	B	0.48-0.53	0.51	0.53	0.54-0.58	0.57	0.56	0.59-0.69	0.65	0.66, 0.71	0.680
	T. l.	3.14-3.24	3.19	3.24	3.18-3.47	3.32	3.31	3.70-4.20	4.01	4.02, 4.06	4.040
	C. I.	0.51-0.58	0.56	0.58	0.58-0.60	0.59	0.59	0.56-0.60	0.58	0.60, 0.61	0.605

L, length; L_1, length of preantennal region; L_2, length of postantennal region; B, breadth; T l., total length; C. I, head index

4. *Ardeicola bicolor* (Piaget, 1888)

(Text-figs 3, 11, 14, 22, 27, 51; Tables III, IV)

Lipeurus bicolor Piaget, 1888 : 157, pl. 4, fig. 1. Host: *Tantalus senegalensis*. [Error.]

Piaget gave *Tantalus* (= *Ephippiorhynchus*) *senegalensis* as the host of *bicolor* and in the check list (Hopkins & Clay, 1952) also this bird is given as its host. But later Hopkins & Clay (1953 : 447) changed the host to *Sphenorhynchus abdimi*, and after examining the syntypes and series from *S. abdimi* we agree with them in regarding *S. abdimi* as the type-host of *bicolor*.

In 2 males and 2 females of *bicolor*, out of 7 and 13 respectively (excluding the syntypes), tergum III has besides the 2 tc setae, 1 tl seta also which closely resembles in proportions the 2 tl setae on tergum II. Whereas in 5 males out of 6 (1 being unfit for counting) and all the 10 females of *dissourae* tergum III has only 2 tc setae. Thus, the average number of setae on tergum III is greater in *bicolor* than in *dissourae*. This difference, even in the small numbers examined, with other differences shows the populations of *Ardeicola* on *S. abdimi* and *D. episcopus microscelis* to be distinct.

CHAETOTAXY. MALE (7). Inner pronotal ml. Telg setae, 5+4 (1/6). Tergal: II, ant. tc sh. Post. II, 2 tl + 2 tc (6) and 2 tc (1) as tl ?; III, 2 tc (5), 1 tl + 2 tc (2); IV–VII, 2 tc; VIII, 2 tl + 2 tc, the 2 tc close together (Table IV); IX–XI, ant. sh, post ml, tc and tl equal or tc slightly longer; *a*, 0+1 (2), 1+1 (3) almost lg to lg; *b*, sh to lg, on tergite, of two sides may be asymmetrical, 1+0 (1/5). Post-spiracular: III, sh; IV, sh to ml; V, VI, ml; VII, almost lg. Pleural: IV, 2–4, total 5–8, $\bar{x}$ 6·66 (6); V, 3–4, total 6–8, $\bar{x}$ 6·66 (6); VI, 4+4 (5), 2+4 (1); VII, 4+2 (1/6); VIII, 3+2 (1/6); *p*, sh fine; *v*, 1–2 (total 3–4); marginal and submarginal, 2–3

Table III. Measurements in millimetres of Ardeicola species mounted in Canada balsam

		Male				Female			
		bicolor (5)		castaneus (8)		bicolor (12)		castaneus (9)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Head	L	0.74-0.78	0.76	0.76-0.83	0.80	0.76-0.86	0.83	0.82-0.86	0.83
	L_1	0.39-0.41	0.40	0.40-0.43	0.41	0.41-0.44	0.43	0.41-0.44	0.43
	L_2	0.35-0.37	0.36	0.35-0.40	0.39	0.35-0.41	0.40	0.39-0.43	0.40
	B	0.42-0.43	0.42	0.44-0.47	0.46	0.43-0.48	0.46	0.48-0.51	0.50
Prothorax	L	0.14-0.19	0.17	0.14-0.18	0.15	0.15-0.21	0.18	0.15-0.19	0.17
	B	0.30-0.35	0.32	0.33-0.36	0.35	0.33-0.36	0.35	0.36-0.40	0.38
Pterothorax	L	0.36-0.42	0.39	0.36-0.43	0.40	0.39-0.44	0.42	0.37-0.41	0.39
	B	0.42-0.47	0.44	0.43-0.48	0.46	0.46-0.55	0.50	0.48-0.55	0.51
Abdomen	L	1.77-1.91	1.84	1.69-1.88	1.74	2.06-2.63	2 48	2.30-2.54	2.43
	B	0.42-0.50	0.46	0.48-0.55	0.50	0.44-0.58	0.52	0.59-0.71	0.65
	T l.	3.02-3.25	3.17	2.96-3.20	3.10	3.35-4.08	3.87	3.73-4.01	3.82
	C.I.	0.55-0.57	0.56	0.55-0.60	0.58	0.55-0.59	0.57	0.57-0.61	0.59

L, length; L_1, length of preantennal region; L_2, length of postantennal region; B, breadth; T.l., total length; C.I., head index

(total 4–6). Mesosternal, 2 (4), 2+1 and 0 (2); metasternal, 2. Sternal: II, all lg, normal (2), 3 sl + 2 sc (1), sl usually much otherwise slightly longer than sc; III, sl ml fine, sc sp or sh; VI, VII, 6–8; *d*, sh to almost lg.

FEMALE (13). Inner pronotal, sh to ml. Telg setae, 5+4 (1/10). Tergal: II, 2 tl + 2 tc (9); III, 2 tc (11), 1 tl + 2 tc (2); IV–VII, 2 tc; VIII, 2 tl + 2 tc (8), 3+2 (2); IX–XI, ant. 0+1 (1) and post. sh, tl on edge of or on tergite; *b* sh or sp off tergite; a seta like *b* may be present anterior to it on one side. Post-spiracular as in male, but on IV, sh and on V, sh to ml. Pleural: IV, 3–4, total 6–8, $\bar{x}$ 7·60 (10), 4+4 (8); V, 3–5, total 7–9, $\bar{x}$ 8·00 (10), 4+4 (8); VI, 4+4; *v*, 1–3 (total 3–6); marginal and submarginal, 3–6 (total 7–11). Meso- and meta-sternal, 0–2 (total 1–4); on both, 1+1 (1/3). Sternal. II (6), III (4), VI and VII as in male, but on II sl and sc equal or sl slightly longer, on III sl lg and sc sh, on VII also 9, and between VII and VIII, 1–2 ml; *d*, ml to lg. Sp setae on or near margin of vulva 14–21 (4–9 central, 4–7 (total 8–14) lateral); on sub-genital plate, 4–7 m setae.

Width of genital opening 0·209–0·216 mm, $\bar{x}$ 0·212 (7); curvature of vulval margin pronounced.

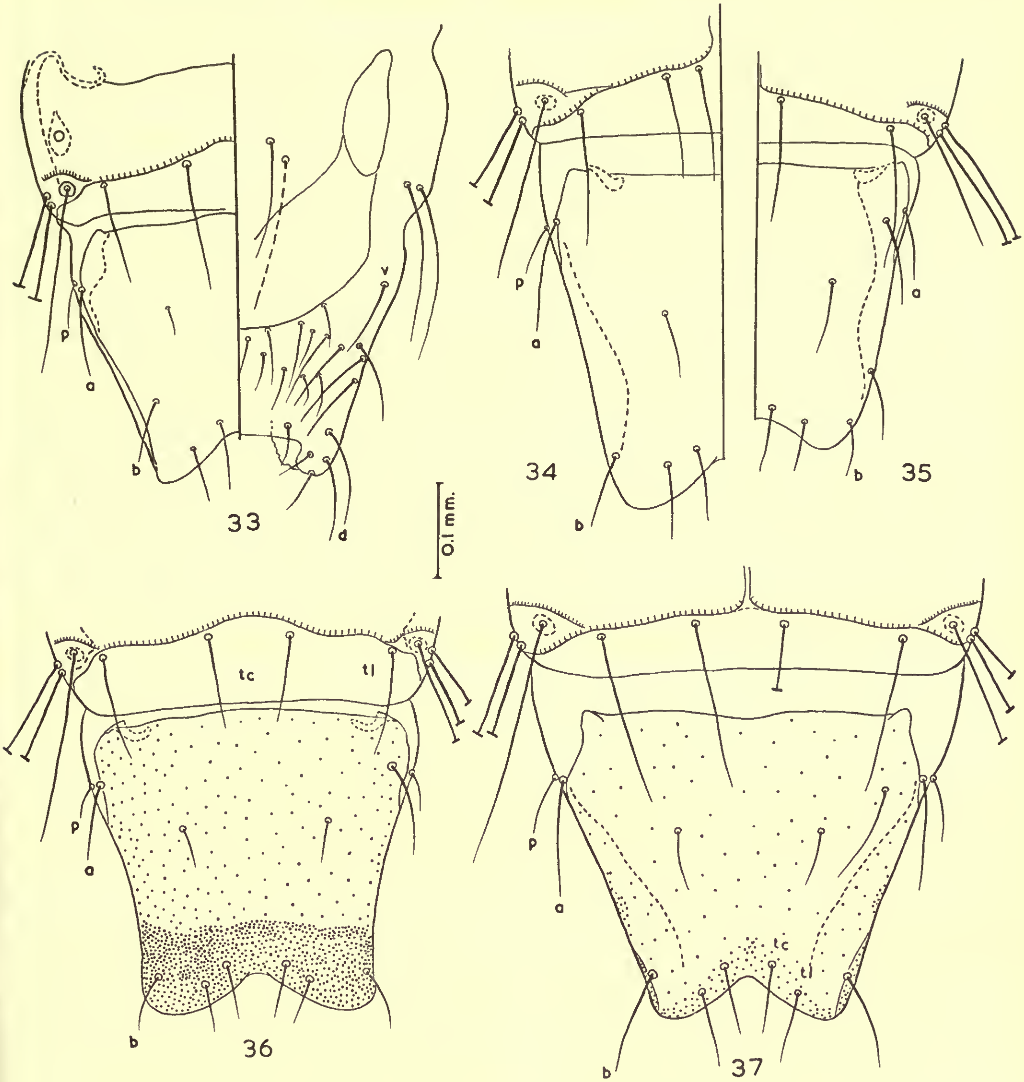
MATERIAL EXAMINED.

Piaget's syntypes: 2 ♂, 4 ♀ (no locality) of which the given host, *Tantalus senegalensis*, is wrong.

LECTOTYPE ♂ of *Lipeurus bicolor* Piaget, by present designation, slide no. 795, BMNH.

Paralectotypes of *Liperuus bicolor* Piaget, 1 ♂ 4 ♀, slides nos 795, 796, data as above, BMNH.

From the type-host, *Sphenorhynchus abdimi* (Lichtenstein), 6 ♂, 10 ♀, KENYA, CAMEROONS (Zoo) and N. RHODESIA (now ZAMBIA), BMNH. 1 ♂, 3 ♀, SUDAN, ETHIOPIA, U.S. National Museum, Washington, D.C.



FIGS 33–37. Male terminalia: 33, *A. senegalensis* sp. n. (tc seta on VIII on right-hand side shown by broken line); 34, *A. tantali*; 35, *A. maculatus*; 36, *A. keleri* sp. n.; 37, *A. asiaticus* sp. n.

5. *Ardeicola senegalensis* sp. n.

(Text-figs 15, 33, 38, 52; Tables II, IV)

Type-host: *Ephippiorhynchus senegalensis* (Shaw).

A. senegalensis is at once distinguished from *castaneus* by its tergal chaetotaxy. Other differences are in the size of the body, in the male in the distance between the 2 tc setae on VIII

(Table IV) and their proportions, shape of anterior margin of tergite IX–XI, and in the proportions of posterior sclerites of external genitalia, and in the female (perhaps) in the shape of supra-vulval sclerites.

CHAETOTAXY. MALE (6). Inner pronotal ml. Telg setae, 5+6 (1/6). Tergal: II, ant. tc sh. Post. II, 2 tl + 2 tc (5), and 2 tc (1) as tl?; III, 2 tl + 2 tc; IV, as on II; V–VII, 2 tc; VIII, 2 tl + 2 tc (4), 3+2 (2), the 2 tc setae thicker and much longer than in *castaneus*, (Text-figs 10, 33) and the distance separating them is the maximum among the four related species (Table IV); IX–XI, ant. sh, post ml, 3 tl + 2 tc (1/6); *a*, 1+1 lg; *b*, lg well on tergite. Post-spiracular: III, IV, ?+1 (1); III, IV, sh; V, ml; VI, ml to lg; VII, almost lg to lg. Pleural: IV, 2–4, total 5–8, x̄ 6·83 (6), 4+4 (3); V, 4+4 (5), 3+3 (1), x̄ 7·66 (6); VI, 4+4; *p*, 1+1 ml to almost lg; *v*, 2+2 (5), 1+1 (1); marginal and submarginal, 2–4 (total 5–7). Mesosternal, 4 (5) 3+2 (1); metasternal, 4 (4), 5 (2); on both 2+2 (3/6). Sternal: II, sl lg, sc almost lg to lg, slightly or rather longer than sc, normal (4), 1 and 3 sl + 2 sc (2); III, sl ml to lg, sc sp or (5); VI, 6–8; VII, 7–8; *d*, sh to lg.

FEMALE (2). Count of *allotype* given first, of *paratype* next, if different in the two. II, ant. tc sh. Post. II, 4 tl + 2 tc, 3 or 4+2; III, 2 tl + 2 tc, 2+1 as 1 tc ?; IV, 2 tl + 2 tc; V–VII, 2 tc; VIII, 4 tl + 2 tc, 2+2; IX–XI, ant. and post. sh, both rows asymmetrical; *a*, sh; *b*, sh on edge of tergite. Post-spiracular: as in male, but on VI, ml, and VII ml to lg. Pleural: IV, 4+3, 4+2; V, 4+4, 4+5; VI, 5+4, 4+5; *v*, 2, 4; marginal and submarginal, 9. Meso- and meta-sternal, 2+2. Sternal: II, all lg, 2 sl + 2 sc, 3+2, sl and sc about equal or sl slightly longer; III, all ml, sl and sc about equal; VI, 6, 4; VII, 6, 8; between VII and VIII, 5, 6, ml; *d*, ml. Sp setae on or near margin of vulva, 14, 20; on sub-genital plate, 5–8 sp setae.

MATERIAL EXAMINED.

Holotype ♂, from *Ephippiorhynchus senegalensis* (Shaw), slide no. 708, ZAMBIA: Luangwa Valley, Npika (*W. Büttiker*) BMNH.

Paratypes. 4 ♂, 2 ♀ from the same host-individual (*W. Büttiker*, 657); 1 ♂, SUDAN (*R. Meinertzhagen*, 4807), BMNH.

Table IV. Distance in millimetres between the two tergocentral setae on VIII in males of *Ardeicola* species.

Species	Range	Mean
lepidus	0.016-0.033	0.023 (3)
signatus	0.033 (1)	
bicolor	0.023-0.049	0.034 (4)
dissourae	0.026-0.039	0.032 (5)
senegalensis	0.095-0.114	0.102 (5)
castaneus	0.059-0.095	0.082 (4)

6. ***Ardeicola castaneus*** (Piaget, 1885)

(Text-figs 10, 19, 53; Tables III, IV)

Probable host: *Dissoura episcopus neglecta* Finsch.

Lipeurus castaneus Piaget, 1885 : 62. Host: *Ciconia leucocephala.*
Degeeriella episcopi Qadri, 1936 : 643, fig. 4. Host: *Dissoura episcopa.*

Lipeurus castaneus was described from *Ciconia leucocephala* = *Dissoura episcopus.* Specimens of *Ardeicola* have been examined from two subspecies of *D. episcopus*, the African *microscelis* and Eastern *episcopus*, and prove to differ specifically. It is necessary therefore to determine which of the two races is the true host of *castaneus.* Dr Theresa Clay has kindly examined the two females (segments II, III of one being damaged) in the British Museum (Nat. Hist.) collections, perhaps the original specimens of Piaget, and finds that there are 4 (2 central + 2 lateral) tergal setae on some abdominal segments, apart from II. The count of tl setae is: III (1), IV (1), V (2), VII (1), 2; IV (1), VI (2), VII (1), ?+1. As 4 (2 tl + 2 tc) setae are not present on segments III-VII in *Ardeicola* from *D. e. microscelis*, this as the host of *castaneus* is ruled out. But 4 tergal setae are present on segments III-VII in *Ardeicola* from *D.e. episcopus*, so that either this or some other Eastern subspecies, probably *neglecta*, is the true host of *castaneus.*

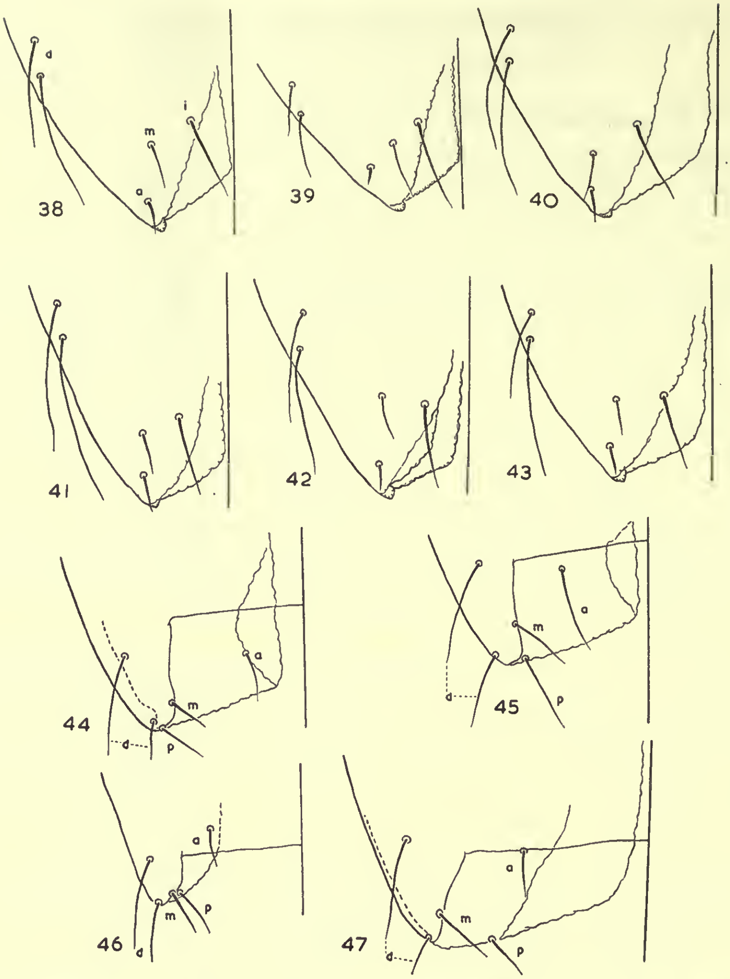
CHAETOTAXY. MALE (8). Inner pronotal ml. Telg setae, 5+4 (1), 4+6 (1), and 1 tsp + 2 ttr + 5+3 telg (1). Tergal: II, ant. tc sh. Post. II (8), III (4), IV (6), V (5), VI (3), VII (5), 2 tl + 2 tc, and in rest on III–VII, 0 or 1 tl + 2 tc as 1 or 2 tl ?; VIII, 2 tl + 2 tc (7), 1+2 (1), the 2 tc setae relatively thin, as in *bicolor*, but wide apart (Table IV); IX–XI, ant. sh, post. ml; *a*, absent (the lateral or dorso-lateral seta near *v* is interpreted as *p* on the basis of its proportions); *b*, ml on or off tergite. Post-spiracular: III, m to sh, 1+1 (only 1/8); IV, sh, 1+1 (4/8); in remaining 7 on III, and in 4 on IV, either 1 or none apparent; V–VIII, 1+1; V, sh; VI, sh to ml; VII, almost ml to lg. Pleural: IV, 2–4, total 4–7, $\bar{x}$ 5·87 (8), 3+3 (4); V, 3–4 total 6–8, $\bar{x}$ 5·62 (8), 3+3 (5); VI, 4+4; *p*, normally sh or ml also, fine; *v*, 2–3 (6), 1+0 (1); marginal and submarginal, 1–3 (total 2–5). Meso- and meta-sternal, 2 (5), 3–4 (3); on both 1+1 (3/8). Sternal. II, almost lg, sl slightly longer than sc, normal (5), 3 sl + 2 sc (1); III, sl ml to lg, sc sh; VI, 6–8; VII, 7–9; *d*, ml to almost lg.

FEMALE (9). Inner pronotal sh. Tergal: II, ant. tc m or sh. Post. II (7), III (7), IV (5), V (6), VI (3), VII (6) 2 tl + 2 tc, and in rest as in male; VIII, 2 tl + 2 tc (8), 1+2 (1); IX–XI, ant. sh and post ml; *a*, 0 (2), 1 (2); *b*, sh slightly removed from edge of tergite, 0+1 (1/9). Post-spiracular: III, sh, 1+1 (only 1/9); IV, sh, 1+1 (5/9); in remaining 8 on III, and in 4 on IV, either 1 or none apparent; V (7), VI (8), sh, 1+1, and respectively in remaining 2 and 1 only 1 apparent; VIII, sh to ml, 1+1. Pleural: III, 1+2 (1/8) IV, 2–4, total 5–8, $\bar{x}$ 6·62(8), 3+3 (2); V, 3+3 (3), 4+4 (5), $\bar{x}$ 7·25 (8); VI, 4+4; VIII, 3+4 (1/8); *v*, 2–3 (5), 0+1 (1); marginal and submarginal, 3–5 (total 7–9). Mesosternal, 2 (5), 3–4 (4); metasternal, 2 (1), 3–4 (6). Sternal: II, sl lg, sc usually lg or sh also, sl slightly or rather longer than sc, normal (3), 3 sl + 2 sc (2), 4+2 (3); III, sl lg, sc sh to ml, normal (6), 4 sl + 2 sc (1); VI, 7–9; VII, 6–8; between VII and VIII, 2–4 sh; *d*, sh to lg. Sp setae on or near margin of vulva, 13–22 (5–9 central, 3–7 (total 8–14) lateral); on sub-genital plate, 4–8 sp setae.

MATERIALS EXAMINED

Piaget's syntypes, 2 ♀ (no locality) from *Ciconia leucocephala* = *Dissoura episcopus neglecta.*

LECTOTYPE ♀ of *Lipeurus castaneus* Piaget, by present designation, slide no. 1088, BMNH.



FIGS 38–47. Anal setae. 38–43, Female: 38, *A. senegalensis* sp. n.; 39, *A. lepidus*; 40, *A. maculatus*; 41, *A. hopkinsi*; 42, *A. hardayali*; 43, *A. ciconiae*. 44–47, Male: 44, *A. ciconiae*; 45, *A. dissourae* sp. n.; 46, *A. hardayali*; 47, *A. fissimaculatus*.

Paralectotype ♀. Mounted on same slide as lectotype, BMNH.

Other material. 8 ♂, 9 ♀, from *Dissoura e. episcopus* (Boddaert), BURMA (*R. Meinertzhagen*, 4811), BMNH.

The four species to follow (7–10), of which the series are below optimal quality, are closely related. Their males can be distinguished from each other by a combination of some or all of the following characters: (1) degree of sclerotization and colour pattern of the dorsum; (2) shape of head and terminalia; (3) proportions of the components of the genitalia, especially the length of the parameres and lower endomere of the mesosome (Table VII); (4) length and/or proportions of setae *a* and *p*; (5) length of post-spiracular setae and anterior tc setae on II and anterior tergals on IX-XI; (6) relative lengths of tc and tl setae on VIII, (7) of sl and sc setae on II and III; (8) number and average of pleural setae on III-VI. Their females are less easily separable by characters 1, 2, 5, 7 and 8.

In these forms other non-sexual characters show slight differences only. As terga II–VII normally have 4 posterior (2 tl + 2 tc) setae, only the deviation therefrom has been given in the descriptions. Whether it is real or apparent could not always be determined due to the poor state of the specimens. For the same reason the nature of tergal thickening VIII and proportions of tergal setae on this segment in the male, and the shape of supra-vulval sclerites in the female, could not be determined precisely. A study of these characters in good series is most essential.

7. ***Ardeicola maculatus*** (Nitzsch, 1866)

(Pl. I, fig. 1; Pl. II, fig. 5; Text-figs 12, 35, 40, 57; Tables V, VII)

Lipeurus maculatus Nitzsch, 1866 : 383. Host: *Ciconia nigra.*
Lipeurus variegatus Neumann, 1912 : 381, figs 27, 28. Host: *Ciconia nigra* and other birds.

Figure 27 in Neumann (1912) is of a nymph, and fig. 28 suggests it to have been a third instar nymph of the species named by him as *Lipeurus variegatus.*

Table V. Measurements in millimetres of *Ardeicola* species mounted in Canada balsam.

		Male					Female			
		maculatus (6)		keleri (7)			maculatus (4)		keleri (8)	
		Range	Mean	Range	Mean	Holotype	Range	Mean	Range	Mean
Head	L	0.95-1.00	0.97	0.87-0.91	0.89	0.89	1.04-1.07	1.05	0.91-1.01	0.95
	L_1	0.48-0.54	0.52	0.51-0.54	0.52	0.52	0.54-0.58	0.55	0.54-0.59	0.57
	L_2	0.43-0.47	0.45	0.36-0.39	0.37	0.37	0.48-0.51	0.50	0.37-0.42	0.38
	B	0.57-0.61	0.58	0.50-0.55	0.53	0.50	0.61-0.65	0.63	0.57-0.62	0.60
Prothorax	L	0.21-0.24	0.22	0.18-0.21	0.19	0.21	0.22-0.24	0.23	0.19-0.22	0.22
	B	0.46-0.48	0.47	0.36-0.43	0.40	0.36	0.48-0.51	0.50	0.40-0.47	0.44
Pterothorax	L	0.46-0.53	0.50	0.40-0.46	0.43	0.40	0.51-0.55	0.53	0.42-0.50	0.47
	B	0.60-0.64	0.62	0.43-0.64	0.55	0.43	0.59-0.69	0.64	0.57-0.69	0.65
Abdomen	L	2.39-2.60	2.48	1.94-2.19	2.05	2.05	3.22-3.33	3.26	2.78-3.03	2.93
	B	0.71-0.75	0.72	0.57-0.66	0.61	0.58	0.83-0.86	0.84	0.65-0.84	0.75
	T. l.	4.07-4.25	4.16	3.42-3.73	3.58	3.54	5.02-5.19	5.09	4.33-4.73	4.58
	C. I.	0.59-0.62	0.60	0.56-0.62	0.58	0.61	0.57-0.61	0.59	0.59-0.67	0.62

L, length; L_1, length of preantennal region; L_2, length of postantennal region; B, breadth; T. l., total length; C. I., head index.

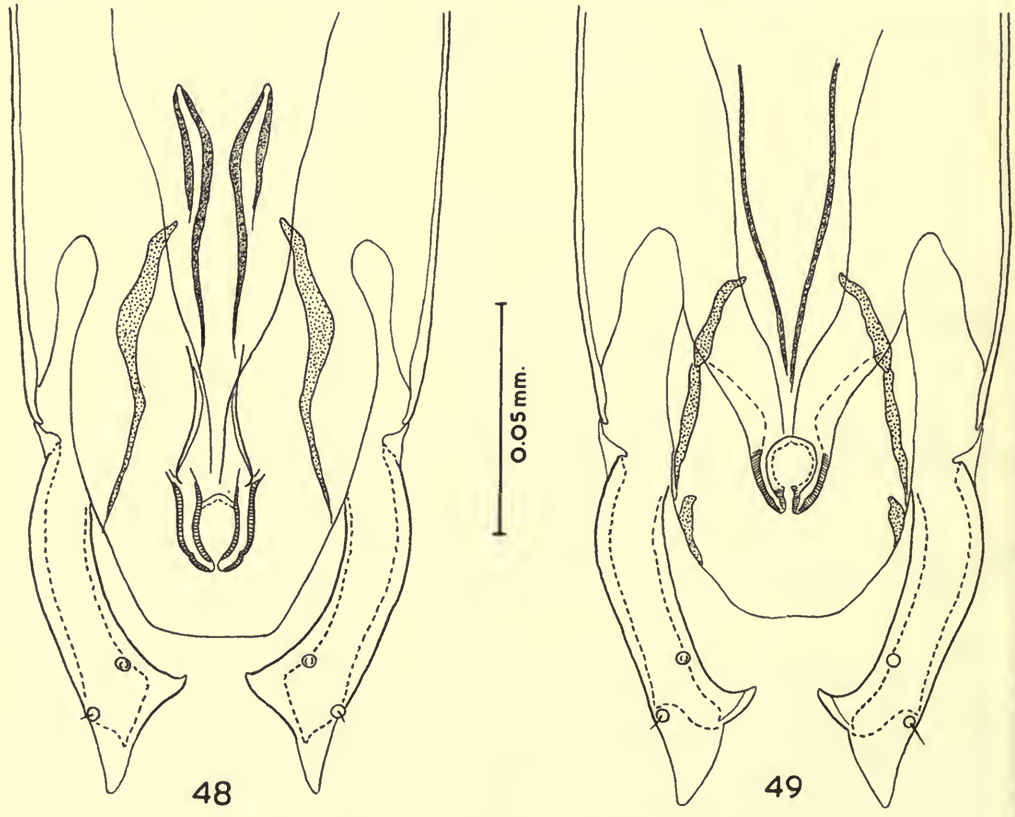
This is a moderately sclerotized species, producing the general affect of light brown. Lateral margins of terga II–VIII characteristically pigmented and merging rather gradually with the general tergal pigmentation. Outlines of lateral tergites III–VIII distinct, unlike the other three related species. In the male no striking, in the female only slight, contrast in the intensity of pigmentation of anterior and posterior portions of terga IX–XI. Male terminal segment rather short and broad, its lateral margins rather straight. Among the closely related species its lower endomere and parameres are the longest (Table VII).

Chaetotaxy. Male (6). Inner pronotal almost lg to lg. Telg setae, 5+6 (1). Tergal: II, ant. tc sh. Post. II (1), III (1), VI (1), 1 tl + 2 tc as 1 tl ?; VII, 3 tl + 2 tc (1); VIII, 3 tl + 2 tc (5), 2+2 (1); IX–XI, ant. ml to almost lg, post. broken but alveoli of tl setae asymmetrical (1); *b*, ml to almost lg, well on tergite, 1+2 (1). Post-spiracular: III, IV, ml; V, ml to almost lg; VI, VII, lg.

Anterior submarginal setae on IX–XI, 4–6 (total 8–11). These are similar in proportions, hence not separable into *a* and *p*, but the 2–4 (total 4–7) ventral setae are perhaps *v*.

Pleural: IV, 3–6, total 7–10, $\bar{x}$ 8·16 (6), 4+4 (4); V, 4–7, total 8–13, $\bar{x}$ 10·66 (6); VI, 4–5, total 8–10, $\bar{x}$ 9·16 (6), 4+4 (1); marginal and submarginal, 2–6 (total 5–10). Mesosternal, 2+2 (5), 3 (1); metasternal, 1+1 (5); respectively on these 2+2 and 1+1 (4). Sternal: II, sl lg, sc usually ml or lg also, sl much longer than sc; III, sl lg, sc sh; VI, 6–9; VII, 7–9; VIII, 3 (1/6); *d*, lg.

Female (4). Post. III (1), V (1), 2 tl + 3 tc; VIII, 2 tl + 2 tc (1), 4+2 (1), 5+? (1), ?+2 (1); IX–XI, ant. sh, close to lateral margins of tergite, post. tl sh, tc sh to almost ml; *a*, sh;



Figs 48, 49. Male genitalia: 48, *A. signatus*; 49, *A. lepidus*.

b, sh, on edge of tergite or near it. Pleural: IV, 5–7, total 10–13, x̄ 11·00 (4); V, 4–8 total 9–15, x̄ 11·75 (4); VI, 4–7, total 10–13, x̄ 11·00, 4+4 in none; VII, 5+5 (1/4); *p*, sh to almost ml; *v*, 2–4 (total 5–7); marginal and submarginal, 4–9 (total 10–15). Meso- and meta-sternal, 2+2 and 1+1 respectively. Sternal: II, sl lg, sc almost lg to lg, sl usually slightly or much longer than sc; III, sl ml to lg, sc sh; VI, 8; VII, 6; between VII and VIII, 3–6 (total 7–10) sh to ml; *d*, lg. Sp setae on or near margin of vulva, 22–29 (8–13 central, 6–10 (total 12–17) lateral); anteriorly in genital region, 9–11 sp setae.

MATERIAL EXAMINED

9 ♂, 8 ♀ from the type-host *Ciconia nigra* (Linnaeus), RUSSIA (*R. Meinertzhagen*, 1768, 1770 c, d and 4816).

NEOTYPE ♂ of *Lipeurus maculatus* Nitzsch, by present designation, from *Ciconia nigra*, slide no. 1768a, RUSSIA: Caucasus, xi. 1903 (*R. Meinertzhagen*), BMNH.

Neoparatypes 8 ♂, 8 ♀ from the type-host, RUSSIA: various localities.

8. ***Ardeicola tantali*** (J. C. Fabricius, 1798)

(Pl. I, fig. 2; Pl. II, fig. 6; Text-figs 34, 54, 58; Tables VI, VII)

Pediculus tantali J. C. Fabricius, 1798 : 571. Host: *Tantalus leucocephalus*.

This Fabrician species has been dealt with by Clay & Hopkins (1960: 10), who examined the syntypes and designated a male as the lectotype (l.c., p. 6, figs 3, 4).

This species is close to *maculatus* and *asiaticus*. Feebly to moderately sclerotized, producing the general affect of light brown. Outer margins of terga II–VIII brown, and in their colour intensity and that of the rest of the thickening there is strong contrast. Male terminal segment rather long and narrow and its lateral margins slightly curved. Colour pattern of terga IX–XI as in *maculatus*.

CHAETOTAXY. Length of many setae as in *maculatus*. MALE (10). Telg setae, 4+5 (2). Tergal: II, ant. tc sh to almost ml. Post. II (1), III (1), 2 tl + ? tc; VI, 2+3 (1), 3+2/(1); VIII, 2 tl + 2 tc (2), 2+? (1), 3 or 4+2 (3), 2 or 3+3 (2); IX–XI, post. ml, 2 tl + 3 tc (1), tc and tl equal or tc slightly longer; *a*, lg, 1+0 or 0+1 (3), 0 (2); *b*, ml to lg, apparently on tergite, 1+2 (1). Post-spiracular: VII, 1+2 (1); III–V, ml; VI, VII, usually lg or ml also. Pleural: III, ?+1 (1); IV, 3–5, total 7–9, x̄ 7·80 (10), 4+4 (6); V, 4–6, total 9–11, x̄ 9·80 (10); VI, 3–6, total 8–11, x̄ 9·62 (8); VII, 4+5 (1/9); VIII, 3+4 (1); *p*, usually ml to almost lg or sh also, slightly shorter and finer than *a*, and 1+0 (1/9); *v*, 2–4 (total 4–8); marginal and submarginal, 2–3 (total 5–6). Mesosternal, 2–3 (2), 4 (6), 5 (1); metasternal, 1+1. Sternal: II, sl lg, sc usually ml to lg or sh also, sl much longer than sc; III, sl lg, sc sh; VI, 7–9; VII, 8–9; *d*, ml.

FEMALE (9). Inner pronotal ml to lg. Telg setae, 4+5 (1), 5+4 (1). Tergal: II, ant. tc sh. Post. VIII, 2 tl + 2 tc (2), 3+2 (3), 4+2 (3), 3+3 (1); IX–XI, ant. and post. sh, tc very slightly longer than tl; *a*, sh, 0+1 (1/9); *b*, sh near edge of tergite. Post-spiracular: III, ? or 1+? (2); IV, ?+1 (1); III, IV, ml; V–VII, ml to almost lg. Pleural: IV, 3–5, total 7–10, x̄ 8·44 (9), 4+4 (6); V, 4–7, total 9–13, x̄ 11·00 (9); VI, 4–6, total 9–12, x̄ 10·30 (8); VII, 3–5, total 7–9, x̄ 8·22 (9); VIII, 5+4 (1/9), 4+1 (1/9); *p*, sh or ml; *v*, 3–5; marginal and submarginal, 4–6 (total 9–11). Mesosternal, 2 (2), 4 (6); metasternal, 2 (7); respectively on these 2+2 and 1+1 (5). Sternal: II, III, as in male; VI, 6–8; VII, 6–7; between VII and VIII, 2–5 (total 4–9) sh to ml; *d*, ml to lg. Sp setae on or near margin of vulva, 13–23 (4–8 central, 4–8 (total 9–16) lateral); anteriorly in genital region, 3–5 sp setae.

MATERIAL EXAMINED.

From the type-host, *Ibis leucocephalus* (Pennant). Homotypes 4 ♂, 13 ♀, INDIA: Rajputana, iii. 1937 (*R. Meinertzhagen*, 8885). 4 ♂ (dissected) with exactly same data. 4 ♂, 7 ♀, INDIA (*R. Meinertzhagen*, 4817) and 3 ♂ (2 dissected), 1 ♀, INDIA: Lucknow (*B. K. Tandan*), BMNH.

Table VI. Measurements in millimetres of Ardeicola species mounted in Canada balsam.

		Male					Female			
		tantali (12)		asiaticus			tantali (9)		asiaticus (4)	
		Range	Mean	Holotype	Paratype	Mean	Range	Mean	Range	Mean
Head	L	0.84-0.95	0.90	0.89	0.90	0.895	0.95-1.01	0.97	1.00-1.01	1.00
	L_1	0.45-0.54	0.50	0.48	0.53	0.505	0.53-0.57	0.54	0.57-0.59	0.58
	L_2	0.39-0.41	0.40	0.41	0.37	0.390	0.41-0.44	0.43	0.40-0.44	0.42
	B	0.50-0.55	0.53	0.55	0.54	0.545	0.55-0.62	0.58	0.61-0.68	0.64
Prothorax	L	0.17-0.22	0.19	0.20	0.18	0.190	0.18-0.22	0.20	0.19-0.22	0.21
	B	0.40-0.49	0.44	0.43	0.44	0.435	0.42-0.47	0.44	0.47-0.53	0.50
Pterothorax	L	0.37-0.44	0.42	0.43	0.41	0.420	0.42-0.47	0.44	0.43-0.48	0.46
	B	0.50-0.65	0.54	0.54	0.55	0.545	0.55-0.62	0.60	0.59-0.68	0.64
Abdomen	L	2.06-2.24	2.13	2.07	2.06	2.065	2.64-2.95	2.81	2.82-3.04	2.93
	B	0.58-0.69	0.64	0.65	0.68	0.665	0.72-0.82	0.76	0.73-0.91	0.83
	T.1.	3.49-3.82	3.64	3.60	3.55	3.575	4.20-4.63	4.41	4.45-4.59	4.53
	C.I.	0.55-0.63	0.59	0.62	0.60	0.610	0.59-0.64	0.61	0.61-0.66	0.63

L, length; L_1, length of preantennal region; L_2, length of postantennal region; B, breadth; T.1., total length; C.I., head index.

9. ***Ardeicola asiaticus* sp. n.**

(Pl. I, fig. 3; Pl. II, fig. 7; Text-figs 37, 55; Tables VI, VII)

Type--host: *Xenorhynchus a. asiaticus* (Latham)

This species is closest to *tantali*[1] and its male can be distinguished by its smaller size and by characters 3 and 4 given on page 142, but the females are difficult to separate.

CHAETOTAXY. MALE (2). Inner pronotal broken. Telg setae, 4+5 (1). Tergal: II, ant. tc sh, rather fine. Post. VIII, 3 tl + 2 tc (?), 4+3 (?); IX–XI, ant. ml relatively more lateral, post. broken; *a*, lg on tergite or near its edge; *b*, lg on tergite. Post-spiracular: III, almost lg; IV, broken; V, almost lg to lg; VI, VII, lg. Pleural: IV, 3+3, 5+5, x̄ 8·00; V, 5+4, 6+5, x̄ 10·00; VI, 5+5, 6+6, x̄ 11·00; VII, 5+4, 5+5, x̄ 9·50; *p*, ml to almost lg, translucent, stouter

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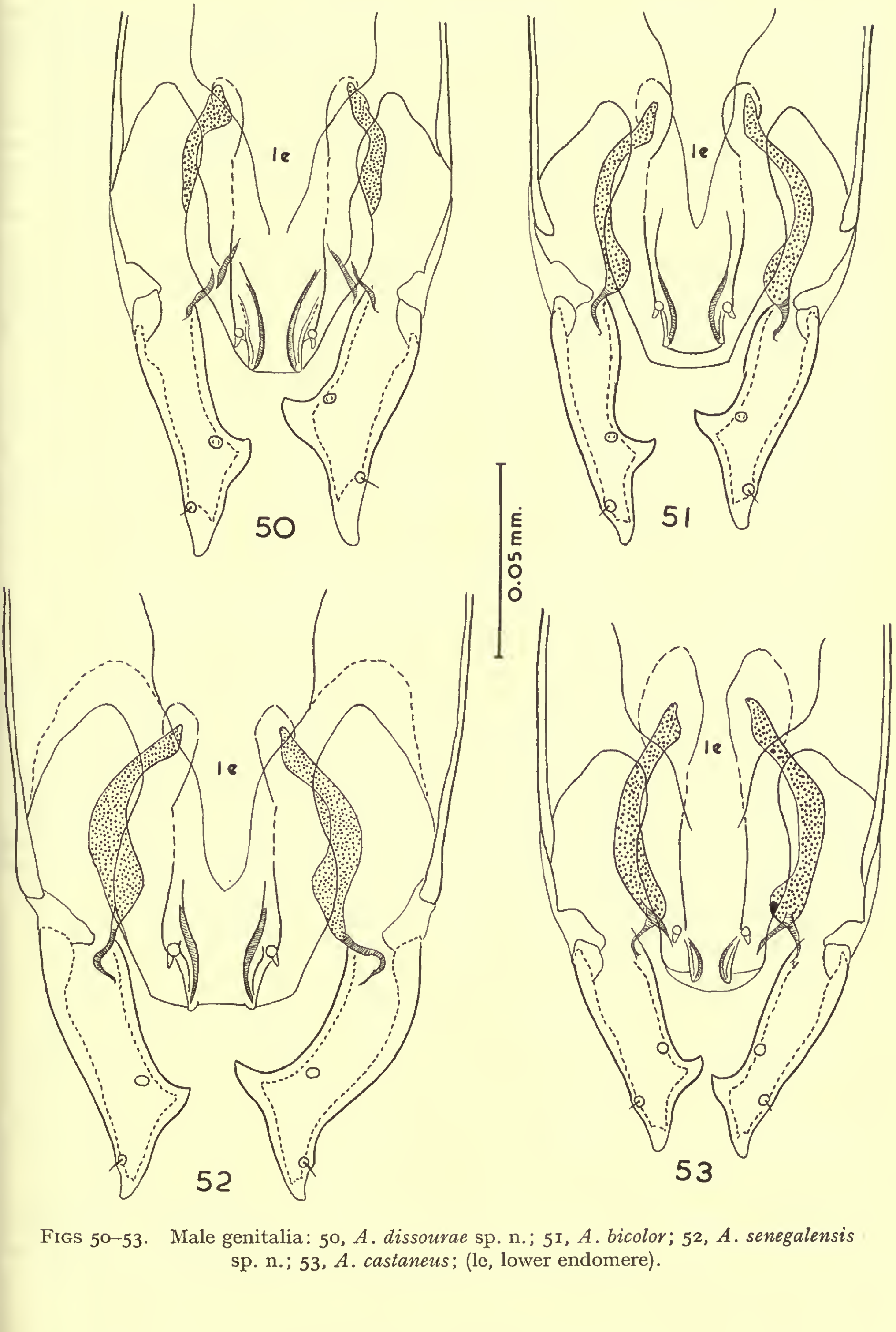
[1] Examination of the single male type of *A. porrectus* (Piaget, 1890), described from *Buceros bicornis*, shows it to be closest to *asiaticus* and *tantali*. Its true host, however, cannot be ascertained until *Ardeicola* from other Eastern Ciconiidae are available.



FIGS 50–53. Male genitalia: 50, *A. dissourae* sp. n.; 51, *A. bicolor*; 52, *A. senegalensis* sp. n.; 53, *A. castaneus*; (le, lower endomere).

than in *keleri*; *v*, 1–2 (total 2–4); marginal and submarginal, 4+4, 5+4, broken. Meso- and meta-sternal, 3, 5, and 2, 4 respectively. Sternal: II, sl lg, sc ml to lg, sl much longer than sc; III, sl ml to lg, sc sh, between sl and sc 1+0 ml also (1); VI, 7, 11; VII, 8, 11; VIII, 3 (1); *d*, ml to lg.

FEMALE (4). Inner pronotal ml to lg. Telg setae, 5+4 (1). Tergal: Post. II (1), III (2), IV (2), V–VII (1), 2 tl + 3 tc; VII, 2 tl + 4 tc (1); VIII, 4 tl + 4 tc (3), 3+? (1); IX–XI, ant. sh, post. tc sh to ml, tl sh, 2 tl + 3 tc (2); *a*, ?+1 or ? (2), sh; *b*, sh off tergite or on its edge. Post-spiracular: as in male but on III, 1+? (2), on III, ml also and on IV, ml to lg. Pleural: III, 0+1 (1); IV, 4+6, total 8–11, $\bar{x}$ 9·25 (4); V, 5–8, total 12–15, $\bar{x}$ 13·00 (4); VI, 5–8, total 10–16, $\bar{x}$ 13·00 (4); VII, 4–7, total 9–15, $\bar{x}$ 10·25 (4), no specimen with 4+4; VIII, 5+5 (1); *p*, sh to almost ml; *v*, 2–4 (total 4–7); marginal and submarginal, 4–6 (total 9–11). Mesosternal, 4–7; metasternal, 2 (2), 4 (1); respectively on these 2+2 and 1+1 (1). Sternal: II, as in male; III, sl lg, sc sh to almost ml, 2 sl + 4 sc (1); VI, 4+4; VII, 5–7; between VII and VIII, 4–6 (total 8–11) sh to ml; *d*, ml to lg. Sp setae on or near margin of vulva, 18–25 (5–7 central, 6–9 (total 13–18) lateral); anteriorly in genital region 2–4 m setae.

MATERIAL EXAMINED

Holotype ♂ from *Xenorhynchus a. asiaticus* (Latham), slide no. 4806 a, INDIA (*R. Meinertzhagen*), BMNH.

Paratypes 1 ♂, 7 ♀, from the type-host, INDIA: Rajputana (*R. Meinertzhagen*, 4806, 9045, 9080), BMNH.

10. *Ardeicola keleri* sp. n.

(Pl. I, fig. 4; Pl. II, fig. 8; Text-figs 36, 56, 59; Tables V, VII)

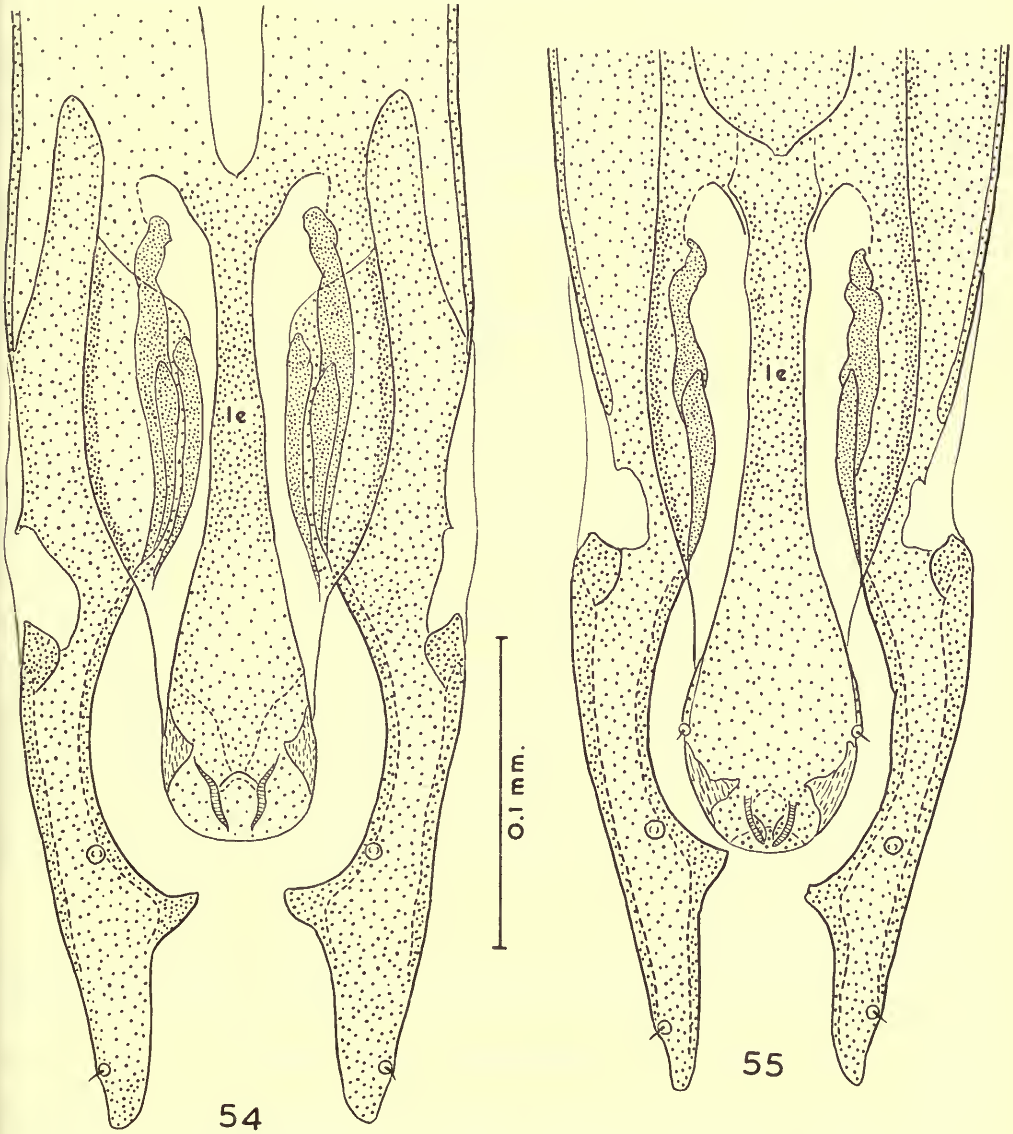
Type-host: *Ibis ibis* (Linnaeus).

Of the four related species, *maculatus* et al., this is the most distinctive and its male is the smallest (Text-fig. 1). Feebly sclerotized, straw-coloured. Outer margins of tergum II unpigmented; in male those of III–VI or VII are dark brown, but the pigmented area is the smallest among related taxa; in the female outer margins of terga III–VIII are dark to chestnut-brown and the pigmented area is distinctive and diagnostic. In both the sezes terga IX–XI are well pigmented and much darker posteriorly. The colour pattern, even of tergum III alone, separates this species readily from related ones. Male terminal segment short and wide and its lateral margins slightly to rather curved; setae in genital region shorter and finer. Tendeiro (1958) has given figures of the male head and genitalia of this species.

Table VII. Length in millimetres of components of male genitalia of Ardeicola species.

		maculatus	asiaticus	tantali	keleri
Basal apodeme	Range	0.93-1.10	1.00	0.77-1.11	0.59-0.77
	Mean	0.99 (6)	1.00 (1)	0.99 (9)	0.69 (7)
Mesosome (lower endomere)	Range	0.227-0.249	0.206	0.183-0.196	0.136-0.152
	Mean	0.240 (6)	0.206 (1)	0.193 (11)	0.145 (4)
Paramere	Range	0.171-0.183	0.152-0.157	0.137-0.170	0.124-0.136
	Mean	0.179 (8)	0.154 (2)	0.153 (22)	0.131 (12)

Chaetotaxy. Male (7). Inner pronotal ml to almost lg. Telg setae, 4+4 (2). Tergal: II, ant. tc sh. Post. VIII, 2 tl + 2 tc (5), 3+4 (1), 2+? (1); IX–XI, ant. ml, 0+1 (1), post. sh to ml, tc and tl equal or tc slightly longer; *a*, lg on or off tergite, 0+0 or 1 (3); *b*, ml to lg well on tergite. Post-spiracular: III, 1+? (1); VI, 2+1 (1); VII, 1+2 (1); III–V, ml; VI, ml to almost lg; VII, almost lg. Pleural: IV, 3–6, total 7–11, x̄ 8·14 (7), 4+4 (4); V, 4–6, total 8–10, x̄ 9·28 (7); VI, VII, 4–5, total 8–9, x̄ 8·14 (7), 4+4 (6); *p*, sh to ml fine, translucent; *v*, 1–3 (total 3–5); marginal and submarginal, 1–4. Mesosternal, 3–5; metasternal, 1+1. Sternal: II, sl lg, sc usually ml or lg also, sl much longer than sc; III, sl ml to lg, sc usually sh or ml also; VI, 7–8; VII, 6–8; *d*, lg.



Figs 54, 55. Male genitalia: 54, *A. tantali*; 55, *A. asiaticus* sp. n. (le, lower endomere).

FEMALE (8). Inner pronotal ml. Telg setae, 4+5 or 5+4 (2). Tergal: VIII, 2 tl + 2 tc (4), 3+2 (2), 3 or 4+? (2); IX–XI, ant. and post. sh; *a*, 0+1 (2), near edge of or well on tergite; *b*, sh and as *a*. Post-spiracular: III, 1+? (1); III, ml; IV, V, ml to almost lg; VI, VII, ml to to lg. Pleural: III, 1+2 (1); IV, 4–7, total 9–13, x̄ 10·00 (8); V, as on IV, but x̄ 11·12; VI, 4–6, total 8–12, x̄ 9·75 (8), 4+4 (3); VII, 5+4 (2); *v*, 1–3 (total 3–6); marginal and submarginal, 5–7 (total 10–13). Meso-sternal, 4 (6), 5 (2); metasternal, 1+1. Sternal: II, sl lg, sc usually ml to almost lg or sh also, sl much longer than sc; III, sl usually ml or sh also, sc sh, sl slightly longer than sc, 2 sl + 3 sc (2), and 1+2 (2) as 1 sl ?; VI, 7–8; VII, 6; between VII and VIII, 1–3 (total 3–6) sh to ml; *d*, ml to lg. Sp setae on or near margin or vulva, 16–20 (5–7 central, 3–8 (total 11–14) lateral); anteriorly in genital region, 4–8 sp setae.

MATERIAL EXAMINED

Holotype ♂, from *Ibis ibis* (Linnaeus), slide no. 710, KENYA: Limuru, 6.i.1937 (*G. H. E. Hopkins*), BMNH.

Paratypes. 2 ♂, 3 ♀ from the same host individual; 4 ♂, 5 ♀ from another bird, KENYA: iii.1945 (*R. Meinertzhagen*, 18865), BMNH.

This species is dedicated to Dr. Stefan von Kéler, the eminent authority on Mallophaga, who died in 1968.

11. *Ardeicola loculator* (Giebel, 1874)

(Text-figs 8, 17, 20, 25; Table I)

Lipeurus loculator Giebel, 1874 : 228. Host: *Tantalus loculator.*
Lipeurus linearis Rudow, 1869 (nec *L. linearis* Nitzsch, 1866): 35.

This is the only species of the *ciconiae* species-group having only 1+1 inner, posterior, prothoracic setae (Text-fig. 8), a character which readily separates it from all other species. Other distinguishing characters are, the well developed temporal carinae in the male (fig. 10 in Kumar & Tandan, 1968) and the dark lateral spots on the occiput and anteriorly on tergal thickening V–VIII in the female (Text-figs 8, 17).

Male heavily, female moderately, sclerotized; gular plate weakly so in both sexes, hence it is less evident in the male.

CHAETOTAXY. MALE (13). See Kumar & Tandan (1968). Seta *b*, lg well on tergite or near its edge; *p*, ml to lg. Meso- and meta-sternal, 1+1. Seta *d*, ml to lg.

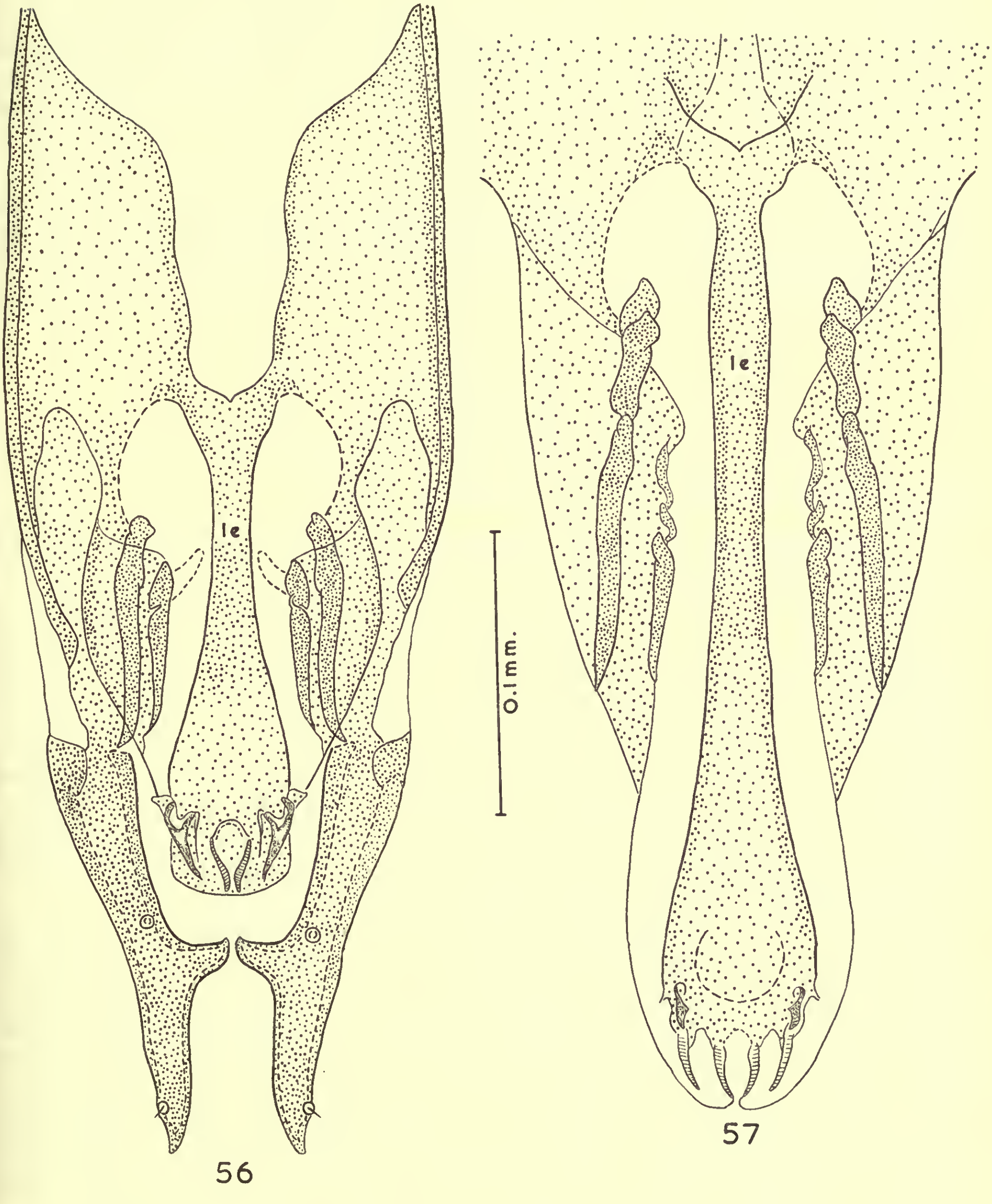
FEMALE (2). Tergal: II–VIII, as in male; IX–XI, ant. sh, relatively outer and close to lateral margins of tergite, and post. tl sh, tc sh to ml; *b*, sh or sp off tergite. Post-spiracular: III, ml; IV–VII, lg. Pleural: as in male, but on VIII, 4+3 (1); *v*, 2+2, 3+1; m and sm, 4+5, 4+3. Meso- and meta-sternal, 1+1. Sternal: II–V, as in male, but on IV, 1 sl lg + 2 sc m (1); VI, 8; VII, 6; between VII and VIII, 4–7 sh to ml; *d*, lg. Sp setae on or near margin of vulva, 15–19 (4–5 central, 5–7 (total 11–14) lateral); on sub-genital plate, 2–3 sp setae.

MATERIAL EXAMINED.

NEOTYPE ♂ of *Lipeurus loculator* Giebel, by present designation, slide no. 4810a, from the type-host, *Mycteria americana* Linnaeus, MEXICO (*R. Meinertzhagen*), BMNH.

Neoparatypes. Same data as neotype and U.S.A.: Arizona, Florida, 22 ♂, 1 ♀, BMNH.

Other material. From the type-host, MEXICO: Tlacotalpan, 2 ♂, 2 ♀, 22.vi.1961 (*D. H. Jancen*), available through courtesy of Dr. D. W. Tuff.



FIGS 56, 57. Male genitalia: 56, *A. keleri* sp. n.; 57, *A. maculatus* (le, lower endomere).

12. ***Ardeicola leucosoma*** Kumar & Tandan

Ardeicola leucosoma Kumar & Tandan, 1968 : 266, figs 7–9, 12–14. Host: *Mycteria americana.*

Drs K. C. Emerson and D. W. Tuff think that *M. americana* is perhaps not the true host of *leucosoma*. Sinec the native and scientific name of *Jabiru mycteria*, also found in Guyana, and *M. americana* are rather similar, confusion might have been caused, especially as the skin was not preserved. The question of the true host of *leucosoma* must therefore await until *Ardeicola* from *J. mycteria* also is available.

This species is distinguished from others of the *ciconiae* species group by the following combination of characters: the weakly sclerotized general habitus, 2+2 posterior pronotal setae, 1+1 pleural setae on segment IV in the male, the posterior components of the male genitalia, and the colour pattern of the female abdomen, especially the lateral, faintly pigmented spots on tergal thickening V or VI–VII.

Chaetotaxy. Male. Pleural: V, 1–4, total 2–7, x̄ 5·28 (7). Both sexes. Sternal: V, 0–2 sc m or sh.

13. ***Ardeicola ciconiae*** (Linnaeus, 1758)

(Text-figs 21, 26, 28, 31, 32, 43, 44)

Pediculus ciconiae Linnaeus, 1758 : 613. Host: *Ardea ciconia.*

This species has been treated by Clay & Hopkins (1950 : 252), who also designated neotypes.

A striking feature of *ciconiae* is the extreme variation in the number of telg (pteronotal) setae (Text-figs 29, 30). Out of 55 males and 51 females examined, only in 7 of each sex was the count normal for the species group (5+5). In the rest it varies thus: male, 4+4 (31), 5+4 or 4+5 (17); female, 3+4 (2), 4+4 (24), 5+4 or 4+5 (18). The neotype male, however, has 5+5 telg setae, while the neallotype female has 4+4 setae. This variation is a clear indication that the species is in the act of changing the number of telg setae, but whether 1+1 setae are being lost or added is not clear. In view of the fact that 4+4 is the normal count of telg setae in *Ardeicola* from Threskiornithidae, the presence of 4+4 setae in a large percentage of individuals of both sexes of this species is worthy of note. Equally striking is the variation in the number of posterior tergal setae on segments V and VI. From these variations, especially in the number of pteronotal setae which is an important group character, it is inferred that in the evolutionary scale *ciconiae* is at a different level than other species of the group.

Chaetotaxy. Male. Inner pronotal ml to lg. Telg setae, see above. Tergal (7): II, ant. tc ml to lg. Post. II, VII (6), III, IV, VI (4), V (3), 2 tl + 2 tc; III, 2+1 (1); III, IV, VII (1), VI (2), 1+2; II, 1 tl + 2 tc (1) as 1 tl?; III, 2+1 (1); VI, 1 tl + 1 tc (1) as setae short?; III (1), IV (2), V (4), 2 tc; VIII, 2 tl + 2 tc (6), 3+2 (1), tl on tergite close to posterior margin; IX–XI, ant. sh to ml and post. tl ml to lg, tc lg to elg; *a*, 1+0 (2/6); *b*, lg on tergite. Postspiracular; III, sh; IV, ml; V, ml to almost lg; VI, VII, lg; alveoli of those on IV and VII on tergite. Pleural: IV, 1+1, an important character; V, 2–3, total 4–5, x̄ 4·42 (7); VI, 3–4, total 6–7, x̄ 6·42 (7); VII, 3+3 (2), 4+3 (1); VIII, 4+3 or 3+4 (2); *p*, sh to lg; *v*, 1–3 (total 3–5); marginal and submarginal, 3–5 (total 6–8). Mesosternal, 2 (8), 3–4 (6); metasternal, 4 (8), 5 (3), 6–7 (3). Sternal: II, all lg, sl and sc equal or sl longer, normal (5), 2 sl (1) as 2 sc ?; III, sl ml, sc lg, normal (2), 0–1 sl + 2 sc (5) as 1 or 2 sl?; V, normal (3), 2 sl + 2 sc (2), 4+2 (1), 2+1 (1), sl sh; on IV, V sc usually ml to lg; VI, 7–11; VII, 8–10; *d*, sh to lg.

Female. Telg setae, see above. Tergal (4): II, ant. tc almost to lg. Post. II, IV (3), III, VII (4), V, VI (1), 2 tl + 2 tc; II, 4 tl + 2 tc (1); IV, V (1), VI (2), 1+2; V (2), VI (1), 2 tc; VIII, 2 tl + 2 tc (3), 3+2 (1); IX–XI, ant. sh, relatively outer and close to lateral margins of tergite, post. tl sh, tc ml; *a*, *b*, sp or sh, near edge, *a*, away also, of tergite. Post-spiracular: as in male, but on IV sh, on V sh to ml, on VI, VII ml. Pleural: III, 1+2 (1); IV, 1+1, an important character; V, 2–3, total 4–6, $\bar{x}$ 5·25 (4), 3+3 (2); VI, 3–4, total 7–8, $\bar{x}$ 7·50 (4), 4+4 (2): *v*, 1–3 (total 3–5); marginal and submarginal, 4–6 (total 9–12). Mesosternal, 2 (4), 3 (7), 4 (1); metasternal, 4 (7), 5 (4), 6 (1). Sternal: II, 3–6 all lg, 2 sc slightly longer or shorter than others; III, 3–4 sh to lg; on II, III 2 are always sc and rest outer to these; IV, V, sc 2–3 and 2–5 respectively; IV, 6–10; VII, 6–9; between VII and VIII, 2–8 sh; *d*, lg. Sp setae on or near margin of vulva, 19–22 (6–9 central, 5–7 (total 10–14) lateral); on sub-genital plate, 4 or more m setae.

MATERIAL EXAMINED.

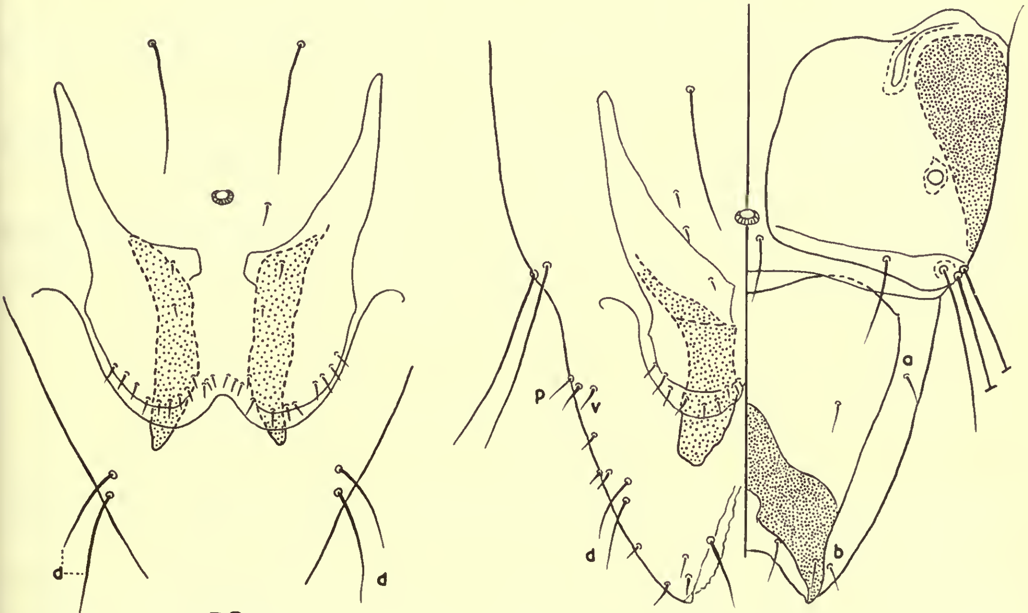
From the type-host, *Ciconia c. ciconia* (Linnaeus). 15 ♂, 12 ♀, KENYA and SUDAN (*R. Meinertzhagen*, 6962, 7857, 14820, 20514). Of these 5 ♂ and 2 ♀ (*R. Meinertzhagen*, 6962, 7857) were neoparatypes and 1 ♂, 1 ♀ neotype and neallotype respectively, BMNH.

14. ***Ardeicola hopkinsi*** Kumar & Tandan, 1968
(Text-fig. 41)

Ardeicola hopkinsi Kumar & Tandan, 1968 : 263, figs 1–6. Host: *Euxeneura galeata*.

Some characters by which this species is distinguished from *ciconiae* are given below.

MALE. Temporal carina not apparent. Post-spiracular setae apparently absent on III Medially anterior margin of tergite V rather, of VI slightly, emarginate, and of VII and VIII very slightly depressed (figs 1, 5 in Tandan & Kumar, 1968). Posterior margin of tergal



58 59

FIGS 58, 59. Female terminalia: 58, *A. tantali*; 59, *A. keleri* sp. n.

thickening V–VIII rather curved. Anterior margin of tergite IX–XI slightly curved, and anterior tergal setae thereon lg. Number of marginal and submarginal setae greater. On III–V, 2 sl lg and 2 sc m. In the genitalia the basal apodeme shorter and broader and its articulation with the parameres distinct.

FEMALE. Post-spiracular setae on IV–VII longer. On IX–XI anterior tergal setae not so close to margins of tergite, and posterior tl setae sh and tc setae almost long.

The following two species (15 and 16) are closely related, and are distinguished from the foregoing species by the presence of post-spiracular setae on tergum II. Their distinguishing characters from each other are given elsewhere (Tandan & Kumar, 1969).

15. ***Ardeicola fissomaculatus*** (Giebel, 1874)

(Text-figs 23, 24, 47)

Lipeurus fissomaculatus Giebel, 1874 : 225. Host: *Mycteria crumenifera*.
Lipeurus genitalis Piaget, 1885 : 58, pl. 6, fig. 5. Host: *Leptoptilos crumeniferus*.

CHAETOTAXY. MALE. Telg setae, 5+4 or 4+5 (2/5). Post-spiracular on II, 0+1 (1/9). Pleural: IV, x̄ 3·80 (5); V, x̄ 7·00 (5); VI, x̄ 8·00 (5). Mesosternal, 2+2 (4); metasternal, 2 (1), 5 (1), 2+2 (2); on both 2+2 (2).

FEMALE. Telg setae, 5+4 (1/3). Pleural: III, 1+2 (1/4); IV, x̄ 5·22 (4); V, x̄ 7·00 (4); VI, x̄ 8·00 (4). Mesosternal, 4 (3), 2 (1): metasternal, 4 (1), 3 and 5 (2); on both 2+2 (1).

MATERIAL EXAMINED.

Syntypes of *Lipeurus genitalis* Piaget, from *Leptoptilos crumeniferus*.

LECTOTYPE ♂ of *Lipeurus genitalis* Piaget, by present designation, slide no. 823, BMNH.

Paralectotypes. 1 ♂, 1 ♀, slides no. 823, 429, BMNH.

Neoparatypes of *Lipeurus* (=*Ardeicola*) *fissomaculatus* Giebel, 1874, designated by G. H. E. Hopkins, 1941 (see also Tandan & Kumar, 1969 : 150), 9 ♂, 11 ♀, UGANDA: Bombo, Buganda, 8.iii.1934 (*G. H. E. Hopkins*), BMNH.

Other material. 5 ♂ (dissected), 4 ♀, from the type-host, *Leptoptilos crumeniferus* (Lesson), SOMALILAND: ii.1949 and KENYA: i.1956 (*R. Meinertzhagen*, 18643, 20535), BMNH.

16. ***Ardeicola hardayali*** Tandan & Kumar, 1969

(Text-figs 42, 46)

Ardeicola hardayali Tandan & Kumar, 1969 : 145, figs 1, 2, 4, 6, 7, 9, 11–16, 20, 22. Host: *Leptoptilos javanicus*.

CHAETOTAXY. MALE. Telg setae, 5+4 (2/10). Pleural: average of 10. IV, 4·10; V, 5·80; VI, 7·60. Mesosternal, 4 (5), 3 (3), 2 (1); metasternal, 4 (6), 3 (4); on both 2+2 (3).

FEMALE. Telg setae, 4+4 (1/8). Pleural: IV, x̄ 4·41 (12); V, x̄ 6·27 (11); VI, x̄ 7·81 (11). Mesosternal, 4 (6), 3 (4); metasternal, 4 (7), 5 (2), 6 (1); on both 2+2 (5).

Artificial Key to the Species of the *CICONIAE* group

In order to have a key common to both the sexes, non-sexual characters have been employed more than sexual characters. As identification through one character is not always conclusive, more characters, arranged in order of their importance, are given. Numbers in some of the couplets refer to notes given after the key. *A. praelongus* (Piaget, 1880) has been omitted from the key as no material from the Type host, *Ibis cinereus* (Raffles), is available.

1 Post-spiracular setae present on terga II–VII (fig. 6 in Tandan & Kumar, 1969)[1] 2

– Post-spiracular setae present on terga III–VII (Text-figs 17, 18)[1,2,3] . . 3

2 (1) Length over 5·00 mm (Text-fig. 1); terminalia as in figs 3, 5, 8, 10 and male genitalia as in figs 21, 23, in Tandan & Kumar (1969); in male 4–6 sternal setae on VIII (Ethiopian) . . . . . ***fissomaculatus*** (p. 154)

– Length under 4·70 mm (Text-fig. 1); terminalia as in figs 2, 4, 7, 9 and male genitalia as in figs 20, 22, in Tandan & Kumar (1969); in male 2 sternal setae on VIII (Oriental) . . . . ***hardayali*** (p. 154)

3 (1) Only 2 central setae on terga II–VII (Text-figs 13, 16) 4

– Normally 4 (2 tl + 2 tc) setae on either tergum II (Text-figs 14, 18) or terga II–IV (Text-fig. 15)[4] or II–VII (Text-figs 17, 19)[5] 5

4 (3) Body larger, head wider (Text-fig. 4); male genitalia as in Text-fig. 49; basal apodeme with a distinct waist (Text-fig. 32); 14–15 setae on margin of vulva (Oriental) . . . . ***lepidus*** (p. 133)

– Body smaller, head narrower (Text-fig. 5); male genitalia as in Text-fig. 48; sides of basal apodeme rather straight (Text-fig. 31); 19 or more setae on margin of vulva (Ethiopian) . . . . ***signatus*** (p. 134)

5 (3) Only on tergum II normally 4 (2 tl + 2 tc) setae (Text-figs 14, 18); on terga III–VII normally 2 tc setae only 6

– On terga II–IV (Text-fig. 15) or II–VII (Text-figs 17, 19) normally 4 (2 tl + 2 tc) setae[4,5] 7

6 (5) On tergum III only 2 tc setae (Text-fig. 18); in male tc setae on VIII thicker and longer (Text-fig. 9); female genital opening wide and straight (Ethiopian) . . . . ***dissourae*** sp. n. (p. 136)

– On tergum III 0–1 tl + 2 tc setae (Text-fig. 14); in male tc setae on VIII finer and shorter (Text-fig. 11); female genital opening narrow and curved (Ethiopian) . . . . ***bicolor*** (p. 137)

7 (5) Normally 4 (2 tl + 2 tc) setae on terga III and IV, and 2 tc setae on terga V–VII[4] (Text-fig. 15) (Ethiopian) . . . . . ***senegalensis*** sp. n. (p. 139)

– Normally 4 (2 tl + 2 tc) setae on terga III–VII[5] (Text-figs 17, 19) . . 8

8 (7) On prothorax 1 + 1 ml posterior setae (Text-fig. 8); male genitalia diagnostic (fig. 15 in Kumar & Tandan, 1968); in female characteristic pigmented antero-lateral spots on terga V–VIII (Text-fig. 17) (Nearctic and Neotropical) . . . . ***loculator*** (p. 150)

– On prothorax 2 + 2 posterior setae, outer sp or sh, inner ml to lg (Text-figs 2, 3) 9

9 (8) The 2 sc setae on III almost lg and longer than 2 sh to ml sl setae. In male 5–8 sternal setae on VIII (Text-fig. 28) and genitalia diagnostic (fig. 43 in Clay & Hopkins, 1950). In female anterior margin of tergite IX–XI deeply emarginate and the 2 anterior tergal setae close to its lateral margins (Ethiopian) . . . . ***ciconiae*** (p. 152)

– The 2 sl setae on III ml to lg and much longer than the 2 usually m or sh and fine sc setae (figs 1, 9, 11 in Kumar & Tandan, 1968). In male normally 2 sternal setae on VIII 10

10 (9) In male 4 (2 sl lg + 2 sc m) sternal setae on V, and the 2 tc setae on VIII reach to anterior tergal setae on IX–XI (figs 1, 5 in Kumar & Tandan, 1968). In female 3–4 (1–2 sl sh or lg + 2 sc m or lg) sternal setae on V[2] (Neotropical) . . . . **hopkinsi** (p. 153)

– In male either no or only 2 m or sh sc setae on V (fig. 9 in Kumar & Tandan, 1968) and the 2 tc setae on VIII fall much or rather short of anterior tergal setae on IX–XI (Text-figs 19, 34–37). In female as in male . . . 11

11 (10) Poorly sclerotized with only traces of pigment; 2 sc setae on II normally m, sp or sh and fine. In male normally 1 + 1 pleural setae on IV and genitalia diagnostic (figs 9, 13 in Kumar & Tandan, 1968) (Neotropical) **leucosoma** (p. 152)

– *Either* feebly to moderately sclerotized and fairly to considerably pigmented *or* heavily sclerotized: 2 sc setae on II usually ml to lg. In male 4 or more pleural setae on IV 12

12 (11) Heavily sclerotized, tergal thickening II–XI sharply distinct. In male anterior margin of tergite V incised medially (Text-fig. 19) and mesosome short and diagnostic (Text-fig. 53); in female no spermathecal sclerite[3] (Oriental) . . . . **castaneus** (p. 141)

– Feebly to moderately sclerotized, tergal thickening indistinct but some tergites usually well pigmented laterally. In male genitalia mesosome long and diagnostic (Text-figs 54–57); in female a sclerotized, ring-like calyx to spermatheca (Text-fig. 59) 13

13 (12) Tergum II unpigmented; colour pattern of tergal thickening III–VI or VII in male and III–VIII in female diagnostic (Pl. I, fig. 4; Pl. II, fig. 8). Basal apodeme and lower endomere (Text-fig. 56) under 0·80 mm and 0·175 mm long respectively (Ethiopian) . . . . **keleri** sp. n. (p. 148)

– Tergum II pigmented laterally; colour pattern of tergal thickening III–VIII not as above. Basal apodeme and lower endomere over 0·90 mm and 0·175 mm long respectively 14

14 (13) Sclerotization moderate; abdominal dorsum as in Pls I, fig. 1 and II, fig. 5; lower endomere over 0·225 mm long (Palaearctic) . . **maculatus** (p. 143)

– Sclerotization feeble; abdominal dorsum rather different; lower endomere under 0·225 mm long 15

15 (14) Lower endomere under 0·200 mm long; seta *p* less translucent (Oriental). **tantali** (p. 145)

– Lower endomere 0·206 mm long seta *p* quite translucent[6] (Oriental). **asiaticus** sp. n. (p. 146)

NOTES TO KEY

1. Variation in the number of segments having the post-spiracular setae is rare, hence their distribution is an exceptionally stable taxonomic character. The recorded absence on segments normally having these setae is due mostly (if not exclusively) to their being broken and the failure to locate even their alveoli as specimens were over-treated with alkali. As opposed to this, only one male of *dissourae*, out of all the specimens from the Ciconiidae, was exceptional in having 1+0 post-spiracular seta on a segment (II) which normally lacks this seta in this species.

2. Whether or not the post-spiracular setae are normally present on tergum III in *hopkinsi* is uncertain. Of the three individuals comprising the series, only in one female tergum III has 1+1 of these setae. In the other female and only male these setae are either absent or not apparent on tergum III. Thus, for covering *hopkinsi* the lower half of the couplet (1) in the key could also be: 'post-spiracular setae present on terga III or IV-VII.'

3. The position in *castaneus* also deserves mention. In only one specimen of each sex, 1+1 post-spiracular setae were seen on tergum III; in the rest either no (five of each sex) or only one (two males, three females) such seta is visible. On IV, 1+1 post-spiracular setae are present in four males and five females; on V-VII, 1+1 setae are present in all specimens excepting on V in two and VI in one female, in which only one seta is visible. It is because most of the seta are broken and even their alveoli are not visible that in five specimens of each sex the post-spiracular setae have not been seen on tergum III (or in some on tergum IV). Hence, their absence on these terga is not accepted as final and this species is also included in the lower half of couplet 1.

4. While in the male of *senegalensis* the normal number of tl setae on II is 2, the two females have more (3–4) tl setae. As such a difference between the two sexes has not been observed in any other species from the Ciconiidae, possibly the females are abnormal. Therefore, 3–4 as the normal number of tl setae on segment II of the female has been accepted with reservation, until confirmed by a larger series. The immediate implication is that the two females are not covered by the relevant portion of the lower half of couplet 3; to include these, the following needs to be added at the end of this half: 'in female rarely 5–6 (3–4 tl + 2 tc) setae on tergum II.'

5. In *ciconiae* 2 tl setae on segments II-VI and VII are present in at least 60 per cent. of the specimens of each sex, and rarely are these setae absent altogether. But on segments V and VI, 2 tl setae are present in 25 per cent. of the females and 50 per cent. of the males. Hence, the relevant portion of the lower half of couplets 3, 5 and 7 does not apply to those high percentage of variants which have either none or only 1 tl seta. For diagnosing *ciconiae*, therefore, through the key a series or males are essential.

6. Females of *tantali* and *asiaticus* are inseparable morphologically.

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We are grateful to the Trustees of the British Museum (Natural History) for the loan of *Ardeicola* from the Entomological Collections of the BMNH, and for the photomicrographs on Plates I and II; and to Dr Theresa Clay for reading the manuscript and making some valuable suggestions.

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EXPLANATION OF ABBREVIATIONS

ant	anterior	sh	short
elg	elongated	sl	sternolateral
lg	long	sp	spiniform
m	minute	tc	tergocentral
ml	moderately long	telg	thoracic elongated seta
post	posterior	tl	tergolateral
ps	post-spiracular	tsp	thoracic spiniform seta
sc	sternocentral	ttr	thoracic trichobothrium

For convenience some abdominal setae have been designated as *a*, *b*, *d*, *p* and *v* (Text-figs 20–27, 33–37, 58, 59); the anal setae of the female as inner (i), middle (m) and outer (o) (Text-figs 38–43), the inner being towards the midline, and those of the male as anterior (a), middle (m) and posterior (p) (Text-figs 44–47).

P. Kumar, M.Sc., Ph.D.
Department of Zoology
University of Lucknow
Lucknow, India

B. K. Tandan, M.Sc., Ph.D.
Department of Zoology
University of Lucknow
Lucknow, India

PLATE 1

Fig. 1. *A. maculatus*, male.
Fig. 2. *A. tantali*, male.
Fig. 3. *A. asiaticus*, male.
Fig. 4. *A. keleri*, male.


1


2


3


4

PLATE 2

Fig. 5. *A. maculatus*, female.
Fig. 6. *A. tantali*, female.
Fig. 7. *A. asiaticus*, female.
Fig. 8. *A. keleri*, female.

5

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BY

PAUL ERNEST SUTTON WHALLEY

Pp. 159- 179; 12 *Plates*: 1 *Map*

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THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

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A REVISION OF THE GENUS *CANAEA* WALKER (LEPIDOPTERA, THYRIDIDAE)

By P. E. S. WHALLEY

CONTENTS

SYNOPSIS

The genus *Canaea* Walker was removed from synonymy with *Rhodoneura* Guenée by Whalley (1964). In the present paper the genus is redefined, ten species are placed in the genus, including five new species and seven new subspecies which are described here. A key to the species and a map of the distribution of this Oriental-Australasian genus are given.

INTRODUCTION

THE genus *Canaea* was erected by Walker for one species, *C. semitessellata*. This species was subsequently transferred to *Rhodoneura* Guenée by Hampson (1897) but the generic name *Canaea* was used by Gaede (1917) for another species (*Canaea janenschi*, transferred to *Hypolamprus* Hampson, Whalley, in press). *Canaea* was removed from synonymy with *Rhodoneura* Guenée by Whalley (1964).

In the present work the genus is redefined and separated into two species-groups, both of Oriental-Australasian distribution. Both species-groups contain similarly patterned species, differing primarily in the structure of the male antennae, and forming a parallel series in their distribution. Within each species-group the differences between species is mainly in the male genitalia, with much smaller differences in the female, but fewer female specimens were available for examination.

The whole genus is very homogeneous and closely allied to *Neobanisia* Whalley from the Ethiopian Region. The main difference between this genus and *Canaea* is in the presence of the secondary sac on the bursa of the females in *Canaea*, which is absent in *Neobanisia*. There are other differences in the males but the basic morphology of these two genera is very similar. The genus *Canaea* is characterized, in the females, by strongly sclerotized and spiny plates round the ostium. The anal papillae and the sclerites of the last abdominal segment are similarly spined and sclerotized. At the edge of the ostium in some species, two leaf-like spiny and sclerotized processes are present.

Canaea is separated into the two species-groups on the basis of the length of antennal pectinations in the male. In the *hyolaspila*-group, the antennae in the male have long pectinations; in the *plagiata*-group, the males have minutely ciliate antennae. Few female specimens of *Canaea* were available for examination and no key is given for this sex. Modifications of structures, here called socii, occur in a number of species. These structures, while covered with modified scales, are often fused or partly fused to the wall of the anal tube (sometimes resembling a scaphium and subscaphium) where they appear to afford some support for it. It is not certain if these sclerotized plates are strictly homologous with socii.

All the wing measurements given in the descriptions are taken from the apex of the fore wing to the centre of the mesothorax.

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All the specimens are in the British Museum (Natural History) unless otherwise indicated.

CHECK-LIST OF THE SPECIES OF *CANAEA* WALKER

THE *HYALOSPILA*-GROUP (pectinate antennae in male)

- *C. semitessellata* Walker
- *C. similella* sp. n.
- *C. complicata* sp. n.
- *C. mercurata* sp. n.
- *C. ignotalis* (Röber)
- *C. brandti* sp. n.
- *C. rusticata rusticata* subsp. n.
- *C. rusticata aversata* subsp. n.
- *C. rusticata pallidata* subsp. n.
- *C. hyalospila hyalospila* (Lower)
- *C. hyalospila fusca* subsp. n.
- *C. hyalospila monsfera* subsp. n.

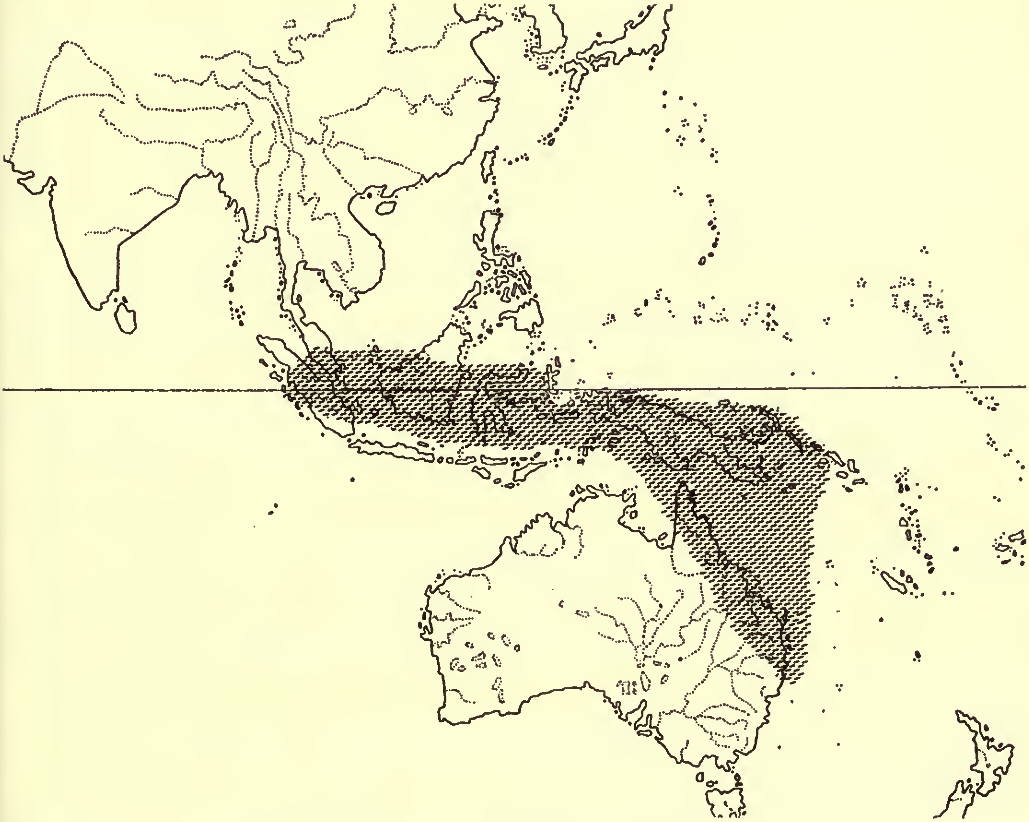
THE *PLAGIATA*-GROUP (simple, minutely ciliate antennae in male)

- *C. semitessellalis* (Walker)
- *C. plagiata plagiata* (Warren)
- *C. plagiata albicollaris* (Warren)
- *C. plagiata neoalbicollaris* subsp. n.
- *C. plagiata propinquita* subsp. n.

CANAEA Walker, 1863

Canaea Walker, 1863: 73. Type-species: *Canaea semitessellata* Walker, by monotypy.
Canaea Walker; Hampson, 1897: 615.
Canaea Walker; Warren, 1905: 410.
Canaea Walker; Dalle Torre, 1914: 17.
Canaea Walker; Gaede, 1917: 369.
Canaea Walker; Gaede, 1929: 495.
Canaea Walker; Whalley, 1964: 118.
Canaea Walker; Whalley, *Bull. Brit. Mus. nat. Hist.* (Ent.) Suppl. 1971: 17, in press.

Generic description. Ocelli absent. Antennae simple or pectinate. Chaetosema absent. Labial palps three-segmented. Eyes without interfacetal hairs. Fore tibia with epiphysis. Hind tibia with two pairs of spurs. Hind tarsi each with pair of apical spines. Fore wing with R_2 to R_5 generally from cell, some radial veins running very close together. Hind wing with $Sc + R_1$ and Rs approaching closely but not joining. Male genitalia with some modifications of socii. Uncus frequently modified. Base of sacculus usually with elongate process, juxta small membraneous. Large sclerotized process near base of costa of valve. Female with ostium and anal papillae strongly spined and sclerotized. Secondary sac on bursa.



Distribution of species of genus *Canaea* Walker

Distribution. The world distribution of species of the genus is shown in Map 1. A single female specimen from the Philippines, tentatively identified as *C. ignotalis* Röber, is not included in the distribution shown in Map 1. Further material of this is needed to confirm this identification. In *C. hyalospila* there are two subspecies on the Australian continent and one in New Guinea. One of the Australian subspecies is more closely allied to the New Guinea subspecies than it is to the other Australian subspecies. With the limited series available in the *hyalospila*-group, the differences in external pattern and genitalia have been used to indicate specific rather than subspecific differences, even though the species in the group form geographically isolated groups from Malaya to Australia.

Biology. No information.

Key to the males of *CANAEA* Walker

1		Antennae pectinate (*hyalospila*-group)	3
–		Antennae not pectinate (*plagiata*-group)	2
2	(1)	Patagia white. Sacculus process short	**plagiata** (p. 175)
–		Patagia grey-brown. Sacculus process long and slender .	**semitessellalis** (p. 174)
3	(1)	Strongly spined pad in centre of gnathus	**hyalospila** (p. 172)
–		No spiny pad in centre of gnathus	4
4	(3)	Prominent process on either side of base of uncus. Valve process relatively simple (Pl. 6, fig. 32)	**similella** (p. 165)
–		No basal process on uncus. Valve process usually more spinose	5
5	(4)	Apex of uncus rounded, no process	6
–		Apex of uncus variously shaped, with process	8
6	(5)	Sacculus process reduced to rounded lobes (Pl. 6, fig. 36) .	**brandti** (p. 168)
–		Sacculus process prominent	7
7	(6)	Sacculus process long and slender, reaching half distance to costa of valve. Basal process on valve slender, sclerotized, with spines (Pl. 6, fig. 35)	**ignotalis** (p. 167)
–		Sacculus process short, not reaching half distance to costa of valve. Basal process on valve a slender, sclerotized spine . .	**mercurata** (p. 167)
8	(5)	Sacculus process reduced to small spine	**complicata** (p. 166)
–		Sacculus process long.	9
9	(8)	Sacculus process long, slightly toothed at apex. Uncus slender (Pl. 6, fig. 31)	**semitessellata** (p. 164)
–		Sacculus process shorter, apex of process usually without teeth. Uncus broad (Pl. 7, fig. 37)	**rusticata** (p. 169)

DESCRIPTIONS OF THE SPECIES

The *HYALOSPILA*-Group

Canaea semitessellata Walker

(Pl. 1, fig. 1; Pl. 6, fig. 31; Pl. 12, figs 68, 69)

Canaea semitessellata Walker, 1864: 73.
Rhodoneura semitessellata (Walker) Hampson, 1897: 619.
[*Rhodoneura semitessellalis* sensu Hampson, 1897: 619, nec Walker, misidentification.]
[*Siculodes ignotalis* sensu Hampson, 1897: 619, nec Röber, misidentification.]
Canaea semitessellata Walker; Warren, 1905: 410.
Canaea semitessellata Walker; Dalle Torre, 1914: 33.
Canaea semitessellata Walker; Gaede, 1917: 369.
Rhodoneura semitessellata (Walker); Gaede, 1932: 755.

[*Rhodoneura semitessellalis* sensu Gaede, 1932: 755, nec Walker, misidentification.]
[*Rhodoneura ignotalis* sensu Gaede, 1932: 755, nec Röber, misidentification.]
[*Rhodoneura hyalospila* sensu Gaede, 1932: 755, nec Lower, misidentification.]
[*Rhodoneura tessellatula* sensu Gaede, 1932: 755, nec Pagenstecher, misidentification.]
Canaea semitessellata Walker; Whalley, 1964: 118.

♂. Wing, 16·5–18·5 mm. Vertex brown, irrorate with white. Antennae strongly monopectinate. Labial palps upturned, not reaching vertex, third segment ⅓ length of second segment. Frons rounded. Tegulae long. Thorax brown. Hind tibia with outer spur of distal pair ½ length of inner spur. Frenulum single. Fore wing, pattern as in Pl. 1, fig. 1, brown with white areas. Veins R_3, R_4 and R_5 arise close together from cell but not anastomosing. Underside, as upperside, paler. Hind wing, as fore wing.

GENITALIA ♂ (Pl. 6, fig. 31). Uncus long, narrow, dorso-ventrally Y-shaped at end. Socii with large sclerotised processes on each side of anal tube. Gnathus arms thickened, just meeting in mid-line. Sacculus produced into long arms on each side of juxta, apex of arms toothed. Valve narrowing in apical third. Large, sclerotized, leaf-like, toothed process on valve at base near costa. Saccus small. Aedeagus without spines in vesica. Ductus seminalis arising one third of way along aedeagus.

♀. Wing, 21 mm. Colour and pattern as male. Frenulum triple.

GENITALIA ♀ (Pl. 12, figs 68, 69). Anal papillae short, sclerotized. Ostium sclerotized and very spiny. Ostial plate roughly rectangular. Duct convolute. Small patches of sclerotized plates forming signum.

DISCUSSION. Few specimens of this species are known. The dorso-ventral Y-shape of the apex of the uncus and the leaf-like sclerotized processes on the valves are characteristic. The gnathus is less heavily sclerotized than in some of the other species in the genus. The single male from Malaya has a more slender process on the valve and shorter arms to the base of the sacculus but is otherwise similar to the Borneo specimen. The only female specimen is similarly coloured to the male, and in this *semitessellata* differs from most other species in the genus, where there is sexual dimorphism in colour. The size of the signum is not clear in the single female specimen examined but is probably less than one third of the size of the whole bursa sac. The sclerotized ostium is similar in shape to *C. ignotalis* Röber. Although the type-specimen of *Rhodoneura tessellatula* Pagenstecher has not been traced, the species is here removed from synonymy with *semitessellata* because this species and the genus are not at present known from the Philippines, the type-locality of *tessulatula*.

DISTRIBUTION. Malaysia: Sarawak, Malaya.

MATERIAL EXAMINED

Holotype ♀. SARAWAK: genitalia slide 430-1964, (B.M. slide no. 9555), in University Museum, Oxford.

SARAWAK: 1 ♂ (*Moore*); 1 ♀ (*Wallace*), abdomen missing; MALAYA: 1 ♂, Perak, Gunong Kledang, xi.1916.

Canaea similella sp. n.

(Pl. 1, fig. 2; Pl. 6, fig. 32)

♂. Wing, 15·5–17 mm. Vertex white with brown-tipped scales. Antennae strongly monopectinate. Labial palps with third segment almost ½ length of second segment. Frons rounded, not projecting between eyes. Thorax pale brown, tegulae long. Hind tibia with outer spur of distal pair less than ½ length of inner spur. Large scale tuft on tibia. Fore wing, pattern as in Pl. 1, fig. 2, brown with lighter areas. Veins R_2, R_3 and R_4 run close together but do not anastomose. Underside, as upper side, paler. Hind wing, pattern and colour as fore wing.

GENITALIA ♂ (Pl. 6, fig. 32). Uncus long, laterally expanded at tip and with lateral processes at base. Socii strap-like. Gnathus lightly sclerotized, just meeting in mid-line. Valve pointed, strap-like sclerotized process at base. Juxta small, lightly sclerotized. Base of sacculus with two short processes, toothed at apex. Saccus small. Aedeagus without spines in vesica, ductus seminalis arising one third along aedeagus.

♀. Unknown.

DISCUSSION. The shape of the uncus and the strap-like, non-serrate, process on the valve are characteristic. This species is related to *semitessellata* where the modifications of the uncus are less extreme. The uncus of *semitessellata* has a long stem to the 'Y'-shape, *similella* has a short stem to the 'Y' with broadly expanded (dorso-ventrally) arms. The pale areas of the wing are generally smaller than in *semitessellata*. Although this species is only known from two specimens, they are sufficiently distinct to be regarded as good species and not as subspecies of *semitessellata*.

DISTRIBUTION. Indonesia: Sumatra.

MATERIAL EXAMINED

Holotype ♂. INDONESIA: Sumatra, Medan, ii, Doloc Baros Estate, Sumatra (coll. Le Moult), B.M. slide no. 10876, in BMNH.

Paratype. INDONESIA: Sumatra, 1♂, data as holotype.

Canaea complicata sp. n.

(Pl. 1, figs 3, 4; Pl. 6, fig. 33)

♂. Wing, 16–17 mm. Vertex brown, irrorate with white. Antennae strongly monopectinate. Labial palps with third segment ¼ length of second, small scale tuft between eyes. Thorax brown, irrorate with white. Tegulae long, reaching 1st abdominal segment. Hind tibia with outer spur of distal pair ½ length of inner spur. Fore wing, pattern as in Pl. 1, fig. 3, brown with circular white areas. Frenulum single. Veins R_1, R_2 and R_3 close together and veins R_4 and R_5 close together but none anastomosing. Underside, as upper, paler. Hind wing, colour and pattern as fore wing.

GENITALIA ♂ (Pl. 6, fig. 33). Uncus long and slender, enlarged at apex. Socii large. Gnathus weakly sclerotized, not meeting at mid-line. Valve pointed. Sacculus enlarged, with small process on each side of juxta. Saccus small. Large, sclerotized, spiny process on costa at base of valve. Aedeagus with two minute sclerotized plates in vesica but no spines.

♀. Unknown.

DISCUSSION. This species can be separated from *similella* by the lack of the basal processes on the uncus and on the shape of the basal process on the valve. Little variation exists in the series examined. The apex of the uncus is expanded as in *C. similella*. *C. complicata* is fairly widespread in Papua and New Guinea, where all the existing specimens were captured at altitudes of over 4000 feet.

DISTRIBUTION: Papua; New Guinea.

MATERIAL EXAMINED

Holotype ♂. PAPUA: Mafulu, 4000 ft, xii.1933 (*Cheesman*), B.M. slide no. 10812, in BMNH.

Paratypes. PAPUA: 2 ♂, data as type; 2 ♂, Mafulu, 4000 ft, i.1934 (*Cheesman*); 1 ♂, Mondo, 5000 ft, ii–iii.1934 (*Cheesman*); 3 ♂, Biagi, Mambare R., 5000 ft, iii.1906 (Meek); 1 ♂, Angabunga R., affl. St Joseph, 6000 ft, xi.1905 (*Meek*). NEW GUINEA: 4 ♂, Tapini, Loloipa River, 6200 ft, 25.ii–2.v.1958 (*Brandt*), in C.S.I.R.O., Canberra; 1 ♂, Finisterre Range, Kiambarvi, 4500 ft (*Brandt*), 22.vii–28.viii.1958, in C.S.I.R.O., Canberra; 7 ♂, Aiyura, E. Hlds, 27.ix.1957, 6000 ft, (*Munroe & Holland*), in Canadian National Collection, Ottawa.

***Canaea mercurata* sp. n.**

(Pl. 1, fig. 5; Pl. 6, fig. 34)

♂. Wing, 15·5–17 mm. Vertex white, irrorate with brown. Antennae strongly monopectinate. Labial palps with third segment ⅓ length of second. Thorax reddish brown, irrorate with white. Tegulae reaching 1st abdominal segment. Hind tibia with outer spur of distal pair less than ½ length of inner spur. Fore wing, pattern as in Pl. 1, fig. 5, brown with yellowish white areas. Frenulum single. Veins R_1, R_2 and R_3 run close together but do not anastomose. Underside, as upperside, paler. Hind wing, colour and pattern as fore wing.

GENITALIA ♂ (Pl. 6, fig. 34). Uncus clavate. Socii lightly sclerotized, broad. Gnathus lightly sclerotized, small projection in mid-line. Valves narrow at apex. Small, double, sclerotized process and raised setose papilla near base of valve. Juxta small, membranous. Base of sacculus upturned into pointed process on each side of juxta. Saccus small. Vesica of aedeagus without spines.

♀. Unknown.

DISCUSSION. This species can be separated from the others in the genus by the short, clavate, uncus, relatively small valve process and lightly sclerotized gnathus. The flattened basal elongations of the sacculus are also characteristic. Externally the pattern is very similar to *C. complicata*. At present *C. mercurata* is known only from a short series collected at the same time on the island of Buru. It is possible that with more specimens examined, this species may prove to be a subspecies of *C. ignotalis* Röber, but the male genitalia are quite distinct. *C. ignotalis* also occurs on Buru.

DISTRIBUTION. Indonesia: Buru.

MATERIAL EXAMINED

Holotype ♂. INDONESIA: Buru, Kako Tagalago, Central Buru, 2700 feet, v.1922 (*Pratt*), B.M. slide no. 10873, in BMNH.

Paratypes. INDONESIA: 3 ♂, data as holotype.

Canaea ignotalis (Röber) **comb. n.**

(Pl. 2, figs 7, 8; Pl. 6, fig. 35; Pl. 9, figs 50, 52, 54)

Siculodes(?) *ignotalis* Röber, 1891: 329.
Siculodes ignotalis Röber; Röber, 1892, pl. 6, fig. 7.
[*Rhodoneura ignotalis* sensu Hampson, 1897: 618, nec Röber, misidentification.]
[*Rhodoneura ignotalis* sensu Gaede, 1932: 755, nec Röber, misidentification.]

♂. Wing, 15–20 mm. Vertex white, irrorate with brown. Antennae strongly monopectinate. Labial palps with third segment ⅓ length of second, upturned, just reaching vertex. Prothorax white, irrorate with brown. Hind tibia with outer spur of distal pair less than

½ length of inner spur. Fore wing, pattern as in Pl. 2, fig. 7, pale grey-brown with white areas. Veins R_2, R_3 and R_4 run close together. Underside as upper, paler. Hind wing, colour and pattern as fore wing.

GENITALIA ♂ (Pl. 6, fig. 35). Uncus partially hidden by socii and anal tube. Gnathus weakly sclerotized, just meeting in mid-line. Valve pointed. Sacculus enlarged and produced on either side of juxta into a prominent toothed and sclerotized process. Aedeagus with row of small sclerotized plates in vesica.

♀. Wing, 22 mm. Antennae minutely ciliate. Labial palps with third segment more than ½ length of second, long, protruding well in front of head. Frenulum double. Pattern as male but darker coloured.

GENITALIA ♀ (Pl. 9, figs 50, 52, 54). Anal papillae short, heavily sclerotized. Ostium strongly sclerotized, spiny. Duct strongly convolute, broad. Bursa with large oval signum, with rows of sclerotized plates. Rest of bursa covered with minute, lightly sclerotized plates.

DISCUSSION. *C. ignotalis* has not yet been found in New Guinea but a closely allied species occurs in the Bismarck Archipelago. Generally the males of *ignotalis* are paler in colour than any other species in the genus but there is some variation within the *ignotalis* series. *C. ignotalis* can be distinguished from the other species in the genus by the shape of the uncus, the very elongate processes of the sacculus on each side of the juxta and the shape of the sclerotized process of the valve. From *C. brandti* it can be separated by the shape of the base of the sacculus; this is very elongate in *ignotalis* but short in *brandti*, and by the presence of cornuti in the aedeagus of *ignotalis* which are absent in *brandti*. The single female from the Philippines is generally similar to the female *ignotalis*, but smaller with small differences in the genitalia.

DISTRIBUTION. Indonesia: Sulawesi [Celebes], Salajar, Buru.

MATERIAL EXAMINED

Holotype ♂. INDONESIA: Sulawesi, Bonerate. This specimen has not been traced and is probably lost. However the original illustrations leave no doubt as to the identity of the species and therefore no neotype is designated.

INDONESIA: 1 ♂, Buru, Kako Tagalago, 2700 ft, 1922 (*Pratt*); 2 ♂, Sulawesi, Pangean, near Maros, 2000 ft, iii.1938 (*Kalis*); 7 ♂, 4 ♀, Loda, Paloe, 4000 ft, v.1937 (*Kalis*); 3 ♂, 1 ♀, Tjamba, near Maros, 1500 ft, ii.1938 (*Kalis*); 1 ♂, 1 ♀, Sidaonta, Paloe, 4500 ft, vi.1937 (*Kalis*); 3 ♂, Lindoe, Paloe, 3700 ft, iv.1937 (*Kalis*); 1 ♂, 3 ♀, Koelawi, Paloe, 3100 ft, iii.1937 (*Kalis*); 2 ♂, Salajar [Selayer], Somarisi, 1660 ft, xii.1938 (*Kalis*). [1 ♀, PHILIPPINES: Mindanao (*Moinsay*)].

Canaea brandti sp. n.

(Pl. 1, fig. 6; Pl. 5, fig. 30; Pl. 6, fig. 36)

♂. Wing, 18·5–20·5 mm. Vertex pale brown, irrorate with white. Antennae strongly monopectinate (Pl. 5, fig. 30). Labial palps upturned, third segment ¼ length of second segment. Patagia coloured as vertex. Thorax brown, irrorate with white. Tegulae reaching to 1st abdominal segment. Hind tibia with outer spur of distal pair ½ length of inner spur. Scale tuft on tibia. Fore wing, pattern as in Pl. 1, fig. 6, brown with white areas. Reddish brown in median fascia. Underside, as upperside, paler. Veins R_2, R_3, and R_4 run very close together but do not anastomose. Frenulum single. Hind wing, colour and pattern as fore wing.

GENITALIA ♂ (Pl. 6, fig. 36). Uncus elongate, slightly clavate. Socii long and lightly sclerotized. Gnathus arms lightly sclerotized, just meeting in mid line. Valve pointed.

Basal sclerotization near costa with one long and several short processes. Sacculus enlarged basally, part of sacculus raised on either side of juxta as minutely toothed process. Saccus small. Aedeagus without strong sclerotization in vesica.

♀. Unknown.

DISCUSSION. This species is closely allied to *ignotalis*, from which it can be separated by less sharply clavate uncus, shape of basal process and the very short process of the sacculus, contrasting with the very elongate ones in *ignotalis*. The aedeagus of *brandti* also lacks the sclerotized plates of *ignotalis*. Until the female of *brandti* is known there is an element of doubt in its exact status. The male genitalia are very different from *ignotalis* but this may, in view of the geographic isolation of this species from *ignotalis*, be of subspecific value only. At present neither species is known from the main island of New Guinea.

DISTRIBUTION. Bismarck Archipelago; New Britain; New Ireland.

MATERIAL EXAMINED

Holotype ♂. NEW BRITAIN: Mt Sinewit, 3500 ft, 27.vi–17.ix.1963 (*Brandt*), B.M. slide no. 10860, in C.S.I.R.O., Canberra.

Paratypes: NEW BRITAIN: 5 ♂, data as holotype, in C.S.I.R.O.; NEW IRELAND: 1 ♂, Schleinitz Mts, Lelet Plateau, 3000 ft, 2.x–15.xii.1959, in C.S.I.R.O., Canberra.

Canaea rusticata sp. n.

This species is separated into three geographically isolated subspecies which differ slightly in genitalia structure and, in one subspecies, in the length of the antennal pectinations in the male. *C. rusticata* is distributed throughout New Guinea and the Solomon Islands and can be separated from the other species in the genus by the presence of a ventral process at the apex of the uncus and the shape of the gnathus of the male. *C. rusticata* is related to *semitessellata* Walker from Sarawak but can be separated from that species by the shape of the uncus and the valve processes.

KEY TO THE SUBSPECIES OF *C. rusticata* sp. n.

1		Antennal pectinations as in Pl. 5, fig. 27	2
–		Antennal pectinations as in Pl. 5, fig. 28	**r. aversata** (p. 170)
2	(1)	Pale brown wings. Uncus with long ventral process . .	**r. pallidata** (p. 171)
–		Reddish brown wings. Uncus with short ventral process .	**r. rusticata** (p. 169)

Canaea rusticata rusticata subsp. n.

(Pl. 2, figs 9, 10; Pl. 5, figs 27, 29; Pl. 7, fig. 37; Pl. 9, figs 51, 55)

♂. Wing 18–21 mm. Vertex brown irrorate with white. Antennae strongly monopectinate (Pl. 5, figs 27, 29). Labial palps with third segment ¼ length of second segment. Frons rounded between eyes. Patagia light brown irrorate with white. Tegulae and thorax rufous brown. Hind tibia with outer spur of distal pair ⅓ length of inner spur. Long scent scales on hind tibia. Fore wing, pattern as in Pl. 2, fig. 9, reddish brown with white areas. Frenulum single. Veins R_2, R_3, and R_4 run close together but do not anastomose. Hind wing, pattern as fore wing. Underside as upper but paler.

GENITALIA ♂ (Pl. 7, fig. 37). Uncus short with ventral projection. Socii long, sclerotized

Gnathus arms with slightly serrate edge, heavily sclerotized, broad, just meeting in mid-line. Valve pointed. Base of sacculus enlarged into curved process on each side of juxta. Large sclerotized process on valve with many small sclerotized plates in vesica.

♀. Wing, 18–22 mm. Pattern similar to male (Pl. 2, fig. 10) but rounded areas of wing orange-brown, not white, and brown colour generally darker than in male. Antennae minutely ciliate. Labial palps with third segment ½ length of second segment, upturned, reaching vertex. Frenulum triple.

GENITALIA ♀ (Pl. 9, figs 51, 55). Anal papillae and ostium strongly sclerotized. Ostium expanded on either side into two spiny plates. Duct convolute. Bursa covered with lightly sclerotized ribbing, no distinct signum.

DISCUSSION. This subspecies is separated from the others by the shorter and more truncated ventral process at the apex of the uncus. The differences in antennae are shown in Pl. 5, figs 27, 28. There are differences in the shape of the process of the valve near the costa between all three subspecies. The females are less distinct but *C. rusticata rusticata* tends to be more reddish brown than the other subspecies. *C. rusticata rusticata* has similar antennal pectinations in the male to *C. rusticata pallidata* from the Solomon Islands but the shape of the apex of the uncus of these subspecies differs.

DISTRIBUTION. Papua.

MATERIAL EXAMINED

Holotype ♂. PAPUA: Kumusi River, low elev., vi.1907 (*Meek*), B.M. slide no. 10845, in BMNH.

Paratypes. PAPUA: 4 ♂, 4 ♀, data as holotype; 1 ♂, Milne Bay, ii.1899 (*Meek*); 1 ♂, Upper Aroa River, ii.1903 (*Meek*); 1 ♂, Peria Creek, Kwagira River, 50 m, 14.viii.1953, in U.S. National Museum.

Canaea rusticata aversata **subsp. n.**

(Pl. 2, figs 11, 12; Pl. 5, fig. 28; Pl. 7, figs 38, 39; Pl. 10, figs 56, 60)

♂. Wing, 18·5–23 mm. Colour and pattern as nominate subspecies. Antennal pectination (Pl. 5, fig. 28), shorter and more truncate than in *C. rusticata rusticata*, otherwise morphologically as nominate subspecies.

GENITALIA ♂ (Pl. 7, figs 38, 39). Uncus with prominent ventral projection. Gnathus broad, strongly sclerotized with toothed edge. Base of sacculus sclerotized and produced into long process on each side of juxta. Sclerotized process on valve with small spines at apex and along process. Aedeagus as nominate subspecies.

♀. Wing, 21–22 mm. Pattern as male but circular areas more yellow-brown.

GENITALIA ♀ (Pl. 10, figs 56, 60). As nominate subspecies, lateral plates of ostium slightly more slender than in nominate subspecies.

DISCUSSION. This subspecies can be separated from the nominate one by the shape and length of the antennal pectinations and in the male genitalia by the relative lengths of the process of the sacculus, the shape of the uncus and the more extensive spines on the sclerotized valve process. The females are less distinct, *C. r. aversata* tend to have more yellow on the wings than the nominate subspecies but few females were available for comparison. This subspecies occurs mostly in the eastern part of New Guinea. The single specimen from the Torricelli Mts differs slightly from the other specimens of this subspecies in the shape of the sclerotized process on the valve but the rest of its genitalia are similar.

DISTRIBUTION: Indonesia: West Irian; New Guinea.

MATERIAL EXAMINED

Holotype ♂. INDONESIA: West Irian, Fak-Fak, 1700 ft, i–ii.[19]08 (*Pratt*), B.M. slide no. 10839, in BMNH.

Paratypes. INDONESIA: West Irian, 1 ♂, Nomnagihe, 25 ml., S. Wanagaar, 2000 ft, i–ii.1921 (*Pratt*); 3 ♂, Mt Kunupi, Menoo Valley, Wayland Mts, 6000 ft, xi–xii.1920 (*Pratt*); 3 ♂, 1 ♀, Fak-Fak, 1700 ft (*Pratt*); 3 ♂, Ninay Valley, Centr. Arfak Mts, 3500 ft, xi.1908; 1 ♂, Humboldt Bay Distr., 31.vii.1937 (*Strüber*); 1 ♂, Humboldt Bay Distr., Wembi, 30.vii.1937 (*Strüber*); 2 ♂, Cyclops Mts, Sabron, 2000 ft, vi.1936 (*Cheesman*); 3 ♂, Waigeu, Camp Nok, 2000 ft, v.1938, at light (*Cheesman*).

Material not included in type-series. NEW GUINEA: 2 ♂, Torricelli Mts, Mokai, 2500 ft, 8.xii.1958–23.i.1959, in C.S.I.R.O., Canberra; 4 ♂, Bainyik, Sepik Distr., 1000 ft, 28.xi.1957 (*Munroe & Holland*), in Canadian National Collection, Ottawa; 1 ♂, NE. Wau, 1150 m, 13.viii.1968 (*Szent-Ivany*); 1 ♂, NE. Wau, 1150 m, 3.xii.1968 (*Szent-Ivany*); 1 ♂, NE. Wau, 1150 m, 25.x.1968 (*Szent-Ivany*); 1 ♂, NE. Wau, 1150 m, 29.ii.1968 (*Szent-Ivany*); 2 ♀, NE. Wau, 1150 m, 2.xii.1968 (*Szent-Ivany*); 1 ♀, NE. Wau, 1150 m, 11.xii.1968 (*Szent-Ivany*); 1 ♀, NE. Garaina, 800 m, x.1968 (*Szent-Ivany*); 1 ♀, NE. Garaina, 800 m, xi.1968 (*Szent-Ivany*), in Bishop Museum, Hawaii; 1 ♂, Jini River, Western Highlands, 4600 ft, 16.vii–21.ix.1961 (*Brandt*), in C.S.I.R.O., Canberra; 1 ♂, Kiungu, Fly River, 2.vii.–31.x.1957 (*Brandt*) in C.S.I.R.O., Canberra; 1 ♀, Torricelli Mts, Mobitei, 8.xii.1959 (*Brandt*), in C.S.I.R.O., Canberra.

Canaea rusticata pallidata **subsp. n.**

(Pl. 3, fig. 13; Pl. 7, figs 40, 41; Pl. 10, figs 57, 61)

♂. Wing, 20–21 mm. Paler colour than nominate subspecies, otherwise similar. Antennal pectinations as in nominate subspecies.

GENITALIA ♂ (Pl. 7, figs 40, 41). Uncus produced at apex into long ventral process. Gnathus with smooth edge. Prominent bifid process on valve near costa with large teeth. Sacculus strongly sclerotized and curved processes.

♀. Wing, 20 mm. Pattern as female of nominate subspecies. Colour as male, but with more reddish brown in hind wings.

GENITALIA ♀ (Pl. 10, figs 57, 61). Sclerotized spiny projections on either side of ostium smaller than in nominate subspecies.

DISCUSSION. The sexual dimorphism of colour shown by the other two subspecies is not as clear in *C. r. pallidata*, which is a much paler colour. In the male genitalia, the length of the ventral process at the apex of the uncus, the shape of the sclerotized process on the valve and the size and shape of the process on the sacculus separate this subspecies from the others.

DISTRIBUTION. Solomon Islands.

MATERIAL EXAMINED

Holotype ♂. SOLOMON ISLANDS: Vella Lavella, iii.1908 (*Meek*), B.M. slide no.

10190, in BMNH.

Paratypes. SOLOMON IS: 1 ♂, data as type; 1 ♂, 1 ♀, Bougainville, iv.1904 (*Meek*).

Canaea hyalospila (Lower) **comb. n.**

Striglina hyalospila Lower, 1894: 87.
Striglina hyalospila Lower; Hampson, 1897: 613.
[*Rhodoneura semitessellata* sensu Dalle Torre, 1914: 33, nec Lower, misidentification.]
[*Rhodoneura semitessellata* sensu Gaede, 1932: 755, nec Lower, misidentification.]

C. hyalospila can be separated from all others in the genus by the large spiny pad at the apex of the gnathus in the male. There are three subspecies of which *C. h. fusca* from New Guinea is darker and slightly larger than the other two. The antennae in the male are strongly pectinate. The two Australian subspecies, *h. hyalospila* and *h. monsfera* are from different parts of the Cape York peninsula. *C. h. monsfera* has more characters in common with the New Guinea subspecies than with the other Australian one.

KEY TO THE SUBSPECIES OF *C. hyalospila* (Lower)

1	Wing 18 mm–21 mm. Dark reddish brown, genitalia as in Pl. 8, fig. 43	***hyalospila fusca*** (p. 174)
–	Wing 16 mm–19 mm. Brown or reddish brown species. Genitalia with uncus and basal costal process differing from Pl. 8, fig. 43	2
2 (1)	Genitalia as in Pl. 7, fig. 42	***h. hyalospila*** (p. 172)
–	Genitalia as in Pl. 8, fig. 44	***h. monsfera*** (p. 173)

Canaea hyalospila hyalospila (Lower)
(Pl. 3, figs 14, 15; Pl. 7, fig. 42; Pl. 10, figs 58, 59)

Striglina hyalospila Lower, 1894: 87.

♂. Wing, 16·5–19 mm. Vertex whitish brown, frons rounded. Ocelli absent. Antennae strongly pectinate. Labial palps with third segment ¼ length of second. Hind tibia with outer spur of distal pair less than half length of inner spur. Spurs with sclerotized tips. Pronotum grey-brown. Thorax reddish brown, tegulae long, reaching to 1st abdominal segment. Fore wing, pattern as in Pl. 3, fig. 14, reddish brown with circular white areas. Frenulum single. Veins R_2, R_3 and R_4 close together but not anastomosing. Hind wing, colour and pattern as fore wing. $Sc + R_1$ and Rs approach closely but do not join.

GENITALIA ♂ (Pl. 7, fig. 42). Uncus simple. Gnathus arms strongly sclerotized, joined in mid-line to form spiny pad. Valves pointed. Strongly sclerotized basal costal process with small spines near base. Base of sacculus enlarged, ending in long slender process, slightly toothed at apex. Saccus small. Aedeagus with sclerotized manica and small plate-like cornuti.

♀. Wing, 17·5–19·5 mm. Pattern as male but darker orange-brown. Labial palps with third segment ½ length of second. Frenulum triple.

GENITALIA ♀ (Pl. 10, figs 58, 59). Anal papillae short, sclerotized. Ostium heavily sclerotized with two lateral, spiny, sclerotized lobes. Duct convolute. Bursa without signum. Secondary sac arising near opening of duct to bursa.

DISCUSSION. This subspecies can be separated from the others by the lack of the ventral process at the apex of the uncus of the male, the shape of the juxta, basal costal processes and by the more flattened spiny pad at the apex to the gnathus. At present it is known only from Queensland, where specimens are variable in size and pattern. Warren (1898: 223) mentions the holotype specimen as being in the Rothschild collection.

DISTRIBUTION: Australia.

MATERIAL EXAMINED

Holotype ♀. AUSTRALIA: St Barnard's Island, [18]91 (*Barnard*), in BMNH, specimen lacks abdomen.

AUSTRALIA: 2 ♂, Queensland, Kuranda (*Dodd*); 2 ♂, Queensland; 1 ♂, Queensland, Mackay; 1 ♂, Queensland, 1 ml. east of Kuranda, 3.v.1955 (*Common*); 1 ♀, Queensland, Kuranda (*Dodd*), 1912; 1 ♀, Queensland, Lockerbie, Cape York, 31.iii.1964 (*Common & Upton*); 1 ♂, Queensland, Mt Lewis, 8 ml. NW Mt Molloy, 2700 ft, 15.iii.1964 (*Common & Upton*); 1 ♂, Queensland, Mt Edith, 18 ml. NE Atherton, 15.iii.1964 (*Common & Upton*), in C.S.I.R.O., Canberra; 1 ♂, Queensland, Kuranda, 4–5.i.[19]29 (*Otter*); 1 ♂ (no date), in South Australian Museum; 2 ♀, Queensland, 3 ml. W. of Mossman, 13-14.iii.1964 (*Common & Upton*), in C.S.I.R.O., Canberra.

***Canaea hyalospila monsfera* subsp. n.**

(Pl. 3, fig. 17; Pl. 8, fig. 44)

♂. Wing, 17–18 mm. Colour and pattern as nominate subspecies but separated by the shape of parts of the male genitalia. Fore wing, pattern as in Pl. 3, fig. 17.

GENITALIA ♂ (Pl. 8, fig. 44). Uncus with rounded ventral projection at apex. Gnathus arms broad, strongly sclerotized, broad median spiny pad. Sclerotized costal process with small spines near apex of process, basal spine reduced. Sacculus process on each side of juxta, long, pointed, with minute spines along length. Aedeagus as in nominate subspecies.

♀. Wing, 16–19 mm. Pattern as in male but darker orange-brown, otherwise as nominate subspecies.

GENITALIA ♀. As nominate subspecies.

DISCUSSION. Externally this species is indistinguishable from the nominate one in either sex but in the male genitalia the shape of the uncus, juxta, and gnathus separate them from one another. The status of this and the nominate subspecies need further study. *C. h. monsfera* is closer in the morphology of the genitalia to *C. h. fusca* from New Guinea and might be considered a subspecies of the New Guinea one if *fusca* was elevated to specific rank. However the females of all the subspecies of *hyalospila* are virtually indistinguishable, although the specimens from New Guinea are generally larger and darker than the others.

DISTRIBUTION: Australia.

MATERIAL EXAMINED

Holotype ♂. AUSTRALIA: Queensland, Iron Range, 12.iv.1964 (*Common & Upton*), B.M. slide no. 10878, in C.S.I.R.O., Canberra.

Paratypes. AUSTRALIA: 1 ♂, data as holotype; 2 ♀, Queensland, Iron Range, 9–15.iv.1964 (*Common & Upton*), in C.S.I.R.O., Canberra.

***Canaea hyalospila fusca* subsp. n.**

(Pl. 3, fig. 16; Pl. 8, fig. 43; Pl. 12, figs 70, 71)

♂. Wing, 18–21 mm. Much darker reddish brown than nominate subspecies and usually larger.

GENITALIA ♂ (Pl. 8, fig. 43). Uncus with rounded ventral process at tip. Gnathus sclerotized with spiny median pad more pointed than in nominate subspecies. Sclerotized basal costal process with small spines. Spine at base of process prominent. Sacculus process on either side of juxta long, slightly spiny. Aedeagus differs from nominate subspecies in having smaller sclerotized plates in vesica.

♀. Wing 20·5 mm. As male but more orange in circular areas in wing.

GENITALIA ♀ (Pl. 12, figs 70, 71). As nominate subspecies.

DISCUSSION. This subspecies is larger and much darker in colour than the other two. Most of the other differences are in the male genitalia. From *C. h. monsfera*, which this subspecies most closely resembles in the structure of the male genitalia, it can be separated by the shape of the sclerotized basal process on the valve and the more pointed spiny median pad on the gnathus. There is variation in colour and some variation in the male genitalia in specimens from different localities in New Guinea. The significance of this is not yet apparent with the few specimens studied.

DISTRIBUTION. Indonesia: West Irian; Papua.

MATERIAL EXAMINED

Holotype ♂. INDONESIA: West Irian, Mt Goliath, 5000 ft, 13° long., ii.1911 (*Meek*), B.M. slide no. 10843, in BMNH.

Paratypes. INDONESIA: 5 ♂, 1 ♀, data as holotype; 5 ♂, West Irian, nr Oetakwa R., Snow Mts, 3500 ft (*Meek*); PAPUA: 5 ♂, Babooni, 3600 ft, ix.1903 (*Pratt*); 2 ♂, Ekeikei, 1500 ft, i–ii.1903 (*Pratt*); 6 ♂, 1 ♀, Mt Kebea, 3600 ft, iii–iv.1903 (*Pratt*).

THE *PLAGIATA*-GROUP

***Canaea semitessellalis* (Walker) comb. n.**

(Pl. 4, figs 19, 20; Pl. 8, fig. 45; Pl. 9, figs 49, 53)

Pyralis(?) semitessellalis Walker, 1865: 1246.
Striglina semitessellalis (Walker) Pagenstecher, 1892: 445.
[*Rhodoneura semitessellalis* sensu Hampson, 1897: 618, nec Walker, misidentification.]
[*Rhodoneura semitessellalis* sensu Dalle Torre, 1914: 33, nec Walker, misidentification.]
[*Rhodoneura semitessellalis* sensu Gaede, 1932: 755, nec Walker, misidentification.]

♂. Wing, 13·5–17 mm. Vertex grey-brown. Antennae minutely ciliate. Labial palps with third segment $\frac{1}{3}$ length of second. Frons rounded, not projecting between eyes. Patagia and tegulae pale grey-brown. Thorax pale grey-brown. Hind tibia with outer spur of distal pair $\frac{1}{2}$ length of inner spur. Fore wing, pattern as in Pl. 4, fig. 19, grey-brown with yellow-brown areas. Translucent circular patch in median area. Underside, similar, paler. Darker patches of scales in median and basal areas. Veins R_2 to R_5 from cell. Hind wing, pattern similar to fore wing, slightly more orange-red around reticulations. Single black spot in basal area.

GENITALIA ♂ (Pl. 8, fig. 45). Uncus clavate. Gnathus and socii fused to form sclerotized ring round anal tube. Valve slender, small sclerotized, hooked, basal process. Juxta membranous. Sacculus on each side of juxta terminating in long slender process, one process longer than the other. Saccus small. Aedeagus with spiny manica and sclerotized cornutus.

♀. Wing, 16–18 mm. Pattern as male, more orange-brown colour. Labial palps with third segment ½ length of second. Venation as male.

GENITALIA ♀ (Pl. 9, figs 49, 53). Anal papillae short. Ostium sclerotized. Projection from end of first part of duct of bursa sclerotized, convolute part then leading to bursa. Bursa with two spiny patches, joined by smaller spines.

DISCUSSION. This species is variable in pattern and intensity of colour. Two specimens from Mt Tamborine (Queensland) (Pl. 4, fig. 20) are much darker and have a more reduced pattern than the majority of specimens examined. The genitalia of these specimens are indistinguishable from the holotype. A single female specimen from Kiungu, Fly River, New Guinea, had a similar signum to *semitessellalis* but there are differences in the shape of the ostium, the size of the signum and the pattern of the wings. The New Guinea specimen probably represents a new subspecies or possibly even a distinct species, allied to *semitessellalis*. In the absence of a male, I do not propose a name for this New Guinea specimen. The majority of specimens examined were similar in pattern to the holotype. This species has a smaller signum than *C. ignotalis*, most of the other species in the genus lack a signum.

DISTRIBUTION. Australia; [New Guinea?].

MATERIAL EXAMINED

Holotype ♂. AUSTRALIA: Moreton Bay, B.M. slide no. 8309, in BMNH.

AUSTRALIA: 2 ♂, Mt Tamborine, Queensland, 1500 ft, 15.xi.1942 (*Tindale*), in South Australian Museum; 3 ♂, 1 ♀, Mt Tamborine, 4.xi.1961 (*Common & Upton*), in C.S.I.R.O., Canberra; 1 ♂, Queensland, Lamington National Park, 2700 ft, 7.xi.1961 (*Common & Upton*), in C.S.I.R.O., Canberra; 1 ♀, Queensland, Brisbane, in C.S.I.R.O., Canberra; 1 ♂, New South Wales, Upper Allyn River, 1000 ft, 8.xi.1960 (*Common & Upton*), in C.S.I.R.O., Canberra; [NEW GUINEA: 1 ♀, Fly River, Kiunga, 2.vii–31.x.1957 (*Brandt*), in C.S.I.R.O., Canberra].

Canaea plagiata (Warren) **comb. n.**

Letchena plagiata Warren, 1897: 382.
[*Rhodoneura semitessellata* sensu Warren, 1898: 223, nec Walker, 1897, misidentification.]
[*Rhodoneura semitessellata* sensu Dalle Torre, 1914: 33, nec Walker, misidentification.]
[*Rhodoneura semitessellata* sensu Gaede, 1932: 755, nec Walker, misidentification.]

This species is separated into four subspecies, partly on pattern and partly on differences in the shape of the uncus and juxta in the male genitalia. The minutely ciliate antennae and larger size together with the strongly clavate uncus, very enlarged sacculus and terminal spine on the aedeagus separate this species from the others in the genus. The females usually have strongly sclerotized processes on either side of the ostium.

Canaea plagiata plagiata (Warren)
(Pl. 4, fig. 24; Pl. 11, figs 62, 65)

Letchena plagiata Warren, 1897: 382.

♀. Wing, 18·5–21 mm. Vertex pale brown. Antennae minutely ciliate. Labial palps with third segment ½ length of second. Tegulae and thorax pale brown. Frenulum triple.

Hind tibia with outer spur of distal pair less than ½ length of inner spur. Fore wing, pattern as in Pl. 4, fig. 24, orange-brown with brown pattern and translucent areas. Veins R_1, R_2, R_3, and R_4 run close together but do not join. Hind wing, colour and pattern as fore wing.

GENITALIA ♀ (Pl. 11, figs 62, 65). Anal papillae short. Ostium heavily sclerotized with two prominent, leaf-like, lateral processes. Ostium and processes strongly spinose. Duct of bursa convolute. No signum. Secondary sac arising from opening of bursa to duct.

♂. Unknown.

DISCUSSION. This subspecies can be separated from the others by the reduction of the grey-brown patterning in the subterminal area of the fore wing. The rest of the colour is more orange-brown than in the other subspecies. The lateral processes on the ostium are more strongly toothed in *C. p. plagiata* than in the other subspecies.

DISTRIBUTION. Trobriand Islands.

MATERIAL EXAMINED

LECTOTYPE ♀, here designated. TROBRIAND IS: Kiriwini, 1895 (*Meek*), B.M. slide no. 10820, in BMNH.

Paralectotypes. TROBRIAND IS: 4 ♀, data as type.

Canaea plagiata albicollaris (Warren) **stat. n., comb. n.**
(Pl. 4, fig. 21; Pl. 8, fig. 46)

Letchena albicollaris Warren, 1907: 104.
Rhodoneura albicollaris (Warren) Dalle Torre, 1914: 18.
[*Rhodoneura sordidula* sensu Gaede, 1932: 757, nec Pagenstecher, 1892, misidentification.]

♂. Wing, 17·5–18·5 mm. Vertex white anteriad, brown posteriad. Antennae minutely ciliate. Labial palps with third segment ⅓ length of second, upturned, just reaching vertex. Patagia white. Thorax and tegulae reddish brown. Hind tibia with scale tufts and outer spur of distal pair less than ½ length of inner spur. Fore wing, pattern as in Pl. 4, fig. 21, grey-brown with lighter areas and reddish brown edges to circular areas. Basal area grey with black spots. Underside, similar, paler. Veins R_1, R_2, and R_3 arise close together from cell but do not anastomose. Hind wing, pattern and colour as fore wing.

GENITALIA ♂ (Pl. 8, fig. 46). Uncus strongly clavate. Gnathum and socii joined round anal tube. Valve slenders in apical half. Sacculus very enlarged, basal process on each side of membranous juxta short, pointed with broad base. Base of costa of valve with prominent sclerotized process. Aedeagus with small sclerotized plate and row of small spines. Apex of aedeagus with strong, sclerotized, thorn-like spine.

♀. Wing, 19–21 mm. Pattern as male but more orange-brown. Labial palps with third segment ½ length of second. Venation as male but vein R_3 and R_4 closer together than in male.

GENITALIA ♀. Similar to nominate subspecies but lateral process on each side of ostium smaller and with less serrate edges.

DISCUSSION. This subspecies cannot be separated from *p. neoalbicollaris* externally in the male but in the genitalia the sclerotized process on the base of the costa of the valves is broader in *p. neoalbicollaris* than in *p. albicollaris*, and the process on the sacculus is more angled in *neoalbicollaris*. The females are very distinct on pattern and *neoalbicollaris* is generally more red-brown than *albicollaris*. In the genitalia the duct of the bursa of *neoalbicollaris* is more sclerotized than *albicollaris* and less convolute. This latter also distinguishes it from the nominate subspecies. The relationship of *albicollaris* and *neoalbicollaris* is not clear. The females are very distinct but the males are less so, the reverse condition of the other species of the genus. The males of *neoalbicollaris* are associated with the females on locality (see under *neoalbicollaris*).

DISTRIBUTION. New Guinea.

MATERIAL EXAMINED

LECTOTYPE ♂, here designated. NEW GUINEA: Biagi, Mambare R., 5000 ft, iv.1906 (*Meek*), B.M. slide no. 10818, in BMNH.

Paralectotypes. 2 ♂, data as type.

Other material. NEW GUINEA: 1 ♂, Biagi, Mambare R., 5000 ft, iv.1906 (*Meek*) (not mentioned in original description); 1 ♀, Kumusi R., low elev. (*Meek*); 2 ♀, Gulf of Papua, Omati, 26–27.iii.1952 (*Barnett*).

Canaea plagiata neoalbicollaris subsp. n.

(Pl. 4, figs 22, 23; Pl. 8, fig. 47; Pl. 11, figs 63, 64)

♀. Wing, 18–18·5 mm. Labial palps long, protruding well in front of head, third segment equal in length to second segment, otherwise as in nominate subspecies. Fore wing, pattern as in Pl. 4, fig. 23, reddish brown with small rounded areas. Basal area with patches of red. Thorax red-brown, tegulae brown. Underside, pattern as upperside but red colour not as prominent. Veins R_1, R_2 and R_3 approach closely but do not join. Hind wing, colour and pattern as fore wing.

GENITALIA ♀ (Pl. 11, figs 63, 64). Anal papillae short, ostium sclerotized. Short sclerotized part of duct with lateral diverticulum. Duct narrows, then broader, sclerotized and regularly spinose part with few convolutions. Bursa with two small patches of spines, secondary sac present.

♂. Wing, 16·5–19 mm. Similar to *p. albicollaris*. Fore wing, pattern as in Pl. 4, fig. 22.

GENITALIA ♂ (Pl. 8, fig. 47). As *p. albicollaris* but differing in shape of sclerotized process at base of costa and in more angled sacculus processes on each side of juxta.

DISCUSSION. The female is very distinct from *albicollaris* and could even represent a new species. The males associated with it were all collected in the same locality and at the same time but it is possible that these males should be associated with *albicollaris*; there are however, small differences in the genitalia. In a short series, it is not clear how much of this is due to intra-specific variation or how much is specific differences. The only other female is from the Amazon Bay area in New Guinea. This specimen matches the type in pattern and has the sclerotized duct to the bursa but it has small lateral sclerotized processes on the ostium which are completely lacking in the holotype.

DISTRIBUTION: New Guinea; Papua.

MATERIAL EXAMINED

Holotype ♀. PAPUA: Hydrographers Mts, 2500 ft, ii.1918 (*Eichorn* Bros.), B.M. slide no. 10815, in BMNH.

Material not included in the type-series. NEW GUINEA: 1 ♀, Amazon Bay, Dogon, 2300 ft, 13.ix–11.xii.1962 (*Brandt*), in C.S.I.R.O., Canberra; 4 ♂, Amazon Bay, Doveta, 2400 ft, 24.vii–11.ix.1963 (*Brandt*), in C.S.I.R.O., Canberra; PAPUA: 2 ♂, data as type; 1 ♂, Hydrographers Mts, 2500 ft, iv.1918 (*Eichorn* Bros.).

Canaea plagiata propinquita subsp. n.
(Pl. 5, figs 25, 26; Pl. 8, fig. 48; Pl. 11, figs 66, 67)

♂. Wing, 16–18 mm. Similar to *C. plagiata albicollaris*. Fore wing, pattern as in Pl. 5, fig. 25, orange-brown with brown basal areas. Venation as nominate subspecies.

GENITALIA ♂ (Pl. 8, fig. 48). Uncus strongly clavate, less rounded than nominate subspecies. Gnathus with two small spines near mid-line and small sclerotized median projection. Sacculus process on either side of membraneous juxta very small. Sclerotized process near base of costal margin of valve broad, with more processes than nominate subspecies. Aedeagus with small sclerotized plate and row of teeth. Curved sclerotized process at apex of aedeagus.

♀. Wing, 18–18·5 mm. (Pl. 5, fig. 26). Pattern as male but darker coloured, more orange-brown or red-brown. Labial palps long, third segment equal in length to second segment. Frenulum triple.

GENITALIA ♀ (Pl. 11, figs 66, 67). Anal papillae short. Lateral processes on ostium spiny and serrate. Duct strongly convolute. Bursa with minute spines and secondary sac.

DISCUSSION. From the other subspecies, the male can be separated by the narrow brown patch in the hind margin of the median area of the fore wing and the much reduced sacculus processes on either side of the juxta. The spine at the apex of the aedeagus is at a more obtuse angle than in the other subspecies. The females are generally darker than the nominate subspecies and have a smaller lateral process to the ostium. From *plagiata neoalbicollaris* the females can be separated by the lack of the sclerotized ductus and from the females of *plagiata albicollaris* by the greater distance between the two lateral lobes of the ostium in *plagiata propinquita*. This subspecies seems to replace *plagiata albicollaris* in West Irian.

DISTRIBUTION. Indonesia: West Irian.

MATERIAL EXAMINED

Holotype ♂. INDONESIA: West Irian, Nr Oetakwa R., Snow Mts, up to 3500 ft, x–xii.1910 (*Meek*), B.M. slide no. 10806, in BMNH.

Paratypes. INDONESIA: 7 ♂, data as holotype; 6 ♂, Upper Setakawa, Snow Mts, 2–3000 ft, viii–ix.1910 (*Meek*); 3 ♂, Mt Goliath, 5000 ft, 13° long., ii.1911 (*Meek*); 1 ♂, 1 ♀, Wandammen Mts, xi.1914, 3–4000 ft (*Pratt*); 2 ♂, Fak-Fak, xii.1907 (*Pratt*), 1700 ft; 1 ♀, Waigeu, Camp Nok, 2500 ft, iv.1938 (*Cheesman*); 2 ♂, Ninay Valley, Centr. Arfak Mts, 3500 ft, ii–iii.1909.

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PAUL E. S. WHALLEY, M.Sc.
Department of Entomology
BRITISH MUSEUM (NATURAL HISTORY)
CROMWELL ROAD
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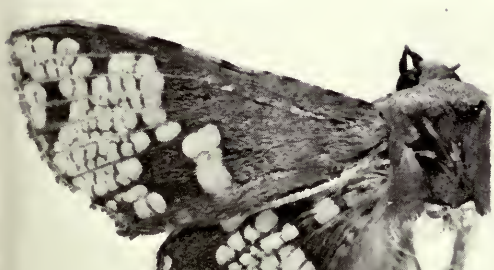
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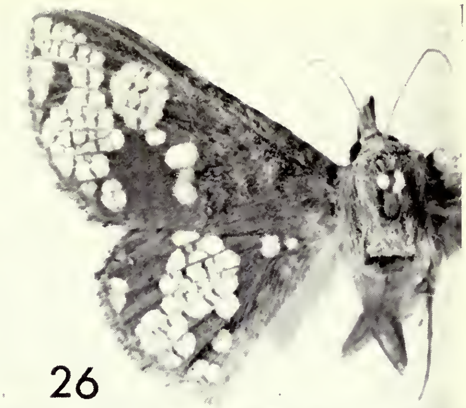
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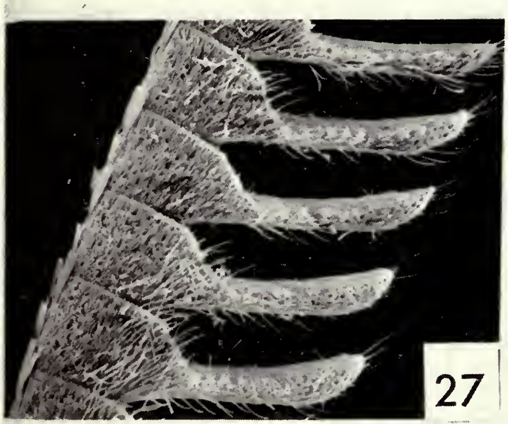
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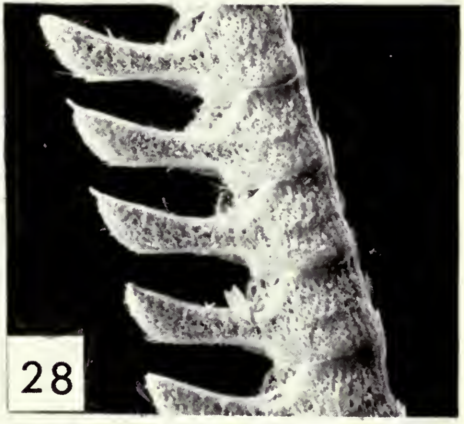
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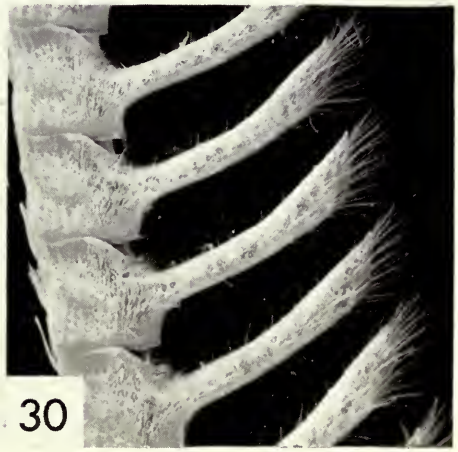
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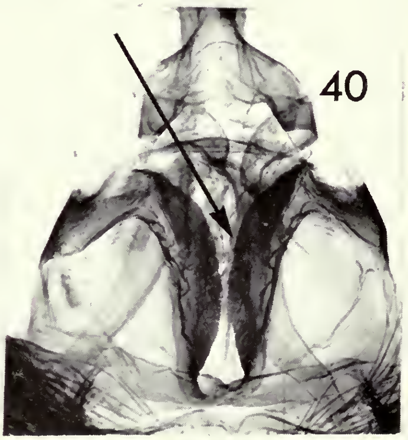

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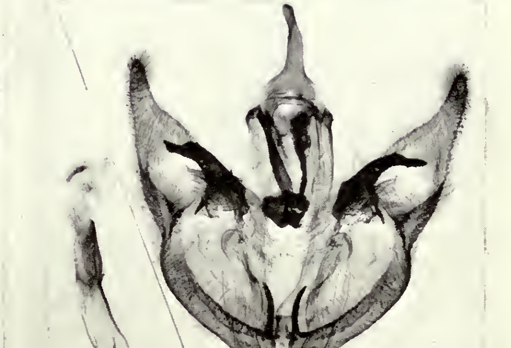

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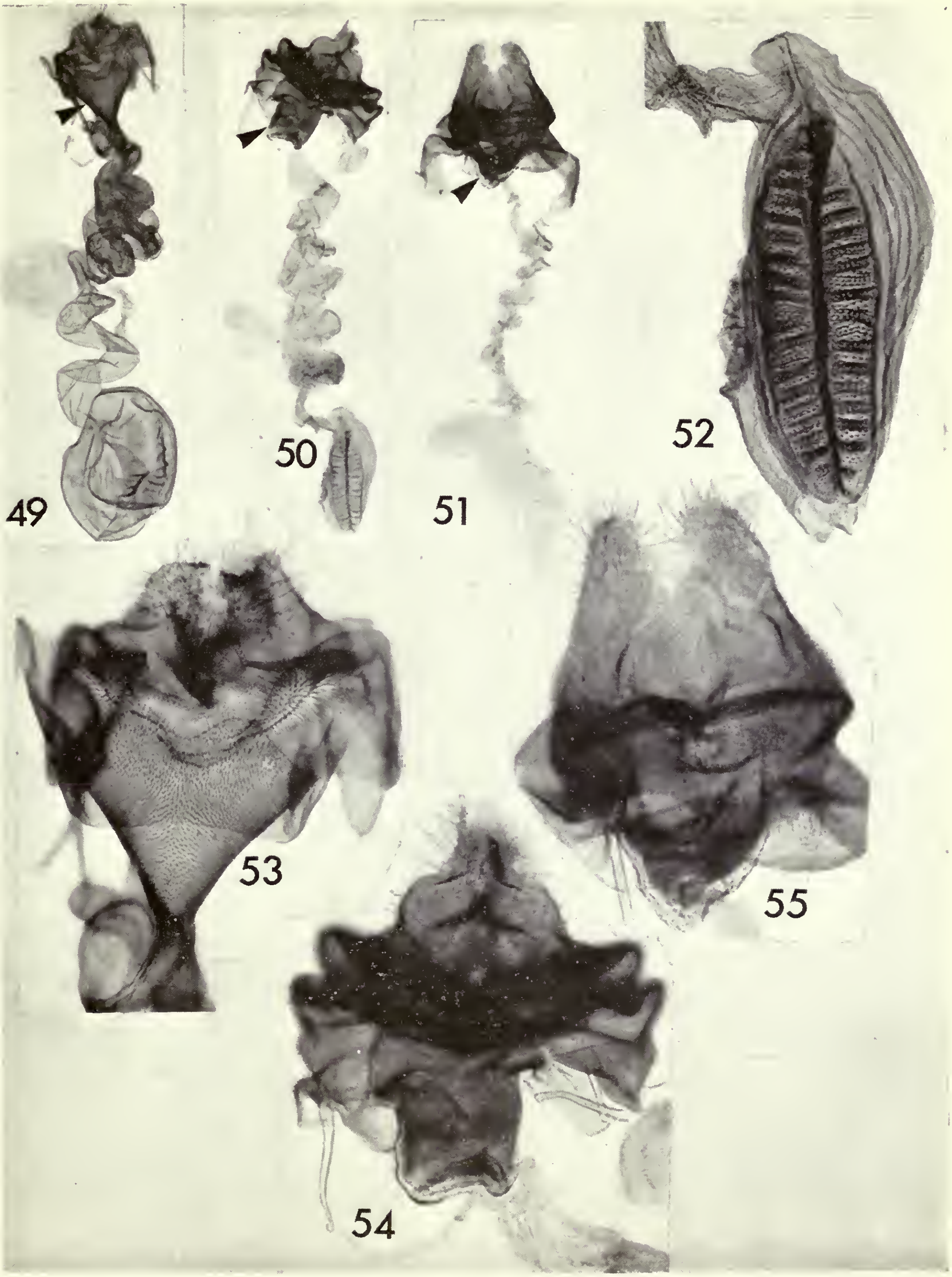
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59 *C. hyalospila hyalospila* (Lower).
60. *C. rusticata aversata* subsp. n.
61. *C. rusticata pallidata* subsp. n.

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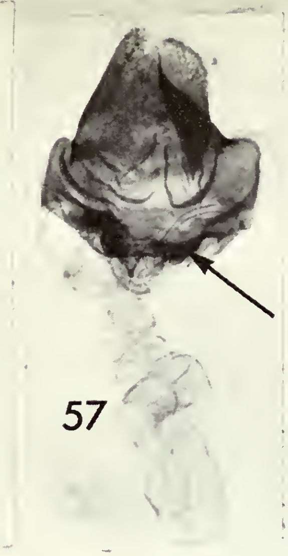

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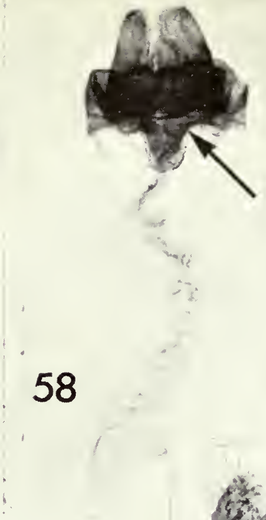

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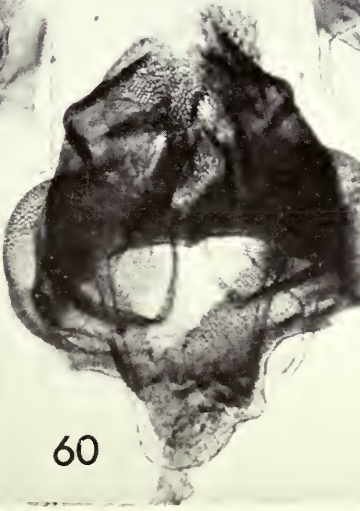

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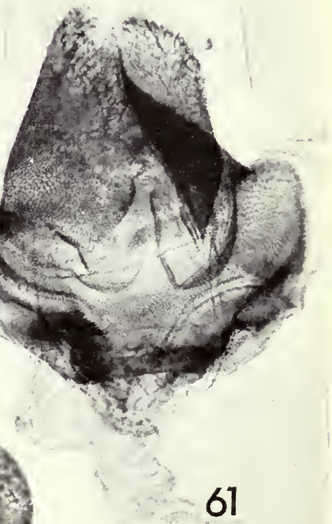

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63. *C. plagiata neoalbicollaris* subsp. n.
64. *C. plagiata neoalbicollaris* subsp. n.
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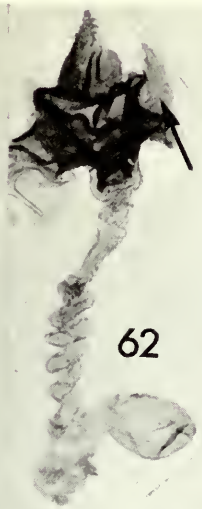
(part of anal papillae not shown in fig. 62).
66. *C. plagiata propinquita* subsp. n.
67. *C. plagiata propinquita* subsp. n.



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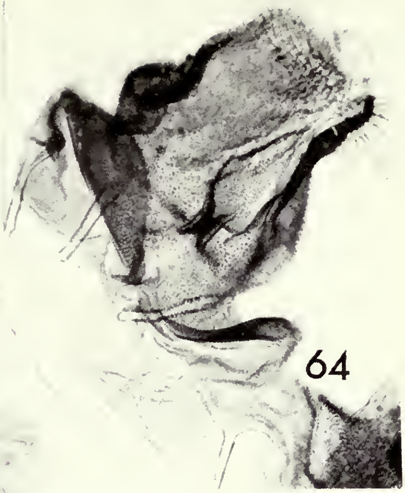

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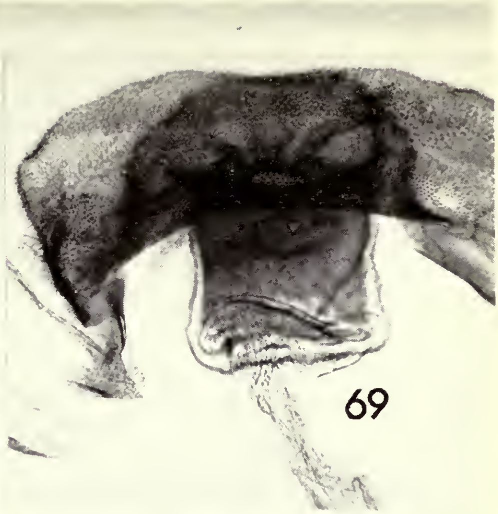
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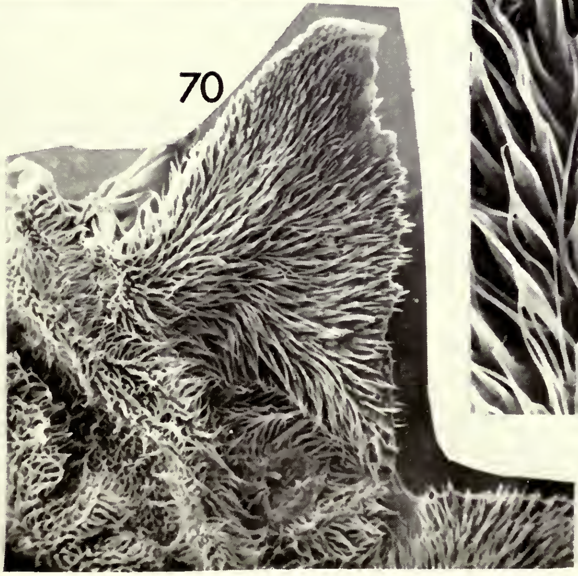
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REVISIONAL NOTES ON AFRICAN *CHARAXES* (LEPIDOPTERA : NYMPHALIDAE)

PART VII

V. G. L. VAN SOMEREN

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ENTOMOLOGY Vol. 26 No. 4
LONDON: 1971

REVISIONAL NOTES ON AFRICAN *CHARAXES* (LEPIDOPTERA : NYMPHALIDAE)

PART VII

BY

VICTOR GURNER LOGAN VAN SOMEREN
The Sanctuary, Ngong
P.O. Box 24947, Karen, Kenya

Pp. 181–226; 6 *Maps*, 11 *Plates*

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REVISIONAL NOTES ON AFRICAN *CHARAXES* (LEPIDOPTERA : NYMPHALIDAE)

PART VII

By V. G. L. VAN SOMEREN

CONTENTS

SYNOPSIS

Nine species and their subspecies and forms are dealt with in this paper, in which eleven new subspecies are described and one name synonymized.

1. *CHARAXES CASTOR* CRAMER AND *CHARAXES HANSALII* FELDER

Charaxes castor Cramer

THIS is a wide-spread species, extending from the west coast of Africa (Guinea) across Africa to the east coast, south to Delagoa Bay and to the Comoro Islands. Several forms have been described and named, but true subspeciation has only taken place in the eastern parts of its range. Apart from variation of the underside, especially in the ground colour, there is evidence of alteration in the size of the insect, presumably in response to its environment. Thus specimens from the Ivory Coast, though agreeing in colour and pattern with nominate *castor* and those from further east in the Congo and Uganda, are small in comparison. On the east coast, nominate *castor* is replaced by *flavifasciatus*, which is a paler-barred insect, but we find that on Pemba Island the endemic race is strongly orange-banded, and the race on the Comoro Islands is even more orange. In the drier parts of Ethiopia and Somalia, the place of *castor* is taken by an allied species *hansalii*, but there is now considerable overlap of the two species.

The wide distribution and success of the species appears to be due, in part, to the multiplicity of its food plants, most of which are abundant throughout its range. *Vide* Biological Note, *post.*)

Charaxes castor castor Cramer

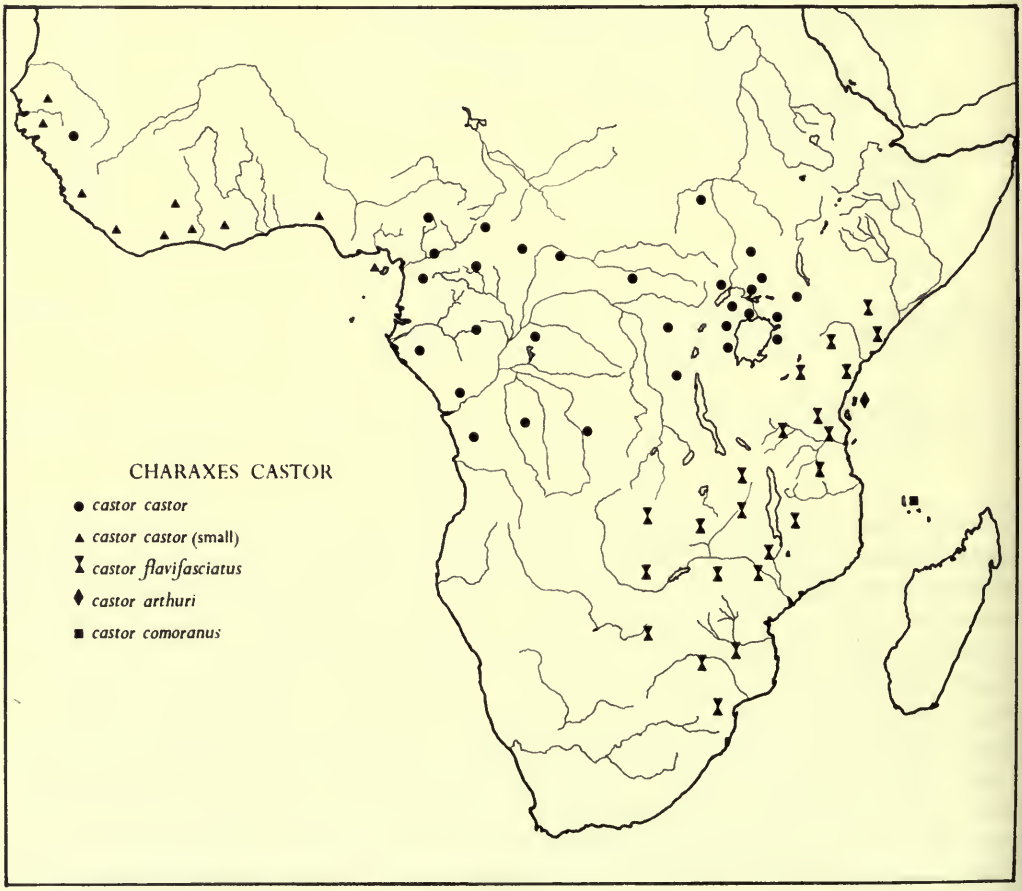
(Pls 1–2, figs 1–7, Map 1)

Papilio Eques Achivus castor Cramer, 1775, 1776 : 61.

For full synonymy, *vide* Stichel, 1939 : 398–402.

AREA 1. SENEGAL, GUINEA, SIERRA LEONE

MALE. Fore wing length 45–50 mm. Shape of fore wing narrow with elongate appearance, rather pointed, but outer margin not strongly incurved. *Upperside.* Ground colour of fore wing brownish black, blacker over the cell and outer border. Disc of wing crossed by an orange-ochre band, rather narrow at hind margin in 1a and 1b, 5 mm where the marks are somewhat quadrate, band divides into two at 2, the discal marks in 2–3 deeply incised on outer border;



MAP 1

mark in 4 narrow, elongate, those in 5 and 6 set out and more quadrate, or the upper one may be angled on outer border. The postdiscal marks are smaller, but increasing in size from 2 to the subcosta, the lower spots may be conjoined to the marks in 2–3 in their lower parts. Margin with only a trace of whitish fringe. Hind wing ground colour brownish black, shading to more greyish on the inner fold ; border black; discal bar widest at the costa, 8–7 mm, tapering rapidly to a point at 5, the costal part often whitish, the rest orange rufescent, deepening in shade at apex. Submargin with conspicuous blue spots above anal angle and in the two spaces above, seldom with a trace beyond; admargin with blue interrupted broken lunules to 5–6, shading to orange ochreous toward upper angle; border black, with white fringe between ends of veins; margin bluntly dentate. Tails black, upper 4 mm, lower 6 mm. *Underside.* Fore wing ground colour at basal half of wings black, which is the dominant form. The subcostal area crossed by white bars, a double bar at base, followed by an 'O' or 'U' mark, then a single line, then a close-set double line, all in the cell; an irregular 'V' mark beyond; basal white lines present in 1b–3. The discal bar is here represented by irregular-shaped white marks in the discal line and by an ochreous line in the postdiscal row, the two rows separated by black triangular marks increasing in size from 2 to costa. The border of the wing greyer in ground colour than base, with a row of black marks of decreasing size, large and double in 1b, and extending to the costa, these marks distally bordered with silvery grey or greenish grey; margin with obscure greyish lunules, interrupted by black. Hind wing ground colour black to discal line, crossed by irregular double silvery lines, in parallel formation on inner fold. Discal band silvery white, widest at the costa, 4–5 mm, narrower than above, tapering rather strongly to above anal angle, then crossing the inner fold at an obtuse angle. Postdiscal zone with a strong deep purplish chestnut band, serrate on its outer edge and abutting on a zone of grey, widest at tornus and ornamented with silvery grey angular marks at tornus, becoming less angular and more rounded and forming ocelli between tails, the anal angle olive-black in ground colour, carrying two lilac spots, this and ocellus outlined proximally by ochreous olive, extending as a line up the admargin of the wing which is black, edged narrowly with a white fringe. The above description of the underside applies to a majority of *castor* but was described as var. *godarti* Aurivillius to distinguish it from the type of nominate *castor*, which has the basal portions of the wings chestnut. (Pl. 1, fig. 1.)

In nominate *castor*, the ground colour of the bases of fore and hind wings are chestnut.

Variation. *antiqua* Le Cerf, 1923. The type-specimen, from Old Calabar, which has been examined, is a female, and is very old and faded, and one wonders why the specimen was described and given a name. However it is well named '*antiqua*'! *Upperside.* The ground colour, more brown than black, is normal in this sex; the orange bar is dull, especially the postdiscal series of spots which are slightly suppressed. On the hind wing, the submarginal and admarginal spots are obscured. *Underside.* The whole surface is so rubbed that it is difficult to make out what was the original coloration, but nevertheless the outer border of the fore wing appears to be a smoky grey, with the black spots obscured. On the hind wing, the chestnut band is dull, paler and narrower than normal; the admarginal orange line is very distinct.

FEMALE. Usually larger than the male and with more or less the same elongate form of fore wing. Fore wing length 55 mm. *Upperside.* Ground colour is less intense black, more brownish in the basal areas and less deep black on the borders. The ochreous orange bar, though similar in formation, is slightly less deep orange and duller and wider. The same remarks apply to the hind wing as regards to general colour and formation of the abbreviated discal band. The tails are longer and thinner, upper 10 mm, lower 10 mm. *Underside.* Very similar to that of the male; in the fore wing the discal bar is buff rather than white, and the postdiscal spots usually separated and duller. The submarginal black marks show up more strongly on a greyer ground. (Pl. 1, fig. 2).

AREA 2. IVORY COAST, GHANA, W. NIGERIA

We have noted that specimens from the Ivory Coast and Ghana are smaller as a rule; the males have a fore wing length of 45 mm–46 mm; they are also blacker in ground colour, with strongly contrasting orange bars. The hind wing submarginal blue spots are small and may be reduced in number or be almost obsolete. There is no noticeable difference on the underside.

AREA 3. CENTRAL AFRICAN REPUBLIC, CAMEROUN, MOYEN CONGO, GABON, FERNANDO PO, N. ANGOLA, CONGO, N. KATANGA, UGANDA, N. W. KENYA, S. ETHIOPIA, LAKE VICTORIA & N. W. TANZANIA.

MALE. Fore wing length uniform 50–53 mm. *Upperside.* Ground colour of fore wing deep velvety brown-black, blacker on the borders of wings. Disco-postdiscal orange bar strong; margin with minute white dots more in evidence at the tornus. Hind wing ground colour as fore, slightly browner at base and along the inner fold, where there may be a obscure whitish line above anal angle. Submarginal blue spots usually strong and bluer, but may be obscured above upper tail. Upper tail short, sharply pointed, 3–4 mm, lower 9 mm, often slightly curved. *Underside.* As in the more western specimens, but pattern usually bolder and stronger, the purplish chestnut band in the hind wing being very well developed. (Pl. 1, fig. 3.)

FEMALE. Fore wing length 56–58 mm. *Upperside.* Ground colour not so deep black as male, but more brownish. Fore wing discal bar well developed and slightly paler than in males; marginal white spots more in evidence. Hind wing discal bar paler, the submarginal blue spots strong, with vestige of spots to 5; admarginal blue lunules strong, shading to orange from 5 to upper angle. Underside as in male but pattern bolder. (Pl. 1, fig. 4.)

It is of interest to note that specimens in this area from Bangui, Central African Republic run to considerable size, males have the fore wing length up to 50 mm and females up to 60 mm, thus agreeing more with the specimens from the Congo and Uganda.

Female aberrations: 1) *flavimarginalis* Stoneham (1936: 2) is an otherwise normal female with most of the admarginal lunules in the hind wing ochre in colour.

2) An interesting aberration has large blue submarginal spots extending from the anal angle to upper angle. (Pl. 1, fig. 5.)

Male aberrations: 1) Aberration *aginga* Stoneham (1931 : 1) is almost entirely melanistic on the fore wing, but the two upper postdiscal spots are still visible, the rest of the discal and postdiscal spots almost entirely obliterated. On the hind wing, which is also melanistic, there is a remnant of the orange discal bar in the costal region; the submarginal blue spots are strong to 5; the admarginal lunules obscured, but the white fringe on edge of wing strong above upper tail. Underside pattern more or less as in the normal male, but the discal bar is greyish white; the postdiscal orange spots reduced in size; the outer border of wing strongly greyish in ground colour, but black marks are reduced in size. Hind wing shows little change except that the purplish chestnut marks are reduced in size and more separated; the border of wing more greyish, the orange admarginal line obscured.

2) An aberration very similar to *aginga*, but fore wing blacker, with no clear orange spots in postdiscal line, but just the faintest indication of the joint bar visible. Tornus with two ochreous spots in 1b. Hind wing with a mere trace of the discal bar in subcostal region, the submarginal blue spots bold, and in diminishing size, extend to the upper angle; the admarginal lunules are strong, blue to upper tail, then orange to upper angle. Underside as in *aginga*, the fore wing discal bar is greyish white, more greyish in subcostal region while the postdiscal orange spots are reduced and separated; the border of the wing grey, with the black marks clear. On the hind wing the pattern is almost normal, though the admarginal border is greyish ochre to orange. Edge black with bold white fringe. (Pl. 2, fig. 6.)

3) A melanistic aberration which on the upper side retains bold orange marks of very reduced size in the discal line, and barely a trace of marks beyond in both lines. On the hind wing the whole is melanic, leaving only a trace of the discal bar in subcostal area. The blue submarginal spots limited to a double blue spot in the anal angle and smaller spots in spaces above. No trace of an admarginal line, but white fringe on edge distinct. Underside, the whole base of the fore wing except for basal half of costa and area 1a, solidly black. In the discal line the

bar is reduced and buffish in colour to 2, the upper marks reduced in size and greyish in colour; in the postdiscal line the orange bar is strong in 1b then becomes obscured; the submarginal black marks, large at tornus, are obscured by the dark blue-grey of the ground colour on border; the margin carries a series of black marks. Hind wing: basal area to discal line jet-black with just a few white lines on inner fold; the discal bar is white, shading to greyish then black at anal angle, this greyish band crossed by strong black rays; border of wing black, fringe white. (Pl. 2, fig. 7.)

RANGE. From Guinea, Senegal, Sierra Leone, Ivory Coast, Ghana, and western Nigeria for the small ecological form. From Cameroun, Central African Republic, Moyen Congo, Gabon, Fernando Po, N. Angola, Congo and N. Katanga to Uganda, N. W. Kenya, S. W. Abyssinia and N. W. Tanzania for the larger ecological form.

Charaxes castor flavifasciatus Butler

(Pl. 2, figs 8, 9, Map 1)

Charaxes castor var. *flavifasciatus* Butler, 1895 : 251.
?*Charaxes hansalii* Butler, *nec* Felder, 1891 : 42.
Charaxes castor var. *orientalis* Lanz, H., 1896 : 140.

Differs from nominate *castor* by its generally lighter, more brownish ground colour at bases of wings, and paler ochreous bars on fore and hind wings. It thus bears some resemblance to *Charaxes hansalii* Felder, with which it might be confused, especially with the larger subspecies *baringana*. There is some variation in the ground colour of the upperside, which is not related to season or environment, the colour varying from black to rufous; this occurs in both sexes. On average smaller than *castor castor*, except the small form of Ivory Coast, the males varying in fore wing length from 44–49 mm, and the females from 50–55 mm.

MALE. Shape of fore wing very similar to *castor*, but less elongate, the outer margin slightly incurved at 2–3. *Upperside*. Ground colour at base of wing brownish black or black, darker in region of disc and outer border; the margin of wing with distinct whitish marks; the disco-postdiscal bar paler ochreous orange to ochreous, formed in similar manner to *castor*. Hind wing brownish black to grey-brown at base, shading to grey or almost whitish on inner fold, with a whitish spot on fold above anal angle. Discal bar pale orange-ochre to ochre, whiter at the costa, tapers to lower part of cell where it becomes dyslegnic. Border of wing broadly black, the hind angle with three or four blue spots, double and largest at anal lobe, the spots diminishing in size; admargin with series of lunules, greenish at anal angle, then blue to 5, shading to ochreous at upper angle; these lunules may be broken and become obsolete toward the upper angle. Tails thin and sharply pointed, upper 7 mm, lower 11 mm, black. *Underside*. Pattern basically similar to that of *castor castor* but generally brighter. Fore wing, ground colour at base of wing chestnut, crossed by black bar strongly bordered in white; the discal bar satiny white, separated from the postdiscal ochreous line by rounded black marks; border of wing silvery bluish grey in which the graduated submarginal black marks show up strongly; margin with alternating black and white linear marks. Hind wing basal area chestnut with pattern of black bars outlined in white, finer than in *castor castor;* the discal silvery bar narrower than orange bar above, more tapering, and extending to above the anal angle where it crosses the inner fold at an oblique angle; chestnut zone strong, the marks distally angled and outlined in white and intruding into the greyish submarginal band; the admarginal ochreous line shading to whitish distally, is bounded proximally by a row of fine black lunules; marginal black lunules with white fringe well marked. (Pl. 2, fig. 8.)

FEMALE. *Upperside*. Coloration very similar to male, slightly more brownish at base of wings. Pattern of fore wing similar, marginal white streaks bolder. Hind wing as in the male, discal bar equally pale ochreous; submarginal blue spots usually larger; the admarginal lunules bolder, bluish green at anal angle, shading to whitish then ochre at the upper angle. Margin of wing bluntly dentate, but tails long and thin, 10–13 mm, black. *Underside.* Pattern as in the male, but bolder. The hind wing admarginal ochreous line bolder, often shading to whitish distally. (Pl. 2, fig. 9.)

Variation. reimeri Rothschild, 1900, only differs in having the ground colour at bases of wings on the underside black, instead of chestnut. Locality. Tanzania, Dar-es-salaam.

RANGE. Malawi, occurring also in Manicaland, N. Transvaal, N. Natal, Mozambique, Rhodesia and Zambia; ranging through Tanzania mainly in south, east and north to Kilimanjaro area; common in Kenya from the coastal belt inland to Teita and Ukambani, all east of the Rift Valley.

***Charaxes castor arthuri* ssp. n.**

(Pl. 2, figs 10, 11; Pl. 3, figs 12, 13, Map 1)

This interesting new race of *castor* was brought to light when Dr Arthur Rydon paid a brief visit to the island of Pemba in September 1963, in search of the elusive female of *Charaxes pembanus* Rothschild. By the use of special traps he succeeded in taking one male and four females of *castor*. Although Pemba Island is near the east coast of Tanzania, east of Tanga, it is separated from the mainland by a deep channel, fathoms deeper than the shallow channel between Zanzibar and the mainland (*Vide* van Someren, 1966: Map C).

Because of the proximity of Pemba to the Tanzanian coast, one might have expected that the representative of *castor* on that island to be identical with, or near to the mainland race *flavifasciatus* Butler, but on the contrary, it bears a closer resemblance in pattern and colour to the nominate *castor castor* of central Africa.

MALE. Fore wing length 46 mm; shape slightly less elongate than *castor castor*, and generally similar to *flavifasciatus*. *Upperside.* Fore wing, ground colour black, slightly browner at base. The disco-postdiscal bars dark orange-ochreous as in *castor castor*, the discal spots in 2–6 smaller, so that the postdiscal spots in 2–4 are more separated from those of the discal bar and more discrete, those of 5–7 less curved toward the costa; marginal whitish spots very small. Hind wing ground colour at base brownish black, shading to greyish brown on inner fold; outer border of wing black; submarginal blue spots small; admarginal blue lunules strong at hind angle but fading out above upper tail, but spot at upper angle white. Margin black with white fringe between the blunt serrations. Tails short, upper 5 mm, lower ? (broken). *Underside.* Fore wing ground colour at base of wing chestnut; white-bordered black bars strong; base of 1a–1b greyish; discal bar slightly buffish white, postdiscal orange-ochre line broken into separate spots; the black submarginal graduated marks distinct, edged bluish grey distally; border of wing greyish, traversed by faint black lunules from tornus to apex; edge black interrupted by white lines. Hind wing ground colour chestnut with the usual white-bordered black marks strong; discal bar white, outer border kinked at cell, tapering toward anal angle and crossing the inner fold at an oblique angle where it becomes slightly buffish. The zone of chestnut triangles, edged greyish, are on a darker greyish ground; admarginal bluish orange line well developed, forming an ocellus, with two lilac spots in the anal lobe. Edge black with white internervular fringe. (Pl. 2, figs 10, 11.)

FEMALE. Fore wing length 55–56 mm. Shape as in the male or less incurved on the outer border. *Upperside.* Fore wing ground colour deep brownish black; border blacker. A trace of an orange spot at end of cell and one beyond in two specimens. Disco-postdiscal orange-ochre bar as in the male. Margin of wing with minute white linear marks. Hind wing ground colour greyish brown at base fading to smoky grey on inner fold, paler mark above anal angle. Discal bar pale at costa, then more strongly ochre, tapering toward the cell where it merges into the ground colour and is dyslegnic. Border of wing broadly black; submarginal blue spots at hind angle rather linear; admarginal blue line to above upper tail shades to ochreous at upper angle; margin bluntly serrate, tails long and thin, upper 11 mm, lower 11 mm, slightly curved. *Underside.* Fore wing coloration and pattern as in the male, but bolder. Hind wing orange-bluish, admarginal line strong, forming ocellus at anal angle which carries two lilac spots, a series of lilac linear marks in spaces above. (Pl. 3, figs. 12, 13.)

Holotype male. PEMBA ISLAND: ix.1963 (*Arthur Rydon*).
Allotype female, same data. To be deposited in the B.M.(N.H.).
Paratypes. Two females, same date.

RANGE. Known only from Pemba Island.

Charaxes castor comoranus Rothschild

(Pl. 3, figs 14, 15, Map 1)

Charaxes castor comoranus Rothschild, 1903 : 310.

This insular race of *castor* from the Grande Comoro Islands presents most interesting features, particularly the depth of colour of the fore wing bar, and the ground colour of the bases of the wings on the underside, both of which bear a closer resemblance to *castor* of western Africa than to *flavifasciatus* of the eastern mainland. (Cf. note on *Ch. c. arthuri*, above.)

MALE. Fore wing length 50–51 mm; shape similar to that of the mainland race and *arthuri* of Pemba Island. *Upperside.* Fore wing ground colour black, slightly browner at base; disco-postdiscal bar deep orange-ochre to tawny orange, the marks in 2–3 strongly angled, that in 4 linear, those in 5–6 quadrate and angular; the postdiscal series of spots well separated from the discal ones, small and ovoid, that at subcosta larger and quadrate. Margin of wing without any white spots. Hind wing ground colour black, more greyish on the inner fold, border of wing broadly black; discal bar short, paler at the costa but shading to rich tawny orange over the cell. Hardly any trace of submarginal spots at hind angle; admarginal line of blue spots greenish at anal angle, then blue, shading to orange at upper angle; margin bluntly serrate with just a trace of white fringe between ends of veins; tails black, short, upper 5 mm, lower 6 mm. *Underside.* Fore wing basically similar to *flavifasciatus* and differs from *arthuri* in that the ground colour at the bases of the wings is black, not chestnut; moreover the white bordered black marks are as bold as in nominate *castor.* In the hind wing the admarginal ochreous-bluish band is broad, and the discal white bar does not cross the inner fold so obviously, the line being very narrowed. (Pl. 3, fig. 14.)

FEMALE. Fore wing length 60 mm. *Upperside.* Fore wing ground colour browner than that of the male but orange-ochre disco-postdiscal bar is similar, though bolder. The edge of the wing without white marks. Hind wing basal area brownish black, more smoky grey on the inner fold with a narrow paler grey mark above the anal angle. Discal bar, pale at costa, darkens to rich ochreous at the cell where it tapers out; border of wing broadly black, the submarginal blue spots at hind angle not strongly marked; the admarginal blue line obscured above upper tail, but represented by an ochreous spot at upper angle. Margin with slight white internervular fringe; edge bluntly serrate, tails comparatively short and thick, upper 7 mm, lower 9 mm. *Underside.* Fore wing ground colour and pattern as in the male but bolder; the upper postdiscal orange spots shading to whitish. On the hind wing there is little difference from the male except that the pattern is larger, and the black spots at the convergence of vein 4 and 5 large and conspicuous. (Pl. 3, fig. 15.)

RANGE. Confined to Grande Comoro, Mayotte and Comoro Islands.

Biological Note

It was noted in the introductory remarks that *castor* was a highly successful species, probably due to the abundance of its multiple food plants; amongst these we have listed:—Gramineae, *Sorghum* spp. very commonly; Celastraceae, *Gymnosporia senegalensis, et al.*; Ulmaceae, *Chaetacme macrocarpa*; Caesalpinaceae, *Afzelia cuanzensis* & *Afzelia* sp.; *Bauhinia* spp.; *Brachystegia* spp., *Erythrina* sp.; *Entada* sp.; Euphorbiaceae, *Tragia* spp.

For full life history, *vide* van Someren (1926 : 338); van Someren & Rogers (1928 : 12); van Someren & Rogers (1929 and 1930): 31 & 33.

Charaxes hansalii hansalii Felder

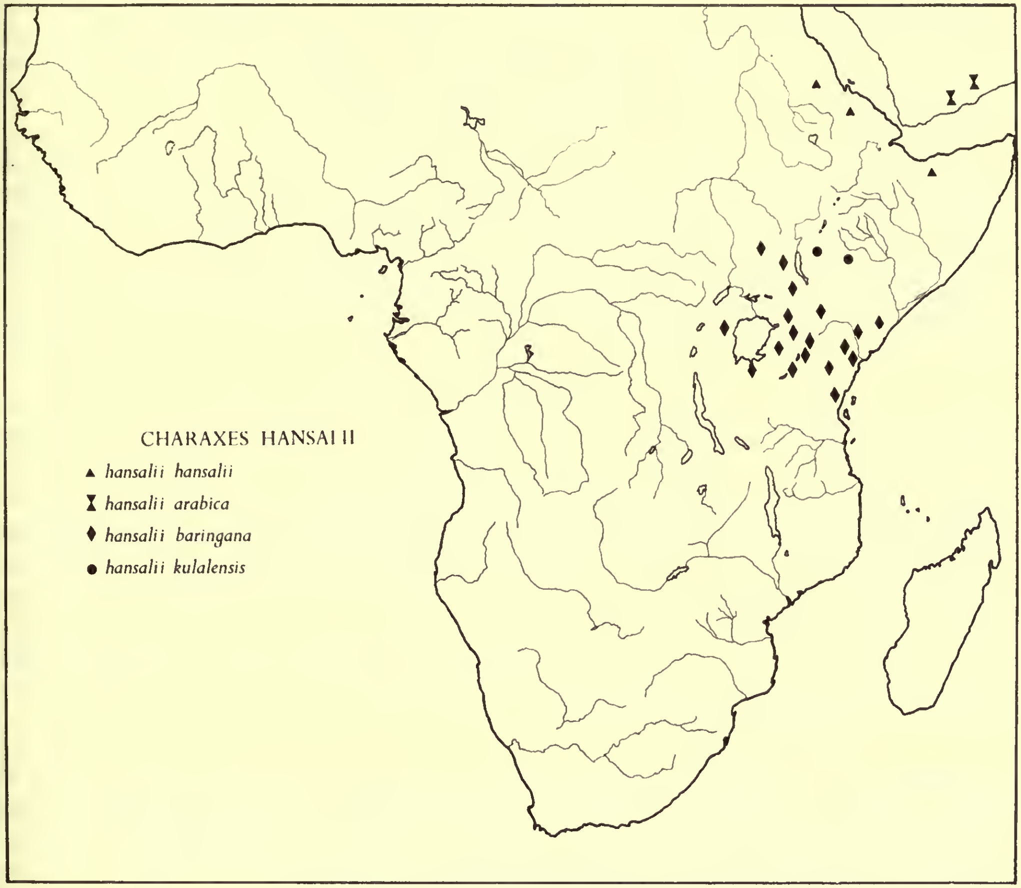
(Pl. 3, figs 16, Map 2)

Charaxes hansalii Felder, 1866 : 446, Pl. 59, figs 5–6.

MALE. Fore wing length 38–40 mm. *Upperside.* Fore wing shape rather pointed at apex, outer margin slightly incurved. Ground colour at base olive-brownish, shading to black beyond cell and outer border; an obscure ochreous spot usually present beyond end of cell; discal bar strongly developed, creamy ochre in colour, crossing the wing from the hind border to subapex, 5–7 mm wide at hind margin in 1a–1b, spot in 2 smaller, outer border oblique, spot in 3 similar in shape but set out slightly, mark in 4 elongate, that in 5 again set out and quadrate in shape, the spot in 6 more triangular, two smaller spots in subapex in 6–7, part of a postdiscal series. Margin of wing with distinct creamy internervular marks, double at tornus in 1b. Hind wing basal area olive-brown, shading to more greyish on inner fold, slightly white-edged above anal angle. Distal border of wing broadly black; discal band creamy white in colour at costa, 6 mm wide which becomes slightly darker cream and tapers slightly, then merges into the inner fold above the anal angle. Submargin with small blue spots, double at anal angle, which decrease in size and become obsolete at upper tail; margin with strong creamy linear marks, greenish at anal angle; margin very bluntly dentate, tails long and thin, black in colour, 5–7 mm long. *Underside.* Fore wing ground colour pale chestnut or reddish hazel, crossed in the costal region by black bar narrowly outlined in white, the bars abutting on the discal bar are black. Discal bar white, similar in shape to that above, the marks in 2–5 with oval black marks on distal border, the black spots extending to subcosta between the discal and postdiscal white marks in this area. The white bar distally bordered by a series of reddish hazel lunules or half moons; the border beyond greyish, carrying a series of black rounded spots, double in 1b, diminishing in size as they approach the subcosta at sub-apex. Margin with ochre lunules proximally shaded reddish hazel separated by black spots. Hind wing ground colour reddish hazel, crossed by wavy black lines bordered in white, in parallel series; a black wavy line abuts onto the white discal bar, the distal outline of which is irregular on its borders, and tapering to above the anal angle where it narrows, then expands at the inner fold. There is a conspicuous black spot within the white bar between veins 4 and 5, which is sometimes represented on the upper surface. The bar is distally bordered by a series of black lunules with bluish green shading proximally, double at anal angle; the admargin with a strong line of creamy to ochre lunules bordered on margin by white fringe between ends of veins. (Pl. 3, fig. 16.)

FEMALE. No specimen is available to me, but Rothschild describes it as similar to the male but larger with a fore wing length of 50 mm.

Range. Ethiopia, Bogos (type locality) in northern area; also on the Wagga Mts, in Somaliland.



Map 2

Charaxes hansalii baringana Rothschild

(Pl. 3, figs 17, 18, Map 2)

Charaxes hansali baringana Rothschild, 1905 : 78.

Described from a single specimen in bad condition, taken in the Baringo district in the Rift Valley, Kenya. This race is now known to be widespread in East Africa. The characters given for *baringana* hold good for the majority of specimens, but there is considerable variation, even in one area. There is also some evidence of reaction to environment, particularly as regards size, not amounting to subspecific differentiation.

Male. Fore wing length 39–43 mm. Some males from the Baringo-Kamasia area may vary from 36–42 mm and smaller examples occur in the Suk Country to the north. *Upperside.*

Fore wing. With few exceptions, the basal area is dark brownish olive, darker than nominate *hansalii*, and the disco-postdiscal bar paler and narrower, the postdiscal spots often extending down to 2. The marginal creamy spots larger. Hind wing basal area darker olive-grey, shading to greyish on the inner fold. The discal creamy bar narrower, inward curved on the outer border so that the black border of the wing is wider; the submarginal blue spots, evident at the anal angle, become smaller and die out at 4. *Underside.* The pattern is similar to that of the nominate race but the discal bars narrower, the black spot between veins 4 and 5 on distal side of the white bar variable, from a trace to very strong. (Pl. 3, fig. 17.)

FEMALE. Fore wing length rather variable, 43–50, average 47 mm. *Upperside.* Pattern and coloration generally similar to that of male, but ground colour more brownish olive at bases of wings, the distal portion of the fore wing more brownish black. The disco-postdiscal band of fore wing and that of hind wing broader; the marginal spots on the fore wing and creamy line on admargin bolder. *Underside.* Ground colour slightly paler, and pattern generally enlarged compared with that of male. (Pl. 3, fig. 18.)

Variation. One occasionally captures or breeds a female in which the basal fore wing colour is rufescent olive, and the dark borders of both wings, brownish; the discal bars and marginal spots ochreous; the underside similarly brownish.

RANGE. As already indicated, this subspecies occupies a wide area of country in which the ecological environment varies considerably, resulting mainly in variation in size of the insects. Nominate *baringana* came from the low-lying floor of the Rift Valley, in which both Lake Baringo and Lake Hannington lie at between 2500–3000 ft. This type of savanna semi-desert country extends roughly to the south of Lake Rudolf and north into the Suk-Turkana-Karamoja country in Uganda. Specimens from this area are relatively small. However the subspecies also extends into the higher country of 4000–6000 ft; here the specimens are larger, especially in the female sex. In a southerly direction, where the type of country is still savanna, varying from 3000 ft to sea-level, specimens are, on average, large; but there is every degree of intergradation.

Range: Area 1. Baringo, Kamasia, Suk, and Turkana to Karamoja and southern Sudan. Area 2. Samburu, Ukambani, Masai country, Teita and Shimba Hills and Sekoke-Arabuko on the Kenya coast. Area 3. Trans Nzoia, Kitale district, lower Sotik and Chepalungu, S. Kavirondo, Suna and along the southern shores of Lake Victoria to the western shores of the lake in the Bukoba area.

***Charaxes hansalii kulalensis* ssp. n.**

(Pl. 4, figs 19–22, Map 2)

Specimens from the isolated Mt. Kulal in the north-east of Lake Rudolf and a pair from Nighelli, S. Ethiopia differ from *baringana* on the upperside in the ground colour of the basal area of both wings, which is deeper, more olive-black; the distal portions of the wings blacker. There are two or three obscure subcostal ochreous spots in the fore wing, one in the cell, which is not always present, one at end of cell and one beyond. The disco-postdiscal bar is broader and creamy white, paler than in *baringana*; the marginal spots in fore wing and admarginal line in the hind wing bolder, larger and whiter in colour. The underside pattern is stronger and the chestnut basal ground colour darker.

Holotype male. KENYA: Northern Frontier Province, Mt. Kulal, south east of Lake Rudolf, vi.1961 (*H. D. van Someren*). To be deposited in B.M.(N.H.).

Allotype female. Same data. To be deposited in B.M.(N.H.).
Paratypes. Same data, 2 males, 2 females.

RANGE. Kenya, Mt. Kulal, south east of Lake Rudolf; S. Ethiopia, Nighelli.

Charaxes hansalii arabica Riley

(Pl. 4, figs 23, 24, Map 2)

Charaxes hansali arabica Riley, 1931 : 279.

A male and two females loaned to me by the B.M.(N.H.) are in such bad condition that it is impossible to define the characters of this race adequately. The ground colour of both wings appears darker; the discal band of the male very narrow. I am unable to examine the types which are in the B.M.(N.H.) but give a photograph of them.

RANGE. S. E. Arabia, Qara Mts and Wadi Balsh.

Biological Note

The food plants of all races of *Charaxes hansalii* appear to be *Dobera roxburghi* Pl. and *Salvadora persica* Garcin (Salvadoraceae), especially the latter. Both are found in the drier savanna areas of Kenya and Uganda.

SYSTEMATIC LIST

Charaxes castor Cramer

Charaxes castor castor Cramer, 1775. Type locality: Coast of Guinea.

Range: Area 1. Senegal, Guinea, Sierra Leone. Area 2. Ivory Coast, Ghana and western Nigeria. Area 3. Central African Republic, Cameroun, Moyen Congo, Gabon, Fernando Po, N. Angola, Congo, N. Katanga; Uganda, N.W. Kenya, S. Ethiopia and around Lake Victoria and N. W. Tanzania.
ab. *antigua* Le Cerf, 1923. Nigeria, Calabar.
ab. *aginga* Stoneham, 1931. N. W. Kenya, Trans Nzoia, Kitale.
ab. *flavimarginalis* Stoneham, 1936, N. W. Kenya, Kitale area.

castor flavifasciatus Butler, 1895. Type locality: Malawi, Zomba.
Range: Malawi, Zambia, Mozambique, Manicaland, N. Transvaal, N. Natal, Rhodesia, Tanzania, Kenya Coast and hinterland to Teita and Ukambani; east of the Rift Valley.

Variation: *reimeri* Rothschild, 1900, Tanzania, Dar-es-Salaam.

castor arthuri ssp. n. Type locality: Tanzania, Pemba Island.
Range: Confined to Pemba Island.

castor comoranus Rothschild, 1903. Type locality: Comoro Islands, Mayotte Islands.
Range: Confined to Comoro Islands.

Charaxes hansalii Felder

Charaxes hansalii hansalii Felder, 1866. Type locality: N. Ethiopia, Bogos.

Range: N. Ethiopia, Bogos; also on Wagga Mts, N. Somaliland.

hansalii baringana Rothschild, 1900. Type locality: Kenya, Lake Baringo area.

Range: Area 1. Baringo, Kamasia, Suk, Turkana to Karamoja and S. Sudan. Area 2. Samburu, Ukambani, Masai country, Teita and Shimba Hills and Sekoke Forest, on the Kenya Coast. Area 3. Trans Nzoia, Ktale district, lower Sotik at Chepalungu, S. Kavirondo, Suna and along the southern shores of Lake Victoria to the western shore in the Bukoba area.

hansalii kulalensis ssp. n. Type locality: Kenya, Mt Kulal, south east of Lake Rudolf; S. Ethiopia, Nighelli area.

hansalii arabica Riley, 1931. Type locality: S. E. Arabia.

Range: S. E. Arabia, Qara Mts, and Wadi Balsh.

2. *CHARAXES LUCRETIUS* CRAMER, *CHARAXES ODYSSEUS* STAUDINGER AND *CHARAXES MONTIERI* STAUDINGER & SCHATZ

Charaxes lucretius Cramer

It has generally been assumed that this species has not evolved into geographical races throughout its entire range from Guinea to North West Kenya, with the exception, perhaps, of the insular *Charaxes lemosi* Joicey & Talbot from the island of Principe in the Gulf of Guinea. *Charaxes lucretius lucida* Le Cerf, 1923, is generally regarded as a synonym of the nominate race, being founded on a male variation from the adjoining territory of Liberia, and a female from Guinea, which is the type-locality of the species. (*Vide* Fox, 1965 : 202.)

There is a general similarity of pattern and coloration, on the upperside, of males from the occidental area and those from the eastern extremity of the range; on the underside, however, western representatives are darker, more richly coloured, more purplish vinaceous in ground colour. Moreover, there is a remarkably constant difference in size; western males measure 35–36 mm in length of fore wing, whereas Ugandan males measure 42–47 mm. There is also a difference in size in the female: 41–42 mm as against 46–49 mm in eastern Ugandan examples. It is interesting to note that examples from the Central African Republic and adjoining territories are intermediate in size. It is a moot point as to whether size-differences constitute sufficient grounds for recognising geographical races, unless accompanied by pattern and colour differences. In the case of *Charaxes lucretius* such differences do exist.

When Rothschild (1900 : 410–413) dealt with the species, he had before him mainly western examples. He noted, however, that females from the 'Congo basin' have very pale bands, and he also noted a difference in Ugandan examples.

From the material now available for study, the species appears divisable into four subspecies.

Charaxes lucretius lucretius (Cramer)

(Pl. 5, figs 25, 26, Map 3)

Papilio eques Achivus lucretius Cramer, 1777 : 129, t. 82, figs e & f.
Papilio Nymphalis lucretius Fabricus, 1793 : 84.
Charaxes lucretius Doubleday, 1844 : 111.
Charaxes lucretius lucida Le Cerf, 1923 : 366. **Syn. n.**

MALE. Fore wing length 35–36 mm. *Upperside.* Fore wing base, mainly in the cell area and base of costa rufous cinnamon; a faint trace of a sub-basal black mark, followed by a black mark crescentic or rounded toward the end of the cell, the rufous ground colour seldom extending beyond the cell end; remainder of wing black with a conspicuous postdiscal bar of rufous orange spots, widest towards the hind margin, 4–5 mm, where the spots are contiguous, decreasing in size and separated from 2 to subcosta and arranged in almost a straight line; the subcostal spot is often absent. Margin of wing with triangular or semi-lunate rufous orange marks, double in 1b. Hind wing basal area black, shading to more brownish on inner fold and rufous above anal angle. Disco-postdiscal rufous orange band of almost even width, though often slightly wider at costa where the mark extends proximad, forming an angle with the spot below, is strongly marked to 3 where it tapers and shades into the black submarginal border, which is

MAP 3

almost straight on its inner border, but strongly dentate on outer, where it impinges on the rufous orange border; margin black, slightly dentate; tails short, sharply pointed, 2–3 mm long; two lilac spots present in anal angle. *Underside.* Fore wing, ground colour reddish chestnut with a strong vinaceous bloom distad, but slightly paler towards hind margin. Black marks in cell, outlined in bluish white, are: one sub-basal, one more pear-shaped, one straight or slightly curved, followed by a thin line at end of cell adjacent to a sub-basal line in 4; other black marks are: small angular marks in 5–7, larger black marks in sub-base 2 and upper part of 1b followed by more angular marks in 1a–2, with a trace in 3. The postdiscal line of ochreous orange spots, pale at hind margin, darken and fade out toward the costa, but are distally accentuated by strong black marks at hind angle, shaded with bluish grey distally, this shading extending up to the subcosta in decreasing amount. Margin with obscure rusty lunules, most conspicuous and double at hind angle and 1b. Hind wing, ground colour reddish chestnut, slightly darker than fore wing, with vinaceous bloom more marked. Basal black lines thin, more or less straight in sub-bases but more angled and broken in discal line. There is a faint indication of the rufous orange bar of upperside which is accentuated on outer border by a darker zigzag chestnut zone which runs from the costa to the anal angle and is distally bordered by a greyish zone, in which the admarginal series of pinkish lunules accentuate the reddish border; margin black, with slight whitish fringe. Anal angle with black dots on a greenish lilac ground. (Pl. 5, fig. 25.)

FEMALE. Fore wing length 40–42 mm. *Upperside.* Fore wing, ground colour, black, usually with some rufous along the basal half of the costa; occasionally some indication of rufous in upper part of mid cell. Wing crossed by a series of graduated ochreous creamy spots forming a conspicuous bar widest at the hind margin where the spots are contiguous, 4–6 mm, the remaining spots separate and reaching 6, sometimes with a trace of a spot in 7. Margin of wing with rather ill-defined ochreous spots, largest at the hind angle in 1b, but fading out toward the apex. Hind wing basal triangle brownish black, shading to greyish buff on the inner fold. Disc of wing crossed by a strong ochreous creamy band widest at costa, 8 mm, where the mark extends proximad, the outer border almost straight and shaded with ochreous orange where it abuts onto the brownish black border, which extends from the upper angle to the anal angle, tapering at both ends, its outer border serrate, accomodating the conspicuous series of ochreous orange lunules; margin black, slightly dentate; tails short, upper 5 mm, lower 3 mm. *Underside.* Fore wing, ground colour fawn-brown with a distinct purplish bloom; the black cell marks slightly greyish edged; the black marks sub-basal in 1b–2 bold, those in the discal line equally strong but lessening in size, the mark in 4 at the base usually small, those in 5–7 angular and often contiguous. The postdiscal bar represented by a series of graduated buff-ochre spots, widest at hind margin, those in 3 to subcosta outlined distally in brownish; the marks in 1b–2 boldly black, triangular in shape on a submarginal violet-grey ground; edge of wing browner, the hind angle at 1b with two buff spots. Hind wing, ground colour as fore wing but slightly darker; the basal lines thin, but those on the inner border of the buffish bar stronger, the bar is wider than on upperside and more graduated, extending from the costa to above the anal angle and is bordered distally by a strong reddish brown zone in contrast with the more greyish lilac of the border; the bar crosses the inner fold above the anal angle. Margin with a complete series of reddish orange lunules, inwardly edged with greyish lilac lunules; anal angle with black dots on a lilac ground. Edge of wing black with narrow white fringe. (Pl. 5, fig. 26.)

RANGE. Sierra Leone, Guinea, Liberia, Ivory Coast, Ghana and western Nigeria. Also recorded from Fernando Po.

***Charaxes lucretius intermedius* ssp. n.**

(Pl. 5, figs 27–30, Map 3)

Charaxes lucretius f. incl. *caliginosa* Le Cerf, 1923 : 366.
Charaxes lucretius ♀ f. *albofascia* Le Cerf, 1923 : 367.

MALE. Fore wing, length 40–42 mm (majority 42 mm), thus intermediate in size between the nominate western race and that of Uganda. *Upperside.* Fore wing pattern and coloration generally similar to nominate *lucretius*, and exhibiting the same minor differences in pattern. On the underside however, there is a marked difference, especially in the tone of the ground colour, which is more reddish and with less vinaceous bloom, thus the subcostal black marks of the fore wing from base of cell to discal line are more distinct. (Pl. 5, figs 27, 28.)

FEMALE. Fore wing length, 42–45 mm. *Upperside.* As noted by Rothschild and subsequently by Le Cerf, females of the mid area of distribution differ from the nominate form in being slightly larger, more blackish in ground colour of both wings, and the pale bars more whitish cream and thus in strong contrast with the rufous colour limited to the basal third of the costa and the upper part of the cell and its base; the black cell marks are stronger and larger; the creamy spots of the postdiscal bar usually more elongate; the marginal ochreous spots small but distinct. Hind wing, basal triangle blacker, but the inner fold paler ochreous; the pale bar creamy as in the fore wing, with only a slight ochre tinge above the anal angle; the marginal lunules paler creamy ochre, the edge black. *Underside.* Fore wing, ground colour much paler, less rufescent at base and outer border of wing; the pale bars in less contrast, but the black marks strong. Hind wing, the dark line on outer border of pale bar less strong and rufous; the border is generally paler. (Pl. 5, figs 29, 30.)

Holotype female. CENTRAL AFRICAN REPUBLIC: Bangui, xii.1967 (*ex* Plantrou coll.). In B.M.(N.H.).

Allotype male. Same data as holotype. In B.M.(N.H.).

RANGE. Cameroun, Central African Republic, Republic of the Congo (Moyen Congo), Gabon and the Congo Basin, ? Kasai.

Charaxes lucretius maximus ssp. n.

(Pl. 5, figs 31, 32; Pl. 6, figs 33, 34, Map 3)

Charaxes lucretius var. *babingtoni* Stoneham, 1943 : 46.

MALE. Fore wing length 42–47 mm. *Upperside.* Fore wing, general pattern and coloration very similar to the nominate race but basal areas, especially at base of costa and in cell with an extended rufous cinnamon area, so that the black cell-marks are more clearly visible; the postdiscal line of rufous orange spots more uniform in size up to 4, those in 5–6 slightly smaller and rounded, and a spot is occasionally present in 7. Rufous orange marginal lunules well developed and extending from hind angle up to apex. The postdiscal bar is almost straight and is wider than in the intermediate race. Hind wing pattern much as in the nominate race, but rufous orange band slightly darker over the cell area and where it tapers to above the anal angle; the marginal rufous orange lunules rather larger; margin black, bluntly dentate, tails short, 4 and 2 mm; anal angle with lilac spots. *Underside.* Fore wing, ground colour at base of wing paler, more orange, the distal portion less dark and shaded with purplish vinaceous, and more like that of the intermediate race, reddish chestnut. Black cell marks not very strong except that in sub-base; bold black marks sub-basally in 1b–2, those in discal line equally strong. The post-discal bar rufous orange in 1a–2, then fading out; the admarginal black marks at hind angle strong and accentuated by bluish grey streaks distally; margin with orange spots at hind angle, but spots above indistinct and more rusty in colour. Hind wing ground colour more uniform rufous cinnamon, as in the intermediate race; the basal black lines very thin, sometimes obsolete; the bar of upperside hardly indicated, while the postdiscal darker line is not strongly marked; the submarginal pale lilac-grey spots and the admarginal rufous lunules not strong; margin very narrowly black. (Pl. 5, figs 31, 32.)

FEMALE. Fore wing length 46–49 mm, thus larger than nominate *lucretius* or the intermediate race. Though essentially similar in colour and pattern to western examples, Uganda examples differ considerably from those of the mid zones, especially in regard to the bars on both wings. *Upperside.* Fore wing, ground colour brownish black with a greater area of rufous chestnut at the base, especially at the base of the costa and the cell, where the black marks are strong. The postdiscal bar is narrower in proportion to size, narrower at the hind portion and the spots more separated; the edge of the wing is more rusty, due to bigger spots. Hind wing, basal area black, shading to buffish on the inner fold. The creamy ochre band, widest at the costa, is restricted at 6 rather abruptly, but is somewhat uniform in width to the inner fold; in colour slightly less shaded with orange on outer border but much more creamy-ochreous than in *intermedius*. The black border, almost straight on the inner edge is serrated on the outer by the large conspicuous orange-rufous lunules; margin slightly dentate, but tails very short and stumpy. *Underside.* The whole tone of the underside is paler than that of the nominate race, but not as pale as in *intermedius*. Fore wing, the black marks in the cell less strong, those in sub-base 1b–2 not so bold; the pale spots representing the bar of upperside less strongly marked and the marginal border less dark. Hind wing, the ground colour is paler, more uniformly rusty so that the discal bar is less apparent and less defined on both borders but especially on the outer where the dark chestnut line is much less strong. The admarginal pale angles on proximal side of the rufous border less clear. (Pl. 6, figs 33, 34.)

Holotype male. UGANDA: Mawakota, Kamengo, vii.1953 (*van Someren*), in B.M.(N.H.).

Allotype female. UGANDA: Masaka, Katera Forest, xii.1956 (*van Someren*), in B.M.(N.H.).

RANGE. North-west Kenya in the Elgon and Trans Nzoia districts, to the Kigezi district in western Uganda, also present in the Bwamba Valley and the Semliki area and Kivu district. Specimens from Kigoma to the north-east of Lake Tanganyika seem to belong to this subspecies.

Charaxes lucretius lemosi Joicey & Talbot

(Pl. 6, figs 35, 36, Map 3)

Charaxes lemosi Joicey & Talbot, 1927 : 12.
Charaxes lucretius lemosi Joicey & Talbot; Gabriel, 1932 : 24.

The general pattern and coloration of this insect suggest affinity with the mainland species *Ch. lucretius*, and I support Gabriel's action in placing it as a race of this species.

MALE. Fore wing length 37 mm. *Upperside.* Fore wing, shape slightly more pointed at the apex than nominate *lucretius*, the hind angle of the wing projecting more at 1b. Ground colour rufous at the base and over the cell area, and beyond at bases of 5–7; the black cell bars faintly indicated at sub-base, stronger in mid cell and towards the apex; the rest of the wing black, crossed by a postdiscal row of rufous orange spots more set in than other races of *lucretius* and narrower, the contiguous marks in 1a and 1b 4–3 mm wide, decreasing in size and extending up to the costa; the marginal rufous spots, distinct at the hind angle, extend up to the apex in decreasing size and distinctness. Hind wing, basal area brownish black, shading to more brownish on the inner fold but more rufous above the anal angle; disc of wing crossed by an rufous orange bar 5 mm at widest and slightly paler at the costa, reduced in 5, then almost parallel-sided to 2, where it merges into the inner fold. Border black, widest at 6, tapers to above the anal angle, outer border serrate where it abuts onto the rufous marginal border of contiguous lunules; edged black; tails short and stumpy. *Underside.* Fore wing, somewhat similar to *lucretius* of the east mainland but ground colour more rusty grey; the cell marks finer, but those in the sub-bases of 2-1b strong, those in 1b joined by a 'bridge'; the postdiscal bar moderately well represented, buff-orange in the lower half but tending to fade out toward the costa; border of wing more greyish, the black marks in hind angle at 1b–2 strong, the marginal rufous spots strong at hind angle, but fading out above. Hind wing, ground colour generally more rufescent than fore wing, the basal black lines thin, but disco-postdiscal line narrowly whitish, outlined distally by postdiscal brown line, which extends from the costa to above the anal angle; the border beyond is more greyish carrying lilac-grey spots, double and black-edged at anal angle; margin rusty rufous with narrow pinkish lunules proximally; edge narrowly black. (Pl. 6, fig. 35.)

FEMALE. Fore wing length 43 mm. *Upperside.* Ground colour at base of wing brownish, shading to more rusty along the costa and to black in the distal half of the cell and bases of cellules; cell with buff spots in upper half and a more quadrate spot, more whitish in colour at base of 4, with quadrate marks in sub-bases 5–6. The postdiscal bar is whitish, of about even width, 5–6 mm in 1a–3, then decreasing, the three subapical spots in a straight line, small and rounded; border of wing black, immaculate except for minute white linear marks between veins. Hind wing, ground colour brownish black, blacker on the border; disc crossed by a white bar, widest at costa in 6–7, then narrower to cell, then more constricted where it crosses the greyish inner fold at a slight angle above the anal angle; margin with conspicuous rufous orange lunules, paler on proximal side; anal angle with two lilac spots; edge black; tails short. *Underside.* Fore wing, ground colour greyish buff in subcostal area, paler greyish at bases of 1a–2; black marks in cell and subcosta clear, the buff-white marks of above, more strongly buff below; black marks in sub-bases 1b–3 strong and those in 1b 'bridged'; postdiscal bar strongly white in 1a–2, then more buff beyond, arranged as upperside, but accentuated distally by a chestnut bar; the black marks at hind angle in 1b–2 strong and elongate; border of wing more greyish but margin slightly rusty brown. Hind wing basal triangle as fore wing, greyish buff with slight ochre tinge; black lines fine and rather obscured except those on the proximal border of the white bar which is shaped as above, but crossing the inner fold as a triangle, the upper side at right angles to end of the bar; the bar is distally bordered by a chestnut band defined on inner edge but merging into the more greyish border; the submarginal series of whitish spots distinct; the marginal rusty spot well developed and pale edged proximally; edge black with thin white fringe; anal black spots distinct. (Pl. 6, fig. 36.)

RANGE. Limited to the island of Principe in the Gulf of Guinea.

Charaxes odysseus Staudinger

(Pl. 6, figs 37, 38, Map 3)

Charaxes odysseus Staudinger, 1892 : 260.
Charaxes odysseus Staudinger; Rothschild, 1898 : 5, pl. 7, fig. 4; 1900 : 7, 413.

Although this insect bears some resemblance to *lucretius*, especially *lemosi*, it is best regarded as a distinct species, for it differs markedly in many respects.

MALE. Fore wing length 37 mm. *Upperside.* Fore wing, the basal area rufous but more orange in the cell and subcostal area; the black cell marks are heavier, more triangular in shape, and tend to be conjoined, that in sub-base of cell small and rounded. On the proximal side of the postdiscal bar, the black marks are strong and fill the bases of 2–4, but at 2, the black is angled, tapering off to a spot on 1a; the postdiscal row of rufous orange spots is comparatively wide, 6 mm. in 1b–3, then tapering, though the spots in 4–6 are of about equal size, that in 7 is small. Thus the black border is narrow, being reduced in width by the large admarginal rufous orange spots. Hind wing, basal area brownish, shading to blackish on the border of the rufous orange band which is relatively wide and parallel-sided; the black border is somewhat narrowed by the broad rufous orange margin. The only specimen available to me is badly damaged in the hind marginal and tornal areas of both hind wings. *Underside.* Bears a general likeness to *lucretius* of the central area, in ground colour, thus paler than in the nominate race. In the fore wing the black subcostal marks are only faintly represented, as are also the tornal marks, but those at base of 1b are bold and conjoined forming a black 'blob'. Hind wing ground colour more uniform rufous cinnamon. The basal black lines hardly visible; the discal bar only slightly indicated at the costal end; the submarginal pale lunules rather diffuse. (Pl. 6, fig. 37.)

FEMALE. Vaguely resembles the female of *lemosi* above, yet is clearly different. The only specimen available is very damaged, but Rothschild figured a female, presumably the type, which is in the Staudinger collection. *Upperside.* Fore wing length 48 mm. Fore wing, ground colour rufous in basal triangle, shading to brownish black beyond. There are two buff-white subcostal spots in the cell, two or sometimes three at end of cell, the upper one large, followed by two in the upper discal line; the postdiscal series of white spots, 5 mm wide at the hind margin, extends to the subcosta in progressively smaller spots, all well separated. On the ad-margin, the spots at the hind angle in 1b large, becoming progressively smaller and reaching the sub-apex; these spots are set in from the margin. Hind wing, basal triangle brownish black, the disc crossed by a series of white marks, widest at the costa, 6 mm, extending to above the anal angle in decreasing size and distinctly separated by black veins. The border of the wing is blackish, carrying a series of large white triangular marks in the submargin. *Underside.* Fore wing, ground colour greyish buff, slightly more ochre over the disc; black marks in cell clear, those beyond obscured, but the black marks in basal half of 1b–2 strong and intense black and often conjoined. The postdiscal bar creamy, well marked to 3 then obscured; tornal black marks to 2 strong; admarginal white marks at tornus well marked. Hind wing, ground colour as fore wing; dark lines in basal half, obsolete; creamy discal bar fairly strong, outlined distally by a brownish band which bends toward the inner fold at right angles above the anal angle. Border of wing slightly greyish, the submarginal creamy spots present but not strong in upper half. (Pl. 6, fig. 38.)

RANGE. Confined to the island of São Thomé.

Charaxes montieri Staudinger & Schatz

(Pl. 6, figs 39, 40, Map 3)

Charaxes montieri Staudinger & Schatz, 1885 : 59.

This distinctive insect from São Thomé appears to have no relative on the mainland of Africa.

MALE. Fore wing length 45 mm. *Upperside.* Fore wing, ground colour deep blue-black. Disc of wing crossed by a series of strong blue marks, the upper ones at bases of 6–5 elongate, that in 4 smaller, spots in 3–2 more quadrate, angled distally and just touching the postdiscal marks in same areas, the lower marks fused with the adjoining postdiscal marks; the postdiscal series of blue spots are: three subapical in line, spot in 4 set in, those of 3–2 larger and more elongate, the mark in 1b large and incised distally, the mark in 1a a long streak; margin of wing with bluish interneural spots, double in 1b. Hind wing, basal ground colour blue-black shading to more brownish on inner fold. A strong, broad, disco-postdiscal band crosses the wing from sub-costa to above the anal angle, the upper mark in postdiscal line smaller, the band widest at 4, consisting of elongate marks incised on outer end, each mark separated by black veins. Border black, widest at upper angle and carrying a series of blue, white-centred spots, double at anal angle. Marginal border with angled blue spots; edge black, tails short, upper 3 mm, lower 1 mm. *Underside.* Fore wing, ground colour at base bluish grey to discal line, olive-grey beyond to apex; wavy black lines in cell strong, with a straighter line at end of cell; black conjoined curved lines present in the discal line extending from sub-costa to 1b; subbasal black marks in 1b–2 strong; tornal black marks, double in 1b and rounded in 2, well developed and represented in submargin by obscure olive marks extending to costa; margin with obscure pale internervular marks. Hind wing ground colour olive-grey, basal area crossed by bluish grey bars outlined in black; the bar in discal line outlined in black proximally. In the postdiscal zone is a series of whitish lunules accentuated distally in olive; submarginal zone with pale lunules accentuated distally in olive-brown; anal angle with double black spots; edge of wing olive forming narrow lunules. (Pl. 6, fig. 39.)

FEMALE. Fore wing length 50 mm. *Upperside.* Fore wing basal triangle brownish olive, sharply defined from the white bar by black scaling from subcosta to upper part of 1b. The broad oblique white bar extends from the costa to the hind angle where the bar is reduced in width. Apical portion of wing deep black with two large white sub-apical spots in 5–6. Hind wing, ground colour brownish olive to almost the margin, ornamented with a series of submarginal black ocelli, each with white central spot, large at the upper angle and decreasing in size to the anal angle; the marginal lunules at upper angle whitish. Edge of wing black, bluntly dentate, tails short, upper 4 mm, lower 2 mm. *Underside.* Fore wing, ground colour very similar to that of the male but black marks stronger; the white bar prominently reproduced, as also the postdiscal white spots; the ocelli on the submargin with large black centres, represented at the anal angle by black triangles; the edge of the wing at hind angle white. Hind wing, ground colour and pattern as in the male but on an enlarged scale. (Pl. 6, fig. 40.)

RANGE. Limited to the island of São Thomé, in the Gulf of Guinea.

SYSTEMATIC LIST

Charaxes lucretius (Cramer)

Charaxes lucretius lucretius (Cramer), 1777. Type locality: Guinea.
 = *lucretius lucida* Le Cerf, 1923. Type localities: Liberia & Guinea.
 Range: Guinea, Liberia, Ivory Coast, Ghana, W. Nigeria.
lucretius intermedius ssp. n. Type locality: Central African Republic, Bangui.
 = f. *albofascia* Le Cerf, 1923. Type locality: Cameroun.
 = f. *caliginosa* Le Cerf, 1923. Type locality: Gabon.
 Range: Cameroun, Central African Republic, Republic of the Congo (Moyen Congo), Gabon, Congo River Basin.
lucretius maximus ssp. n. Type locality: Uganda, Mawakota, Kamengo.
 = var. *babingtoni* Stoneham, 1943. Type locality: Kenya, Kakamega. Upper Katanga, ♀ (unexamined).
 Range: Eastern Congo, Semliki Valley; Uganda, Bwamba Valley, N. W. Kenya, Trans Nzoia, Elgon and Kisii areas. Kivu. N. E. end of Lake Tanganyika at Kigoma.
lucretius lemosi Joicey & Talbot, 1927. Type locality: Principe Island.
 Range: Limited to island of Principe, Gulf of Guinea.

Charaxes odysseus Staudinger

Charaxes odysseus Staudinger, 1892. Type locality: São Thomé.
 Range : Island of São Thomé, Gulf of Guinea.

Charaxes montieri Staudinger & Schatz

Charaxes montieri Staudinger & Schatz, 1885. Type locality: São Thomé.
 Range: Island of São Thomé, Gulf of Guinea.

3. *CHARAXES PROTOCLEA* FEISTHAMEL AND ITS SUBSPECIES AND FORMS

This species, in its range from West to East Africa, has evolved into three main subspecies, *protoclea protoclea*, *protoclea nothodes*, and *protoclea azota*, each with well defined distributions; in the intervening country, there are aggregates exhibiting characters of adjoining races, thus in Ivory Coast, Ghana and W. Nigeria, the females are transitional between nominate *protoclea* and *protonothodes* and within this aggregate several male forms have been described (Map 4). A corresponding variation in the male is also noted in the population occupying the area Kasai-Katanga, viz. *catenaria* Rousseau-Decelle.

This would indicate a degree of instability, but instability is not limited to these aggregates, for it is noted in other races.

Charaxes protoclea protoclea Feisthamel

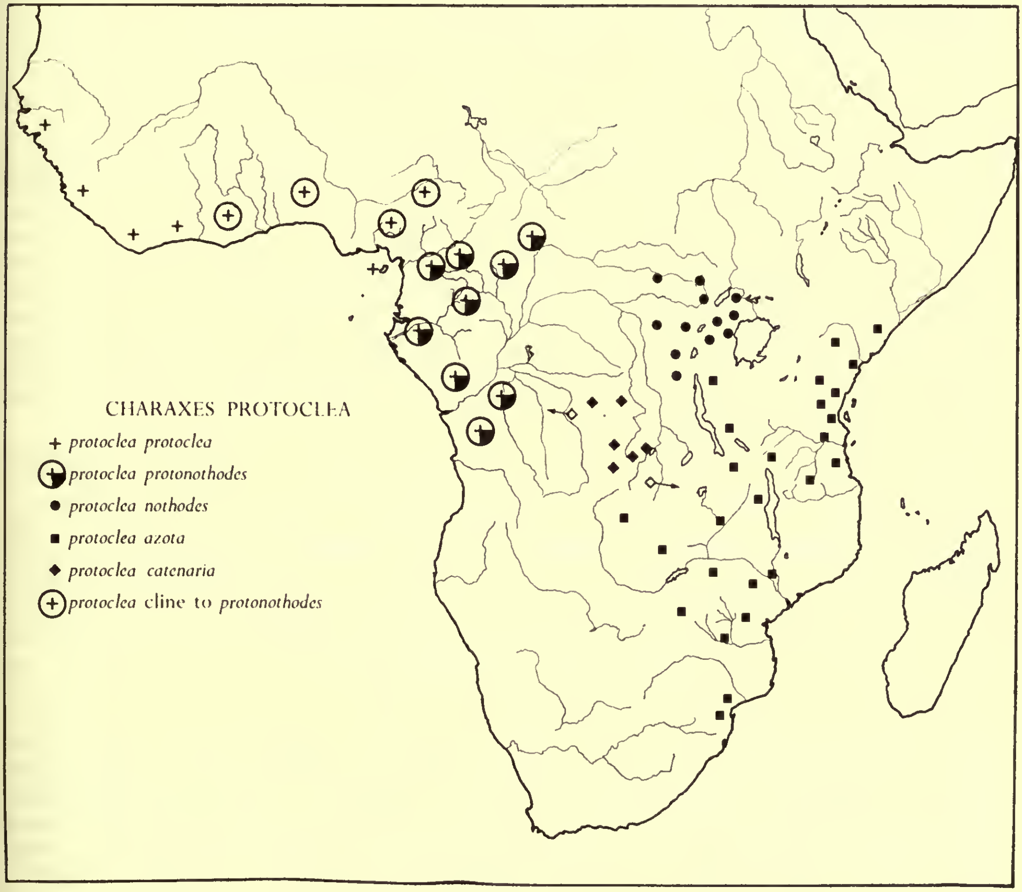
(Pl. 7, figs 41, 42, Map 4)

Charaxes protoclea protoclea Feisthamel, 1850 : 260.
Charaxes aeson Herrich-Schaeffer, 1850 : 54.

MALE. Fore wing length 42–44 mm, but occasionally only 39 mm. *Upperside.* Fore wing, ground colour of fore wing velvety brown-black to black, hind angle of wing with rufous orange margin curving in 1a and extending up margin of wing in 1a–2 in lesser degree, very occasionally represented by smaller spots in 3. Rarely with traces of spots in submargin in 1b–2. Edge narrowly black, with slight white fringe. Hind wing, ground colour brown-black to black, shading to more brownish on the inner fold; border of wing broadly rufous orange, stopping short of costa or abruptly tapering toward it in 7; the rufous orange border may be immaculate or with a varying number of black spots, increasing in size from anal angle to upper angle; edge narrowly black with small white interneural fringe; edge slightly dentate, tails short and blunt. *Underside.* Fore wing, ground colour vinaceous grey. Cell crossed by four purplish chestnut bars of irregular outline; a mark at base of 4 and a zigzag bar crossing the sub-bases of 5–7; a bar crosses sub-base of 3, and there are two black bars each in 1b & 2; submargin of wing with rather indistinct more rufous triangles, more ovoid at costa; tormus more rufous with a large black spot with a conspicuous white mark distally, the rufous area outlined proximally in black. There is a conspicuous whitish spot in the sub-apex. Hind wing, ground colour as fore wing, basal area crossed by chestnut lines, most strongly defined on inner side of discal line; postdiscal zone with more rufescent, conjoined blunt triangles, paler proximally but narrowly edged black; submargin with row of whitish triangles at apices of the marginal rufescent triangles; edge narrowly black. (Pl. 7, fig. 41.)

FEMALE. Fore wing length 45–48 mm, majority 48 mm. *Upperside.* Fore wing, ground colour black, slightly more brownish on border, with a conspicuous white discal band, widest at hind margin, 14 mm, tapering rapidly to 5–6 and a streak in 7, the mark in 4 set well in toward the base; the marks in 2 and 3 angularly incised distally to accommodate the white rounded spots in 2–3 of the postdiscal line, the spots beyond decreasing in size, those of 5–7 curving in toward the subcosta. Hind angle of wing with orange lunules in 1b–3, very faintly indicated in areas above 5. Hind wing, basal triangle black, greyish on inner fold; disc of wing crossed by a wide white band 15 mm broad, of about equal width to 2 then tapering toward, and crossing the inner fold above the anal angle; outer edge of band dentate opposite the end of cell; border black, widest at 4–5, tapering to upper angle and also to anal angle which has two lilac-white spots; margin rufous orange, indented proximally by black serrations on outer border of black zone. Margin bluntly dentate, tails robust but short, upper 5 mm, lower 3 mm. Edge narrowly black, white dots on fringe. *Underside.* Fore wing, ground colour in base a lighter vinaceous grey; cell and subcostal area crossed by rufous chestnut bars as in the male, those in the ad-discal line strong, the two in 1b black in colour. The discal-postdiscal bars creamy in colour; the tornal double spot and the smaller one above, black, the others of decreasing size on the bases of blunt buff triangles; the subapical brown ovoid mark usually strong. Hind wing basal ground colour as fore wing, crossed by rufous chestnut lines, not strong in the basal area but strongly indicated on the proximal border of the discal bar, which is creamy in colour, the band is crossed lengthwise by a series of light rufous triangles in contact or separated, extending from the costa to above the anal angle, in the postdiscal line; the distal border of the band outlined by a darker rufous chestnut irregular line, faint at costa but strong above the anal angle; border of wing greyish, carrying a series of slightly whitish triangles abutting onto the marginal rufous line. Anal angle with two bluish white and black spots. (Pl. 7, fig. 42.)

RANGE. Described from southern Senegal specimens, the species occurs in Guinea, Liberia, and Ivory Coast; but in Ghana to western Nigeria & ? Fernando Po, there is a cline toward *protonothodes* (Map 4).



MAP 4

Charaxes protoclea protonothodes ssp. n.

(Pl. 7, figs 43–48, Map 4)

Specimens of *protoclea* from eastern Cameroun, the Central African Republic, Moyen Congo and northern Angola present characters which distinguish them from nominate *protoclea*, and suggest a transition toward *protoclea nothodes* of eastern Congo and Uganda. These differences are best seen in the females.

MALE. Differs from the nominate male *protoclea* by being generally larger, fore wing length 43–46 mm. *Upperside.* Fore wing, ground colour deeper black; the rufous orange at the hind angle more restricted, seldom extending beyond 1b; the white marginal fringe more distinct. Hind wing, the rufous orange band is narrower above the anal angle, and interrupted at the upper angle by a black mark in 7 and 6, the spots sometimes conjoined. Tails as in the nominate race. *Underside.* Fore wing, pattern as in nominate race, but ground colour darker vinaceous grey; the discal satiny bar in fore wing stronger, so also that of the hind wing which is bordered by a stronger brownish black postdiscal band; the white submarginal spots stronger. (Pl. 7, figs 43, 45, 46.)

FEMALE. Fore wing length 45–50 mm. *Upperside.* Fore wing, pattern intermediate between nominate female and *nothodes.* The discal band white, strongly graduated, 15 mm wide at the hind margin tapers rapidly, the marks in 2 and 3 incised outwardly to accommodate the post-discal rounded spots in these same areas; the spot in 4 minute or absent, the marks in 5–6 quadrate or linear; all these marks are white, but those of the postdiscal line are creamy ochre. The rufous orange marks at hind angle, strong in 1b, may be absent above 2 or very slightly represented. Hind wing, pattern as in nominate race, but white band broader, encroaching on the black border, and slightly tinged ochreous in 6–7; the outer border of the black band strongly dentate; two white dots at anal angle. The rufous orange border narrower, tails less stumpy 5 and 3 mm long. *Underside.* Fore wing, pattern at base as in the nominate race; the discal band creamy and the postdiscal spots ochreous; the submarginal greyish white marks more strongly developed and the black tornal mark in 1b more linear and with a stronger greyish outer border. Hind wing, basal triangle darker, but the chestnut lines not strong except at the subcosta; the rufous brown line on proximal side of creamy band strong; on the distal side shaded with ochre; the zigzag line in the postdiscal-discal line barely indicated or very broken. The dark band beyond may be strong or faint; the submarginal whitish spots distinct or faint; the border rufescent. (Pl. 7, figs 44, 47, 48.)

Holotype female. CENTRAL AFRICAN REPUBLIC: Bangui, vi.1957, in B.M.(N.H.). Allotype male. Same locality, i.1965, in B.M.(N.H.).

RANGE. Eastern Cameroun, Central African Republic, Moyen Congo, N. W. Angola.

Charaxes protoclea nothodes Jordan

(Pl. 8, figs 49, 50, Map 4)

Charaxes protoclea nothodes Jordan, 1911 : 137.

MALE. Fore wing length 45–48 mm, exceptionally 50 mm, thus larger than nominate race. *Upperside.* Fore wing, ground colour velvety black, with rufous orange at hind angle as in nominate race or more extended and wider in proportion to the increase in wing size, the spots larger, usually stopping at 2, but may extend up the margin in decreasing size to 4–5. Hind wing, ground colour black, more brownish on lower part of inner fold. Rufous orange border, widest at hind margin, tapers in 5–6 to subcosta; submarginal black dots variable, may be present at hind angle and upper angle; edge narrowly black, tails very stumpy. *Underside.* Fore wing, pattern as in nominate race, but with an overall more rusty bloom, the hind angle more rufescent, but the tornal black spot not very strong; the subapical whitish spot strong or may be double. Hind wing with some rusty bloom so that pattern is less strong; the submarginal white dots present but small, double at anal angle. (Pl. 8, fig. 49.)

FEMALE. Fore wing length 47–53 mm. *Upperside.* Fore wing, basal area brown-black to black, border of wing slightly browner; the discal band, 15–17 mm wide at hind margin, where the marks are white, tapers strongly from 2 to subcosta, though the marks are generally larger than in the nominate race, all marks strongly tinged with ochreous; the spot at base of 4 is often missing. The postdiscal spots are rather angled proximally, fitting into the incisions of the discal marks, may be contiguous in 1b, all spots orange. Border of wing with rufous orange lunules varying in size and extent from two in 1b at the hind angle to a complete series of diminishing size up to the apex. Hind wing, white band broad, encroaching on the basal blackish area and also on the black border, which is thus narrowed; the band is tinged with orange on the distal border and over the inner fold. The outer border of the black band is strongly serrate, the serrations intruding well into the marginal rufous orange border; the margin of the wing bluntly dentate, the upper tail 5–6 mm, lower very slightly indicated. *Underside.* Fore wing, pattern as in the nominate race, but basal areas and distal borders of the wings more rufous, the discal bands strongly ochreous, the postdiscal spots darker ochreous to orange; tornal black mark strong, so also the elongate ovoid brown subapical mark, accentuated distally with whitish. Hind wing discal patch ochreous, more yellowish distally; postdiscal zigzag brownish line strong or weak, so also the postdiscal brownish bar beyond; border more satiny greyish buff, the small whitish lunules distinct or faint; the edge of the wing more rusty, faintly black on edge with minute interneural white dots. (Pl. 8, fig. 50.)

RANGE. Eastern Congo in region to north-west of Lake Tanganyika; Kivu to Beni and Ituri, extending into Uganda, mostly in the west.

Charaxes protoclea catenaria Rousseau-Decelle

(Pl. 8, figs 53, 54, Map 4)

Charaxes protoclea catenaria Rousseau-Decelle, 1934 : 229.

An unstable aggregate exhibiting the characters of *azota* and *nothodes*, but nearer the former.

MALE. *Upperside.* Fore wing, the main character on which this subspecies can be upheld is the reduction in size of the postdiscal orange spots, so that the series appears more set-in proximad than in *azota*, consequently the width of the black ground separating these spots from those on the margin is greater, and the junction of the two rows in the hind angle is thus lessened, though this character is variable. As in other races, the ground colour is brownish black, more rufous along the costa. On the hind wing, the broad orange-cadmium border is wider and extends further along the costa at the upper angle. *Underside.* Very like that of *azota*, but the paler discal bars of both wings not so strong. (Pl. 8, fig. 53.)

FEMALE. Fore wing length 45–47 mm. *Upperside.* Fore wing, ground colour brown-black, rufous along the costa; pattern intermediate between that of *protonothodes* and *azota*, but much nearer the latter as evidence by the continuous rufous marginal border, the larger postdiscal orange spots and the wider white bar in 1a–1b. On the hind wing the marginal orange border is more uniform in width, the white disco-postdiscal band broader and the intervening black bar clearer. The underside is paler, the black marks less strong and the marginal dark border less accentuated. (Pl. 8, fig. 54.)

RANGE. Southern Congo, in the western Katanga Region; also recorded from the Upemba Park area at Kilwezi and Mabwe by Overlaet.

It may be noted here that examples of *protoclea* from the western region of Tanzania on the east shore of Lake Tanganyika in the Kigoma district to Mukuyu forests are very variable in the male, but they are nearer to *azota* than *catenaria*.

Charaxes protoclea azota (Hewitson)

(Pl. 8, figs 51, 52, Map 4)

Philognoma azota Hewitson, 1877 : 82.
Charaxes azota (Hewitson) Hewitson, 1878 : 181.
Charaxes calliclea Grose-Smith, 1888 : 130.
Charaxes nyasana Butler, 1895 : 249.
Charaxes protoclea var. *aequidistans* Gaede, 1916 : 109.

MALE. Fore wing length 40–42 mm. *Upperside.* Fore wing, apex rather pointed; outer margin incurved at 3–4. Ground colour black, more brownish and rufous on costa and base of wing. Border rather broadly rufous orange, consisting of a row of postdiscal spots contiguous at the hind angle, more discrete from 3–7, the upper spots curving toward the subcosta; the marginal border of wing orange rufous, the two rows of spots separated towards the apex by black, which also narrowly separates the rufous orange on the border; edge very narrowly black; the degree of separation of the postdiscal spots and those of the border rather variable. Hind wing, basal triangle black, shading to brownish on the inner fold, sharply defined from the wide rufous orange border, which extends from the anal angle to the costa, widest at 2–3. Edge very narrowly black, bluntly dentate, tails very short and stumpy, 3–1 mm. *Underside.* Rather strongly rust coloured, especially on the outer border, the basal area duller, separated by a broad satiny greyish band. Basal brownish bars present but not strongly marked, that in sub-base 1b, darker. Border with only a faint pattern, but tornal spots black, variable in size. Subapical spot satiny grey. Hind wing, basal area rusty brown, shading to greyish on the inner fold; pattern obscure, but brownish line on inner edge of discal satiny bar defined; outer border of band with darker rusty brown irregular bar flanked distally by a satiny greyish zone; border more rusty, carrying a series of whitish dots, double at anal angle, these may be distinct or obscure; edge narrowly black sometimes with faint greyish inner border. (Pl. 8, fig. 51.)

FEMALE. Fore wing length 42–48 mm, mostly 45–46. *Upperside.* Fore wing, general pattern nearest to *nothodes* but white areas more extensive in the hind portion of fore wing, the white extending basad and encroaching on the blackish or brownish basal area, the costa and upper part of cell rufous. The white area of the discal band in 1b–2 extends toward the cell and may actually reach it in 2. The mark in 3 is triangular, incised on the outer end, and is ochreous as a rule as are the two subcostal linear marks, the spot in 4 is set well in and may be clearly defined or obscure, or absent. The postdiscal spots are ovoid, strongly orange rufous, extending from 1b where it is in contact with the discal spot, the spots in 5–7 are curved toward the costa. The upper discal marks and those of the postdiscal line are separated by the black ground to 2, and this black ground separates the postdiscal series from the strong rufous orange border of the wing, which is narrowly bordered with black on the edge. Hind wing, with large discal white patch which reaches almost to the dusky base of the wing and upper part of inner fold, the rest of which is whitish or with a slight ochreous tinge particularly above the anal angle; the outer border of the white patch is slightly sinuous at 6 and is weakly tinged with orange on its border with the black submarginal border which is lightly dentate distally; the border is orange rufous narrowly edged black; margin bluntly dentate, tails thin, 6–4 mm long. Anal angle with two white dots. *Underside.* Fore wing, basal area rufous grey, crossed by rusty brown bars as in the male. The discal band is yellowish ochre and postdiscal spots orange-ochre with dark central dot to each spot, the two bars separated by a darker series of rusty brown lunules; border more rusty brown with obscure dark spots and greyish distally; the tornal black spot weak or strong; the subapical greyish white spots well developed; border rusty with minute white dots on margin at interspaces. Hind wing basal area same colour as fore wing, the darker bars ill-defined except the line defining the inner border of the yellowish discal band; there are rusty lunules, rather indistinct in the postdiscal line but distally there is a more rusty brown line bordering the submarginal satiny greyish lilac border proximally;

this border has a series of white angular marks, double at the anal angle where the ground colour is slightly olive, outlined distally in black (Pl. 8, fig. 52.)

Variation. Occasionally a female is taken in which the ground colour of the fore wing upperside is more rusty brown than black. The postdiscal spots larger and more elongate and contiguous; the hind wing discal white patch is strongly shaded orange distally, resulting in a decrease in the width of the black band which does not reach the costa.

RANGE. From Delagoa Bay through Rhodesia to Zambia and Malawi, the south and western parts of Tanzania, and up the east coast to Kenya where it is limited to the coastal belt and immediate hinterland.

Biological Note

The chief food plants of all the races are *Afzelia cuanzensis* (Caesalpinaceae) in eastern Africa, and *Afzelia africana* further west. The species has also been reared on *Syzygium guinensis* (Myrtaceae). For full account *vide* van Someren, 1935 : 175.

SYSTEMATIC LIST

Charaxes protoclea Feisthamel

Charaxes protoclea protoclea Feisthamel, 1850. Type locality: S. Senegal, Casamance.
= *aeson* Herrich-Schaeffer, 1850. Type locality: Gold Coast.
Range: Senegal, Guinea, Liberia, Ivory Coast, cline in Ghana to western Nigeria; Fernando Po (?).
protoclea protonothodes ssp. n. Type locality: Central African Republic, Moyen Congo.
Range: E. Cameroun, Central African Republic, Moyen Congo, N. W. Angola.
♂ var. *ablutus* Schultze, 1914 : 82.
♂ var. *maculata* Strand, 1910 : 30.
♂ var. *marginepunctata* Holland, 1920 : 206.
♂ var. *nigropunctata* Neustetter, 1916 : 106.
♀ var. *sinuosa* Rousseau-Decelle, 1934 : 229.
protoclea nothodes Jordan, 1911. Type locality: N. W. of Lake Tanganyika, Kivu Prov.
Range: E. Congo region, N. W. Lake Tanganyika, Kivu to Beni, Ituri and W. Uganda.
protoclea catenaria Rousseau-Decelle, 1934. Type locality: Katanga, Kafakumba.
Range: S. Congo, in the Katanga-Kasai areas.
♂ var. *bifida* Rousseau-Decelle, 1934 : 230.
♂ var. *kafakumbana* Rousseau-Decelle, 1934 : 231.
♂ var. *parcepicta* Rousseau-Decelle, 1934 : 230.
♀ var. *mutschatschana* Rousseau-Decelle, 1934 : 231.
protoclea azota Hewitson, 1877. Type locality: Mozambique, Delagoa Bay.
= *calliclea* Smith, 1889. Type locality: Kenya, Mombasa.
= *nyasana* Butler, 1895. Type locality: Malawi, Zomba.

Range: Delagoa Bay to Rhodesia, Zambia and Malawi, W. Zambia and up the coast to Kenya in the coastal belt and immediate hinterland.

4. *CHARAXES BOHEMANI* FELDER

Charaxes bohemani Felder

(Pl. 8, figs 55, 56; Pl. 9, figs 57, 58)

Charaxes bohemani Felder, 1859 : 321.

This species occurs in the greater part of Africa south of the Equator. There does not appear to be any variation throughout its range, both sexes being remarkably stable except for minor colour variation.

MALE. Fore wing length 40–42 mm. *Upperside.* Fore wing, distal half of wing black, basal half pale blue with slight greenish tinge, extending from just short of the cell, obliquely across the wing towards, but not reaching the hind angle at 1a; two subapical white spots in postdiscal line, white, followed by small blue spots, often vestigial, in 5–3. Fringe narrowly whitish. Hind wing, discal area pale blue, shading to ashy grey at base and inner fold; distal border black with series of small blue dots in submargin, double at anal angle; admarginal series of blue lunules distinct at anal angle, fade out at upper angle; edge black with narrow but distinct white fringe. Edge slightly serrate; tails thin and sharply pointed, upper 4–5 mm, lower 3 mm. *Underside.* Fore wing, ground colour fawn-brown, darker at base and in discal area, paler more greyish on the border. Cell and bases of 1b–2 with narrow black transverse lines edged white; inner edge of discal band with narrow irregular black line outwardly edged in white; postdiscal series of ochreous lunules strong at tornus accentuated distally with black marks edged with lilac-grey, becoming faint, but terminating in the two whitish buff subapical spots. Margin with obscure darkish lunules; edge narrowly whitish. Hind wing, ground colour as fore wing, basal and sub-basal black lines faint; postdiscal series of whitish ochre lunules more distinct, black-edged proximally at anal angle; submarginal whitish lilac lunules distinct at hind angle where the spots are double; marginal lunules ochreous, strongest in region of tails; fringe buffish. Underside of abdomen often buff-white or brown. (Pl. 8, fig. 55; Pl. 9, fig. 57.)

FEMALE. Fore wing length 48–52 mm. *Upperside.* Fore wing, distal portion of wing black, basal area pale blue or faintly lilac-blue, the two areas separated by a broad white oblique band, widest from beyond the end of the cell and crossing to just short of the hind angle, this band proximally shaded in black to varying extent, most marked in cell, but fading out in 2–1b, if present. Hind wing as in the male, but blue less strong, often lilac tinged. Border as in the male; tails upper 7 mm, lower 3 mm. *Underside.* Very similar to that of male, but ground colour slightly darker, the white band of upperside strong and sharply marked, accentuated with black proximally; the pattern of spots as in the male but more distinct. This also applies to the hind wing. Underside of abdomen greyish brown like thorax. (Pl. 8, fig. 56; Pl. 9, fig. 58.)

RANGE: North Angola; S. Congo, Kasai and Katanga; Zambia; Lake Mweru, Rhodesia; Malawi; Mozambique; Transvaal and Manicaland; Botswana; Tanzania, in western, central and southern areas; Kenya, in coastal forests, but not penetrating the hinterland to any extent. There is a record of the species from the Chepalungu-Mara area, which needs verification.

Biological Note

The species lays on 'Mbembakofi', *Afzelia cuanzensis* (Caesalpinacae). For full life history *vide* van Someren, 1928, *Jl E. Africa Uganda nat. Hist. Soc.* **33–34** : 23.

5. *CHARAXES ANTICLEA* (DRURY) AND ITS SUBSPECIES

It is not unusual to find that in Africa, Lepidoptera, especially *Charaxes*, from the western extremity of their distribution are smaller than their eastern counterparts, but in the case of *Charaxes anticlea*, the position is reversed. Why this should be so, is difficult to explain.

As in the case of *Charaxes baumanni*, the characters on which one might base evidence of subspeciation are not very marked, especially on the upperside of the males, and one must examine the undersides. The same applies to the females. By using a combination of characters in both sexes, linked with a knowledge of geography and ecological data, a reasonable assessment can be made.

When Rothschild (1900 : 494) reviewed the species he recognized only two races, the nominate from 'West Africa to the Niger', and the subspecies *adusta* from Kampala, Uganda, to Cameroun. Subsequently, Aurivillius in 'Seitz' (1913) and Bryk (1938) maintained this division.

A close study of a large assembly of the species, from all parts of its known distribution, arranged geographically, indicates that western examples of *anticlea* are larger than eastern. Western examples have a narrow black border to the hind angle of the fore wing, whereas eastern specimens have a broad border. Intermediate populations are transitional in these respects; the underside pattern changes in a similar manner, from a strong to an obscured pattern. In other words, there is a gradual transition from west to east, from nominate *anticlea* to *adusta*, linked by intermediates, some of which are clines, and others are populations deserving of subspecific rank.

Charaxes anticlea anticlea (Drury)

(Pl. 9, figs 59, 60, Map 5)

Papilio Nymphalis Phaleratus anticlea Drury, 1782 : 36.
Papilio Nymphalis horatius Fabricius, 1793 : 64.

REGION 1. SUB-REGION 1. SIERRA LEONE TO LIBERIA

MALE. Fore wing length 30–32 mm. Shape, apex blunt, but outer margin strongly incurved at 3–4. *Upperside.* Fore wing, ground colour deep velvety black, immaculate except for a pronounced cadmium-orange submarginal band, widest at the hind angle and extending proximad very slightly into the postdiscal line in 1a; the marks are contiguous in 1a–3, decreasing in size very slightly, then as smaller, elongate lunules to 6 and then fading out; marginal border of wing narrowly black from hind angle to 4. Hind wing, basal half velvety black, shading to brownish on the inner fold; border widely cadmium-orange-red from the anal angle to just short of the upper angle, where the black ground intrudes from the costa; this border has a submarginal series of white-centred black spots, double at anal angle and extending up to 4, and as a dot in 5, which is often missing. Edge narrowly black with some white fringe at anal angle and between tails; margin rather serrate, tails very short. *Underside.* Fore wing, base violaceous grey, cell with three black spots; distal half of wing with a strong satiny sheen; crossing the end of the cell and extending to 1b is a dark purplish brown band outlined in black, the outline ending in large black spots in 1b; in the discal line is a strong satiny band crossing from costa to hind margin, with a dark subcostal patch which extends to the hind margin as a narrow line separating the satiny band from a series of paler spots in the postdiscal line at the lower part of which are dark patches in the submarginal zone from tornus at 1a–1b; the border more greyish and satiny, broken in the sub-apex by a darker patch. Hind wing, basal colour similar to that of fore wing crossed by a satiny sub-basal bar outlined in black from the costa to the inner fold, this is followed by a darker brown band (continuous with the fore wing bar) distally bordered by a strong satiny discal bar which extends from the costa to above the anal angle where it crosses the inner fold; beyond this is a series of rusty lunules outlined in black on a darker ground; the submarginal area more satiny greyish carrying lilac and black marks on the proximal side of the rufous marginal border; olive at anal angle; edge black with fine white fringe in region of tails. The underside thus has a strong pattern. (Pl. 9, fig. 59.)

MAP 5

FEMALE. Fore wing length 32 mm. Shape of fore wing, less concave on outer margin compared with the male. *Upperside.* Ground colour at base blackish brown, slightly darker on the border; costa slightly rufous at basal half. Wing crossed by a strong disco-postdiscal orange band, conjoined from the hind margin where it is 7 mm wide, to 3, beyond this the lines divide, the upper discal spots directed toward the costa at an angle to the spot in 3; in the postdiscal row, the spot in 4 is in line, but the three in the subapex, which are in line, are directed toward the costa at an angle. Hind wing, blackish brown at base, darker on the border; disc of wing crossed by a broad orange band, 7 mm wide at costa, where it is slightly paler, extending to the inner fold, through which it passes as a narrow strip above the anal angle. The black border carries a series of linear white marks in the region of the tails, double spot in the anal angle; marginal border strong, orange-red from upper angle to lower tail, but olive at anal lobe; edge black; margin serrate, tails rather thin, 5–3 mm long. *Underside.* Generally light rufous, dominated by the orange colour of the disco-postdiscal band and bars of satiny sheen, thus enhancing the darker brownish dull areas of the sub-base, the costal patch between the divided disco-postdiscal band, and that at the apex and margin. Hind wing, the alternating dull and satiny bars are also evident, dominated by the discal pale band. The whole underside is not however so strongly patterned as in the females of the sub-region described below.

REGION 1. SUB-REGION 2. IVORY COAST & GHANA

MALE. Fore wing length 31–32 mm. *Upperside.* Similar in all general respects to nominate *anticlea* of Sierra Leone; the orange-red submarginal border of the fore wing slightly more developed, the black border very slightly stronger. There is no appreciable difference in the hind wing with regard to the orange-red border nor the submarginal spots. *Underside.* Pattern similar to that of topotypical specimens, with a slight tendency toward density of the dark areas contrasting with the strength of the satiny paler bars, but this may vary according to the age of the example.

FEMALE. *Upperside.* Conforming in general pattern to topotypical examples, the fore wing orange bar, usually narrow, but exhibiting some variation, especially in the development of the upper discal spots. *Underside.* Pattern usually strong, a contrast between the pale orange-ochre satiny bars and the darker brownish band of the sub-bases of both wings, and the dark patches on the outer border and tornal area of the fore wing; hind wing, dark postdiscal lunules, with black outline distally, usually well marked; the submarginal paler spots strong.

Charaxes anticlea proadusta **ssp. n.**

(Pl. 9, figs 61, 62, Map 5)

REGION 2. SUB-REGION 1. E. CAMEROUN AND CENTRAL AFRICAN REPUBLIC

MALE. Fore wing length 30–31 mm. Generally smaller than examples from the Ivory Coast. *Upperside.* Fore wing, general colour velvety black; the reddish orange at the hind border of fore wing more restricted with compensating broadening of the marginal black border. Hind wing, basal half velvety black, reddish orange border slightly deeper in colour; the submarginal white-centred black spots stronger, the spots at upper angle larger, but the orange of the ground colour extending up to the costa. *Underside.* Fore wing, generally darker, the satiny bars and marginal patches more greyish and less shiny and there is a distinct orange-red area in the hind angle corresponding to the orange-red band of upperside. Hind wing, the general tone is similar to that of the fore wing, the discal satiny bar less strong but the postdiscal series of orange-red lunules, outlined in black, are well marked. The submarginal light spots not so strongly developed, but the marginal border is strongly reddish, turning cadmium-yellow at the anal angle, which has two lilac-white black edged spots. (Pl. 9, figs 61, 62.)

FEMALE. Rothschild associated a female from Cameroun with his type male of *adusta* from Kampala, Uganda, but this female belongs to *proadusta*. *Upperside.* Fore wing, disco-postdiscal bar more orange than nominate *anticlea*, slightly wider, the upper spots in the postdiscal line contiguous. Hind wing marginal orange line thin above upper tail, divided by dark veins in region of tails, faint at anal angle. *Underside.* Discal bars stronger, and dark bands heavier; hind wing submarginal white dots larger; posterior marginal orange spots separated by dark veins.

Holotype male. CENTRAL AFRICAN REPUBLIC: Bangui, vii.1967 (*ex* coll. Plantrou) in B.M.(N.H.).

Charaxes anticlea cline from ***proadusta*** to ***adusta***

REGION 2. SUB-REGION 2. CONGO (BRAZZAVILLE) (MOYEN CONGO)

MALE. Specimens from this sub-region of the Congo are smaller and have more pointed fore wings. *Upperside.* Ground colour similar, but fore wing orange-red bar on hind angle narrower. The reddish orange border of the hind wing extended toward the costa at upper angle, as in *adusta;* black sub-marginal spots complete or almost so. *Underside.* Very similar to that of *proadusta.*

FEMALE. None available.

Charaxes anticlea near ***adusta***

REGION 2. SUB-REGION 3. C. and N. CONGO

(Medje-Stanleyville area)

MALE. Unfortunately, the only specimens available to me are old and rather worn, but on general upperside characters, they approach very closely to *adusta.* The underside is also very similar to *adusta,* the whole being suffused with a rufous tone so that the satiny bars are not strongly represented and the dark bands are less strong. The hind angle of the fore wing and the zone on the hind wing carrying the rusty lunules have a decided reddish tinge.

FEMALE. None available.

Charaxes anticlea adusta Rothschild

(Pl. 10, figs 63, 64, Map 5)

Charaxes anticlea adusta Rothschild, 1900 : 494.

REGION 3. E. & C. & PART OF W. UGANDA

The type of *adusta,* a male, is from Kampala, Central Uganda, and is in the Tring Museum. It is extremely unfortunate that Rothschild had a mixed aggregate before him when he described this race and though he designated a male from Kampala as type, one of five examples from various localities, he described a female from Cameroun as belonging to this subspecies. Furthermore, in giving its distribution, he naturally includes 'Cameroon to Angola, Congo and Uganda'! Apart from the basic differences between males from the west and those of the east, i.e., the width of the black border to the orange band in the hind angle of the fore wing, he stresses the differences between the females from the two regions. While it is true that these differences exist, I have shown that the males within the range of *adusta* as cited by Rothschild, differ considerably. It seems reasonable to suggest that the female from Cameroun is not the true female of *adusta* of Kampala, but of the intermediate *proadusta* ssp. n.

For descriptive purposes, topotypical Kampala examples have been selected.

MALE. Fore wing length 27–28 mm. *Upperside.* Ground colour velvety purplish black, immaculate except for the conspicuous orange-red submarginal bar at the hind angle. This bar is fairly uniform in width, extending from the hind margin to 2 as a block, 4 mm wide, or slightly reduced at 2, with a free spot in 2. The marginal black border uniformly wide, 3.5 mm, increasing in width at 3 proportionately to the reduction in the orange bar. Hind wing, basal half black, shading to brownish on the inner fold; distal part of wing orange-red, extending from the costa to the anal angle, the submargin with row of black spots, those in the tail region and anal lobe with white dot, the spot in 5 small; edge of wing narrowly black. Margin very bluntly dentate; tails very short and stumpy. *Underside.* The whole with a marked rufous or ruddy tinge so that the satiny bars, though present, are overshadowed; the hind angle of the fore wing is orange, reflecting the orange bar of upperside; hind wing pattern overshadowed by the generally 'ruddy' tone, the satiny lines suppressed; the postdiscal rusty red lunules outlined in black, fairly strong, but the admarginal marks are not strong; margin rusty to lower tail then olive-ochre at anal lobe.

FEMALE. Shape of fore wing, outer margin less concave than male *Upperside.* Fore wing, base and outer border brownish black; the main feature is the very broad disco-postdiscal band, 9–11 mm wide at the hind margin, usually widening in 2, the mark in 3 with inclined ends reducing the width where the two series of marks divide, the discal marks, three in line being directed toward the costa, while the postdiscal are angled, the two or three subapical directed toward the costa. In fresh specimens this conjoined band is orange, slightly paler on the proximal border. Hind wing, base brownish black, border darker, but mid-portion of wing with an equally broad orange disco-postdiscal band paler on the discal line, extending from the costa to above the anal angle, broadest in 4–5; the black border with series of white linear marks most in evidence opposite the tails and anal angle; marginal border orange-red turning olive-ochre at anal angle. *Underside.* Strongly satiny over the pale areas, but the dark brownish bar on both wings on proximal side of discal line well defined, especially distally. Fore wing, disco-postdiscal band buff, ill defined on its outer border, where the postdiscal line carries a series of ill-defined lunules; border of wing brownish. Hind wing, discal band well defined proximally, and on its outer border is a series of rusty lunules outlined in black. Submarginal lilac-black lunules strongest in region of the tails, fade out toward upper angle; marginal border rusty red to lower tail then ochreous olive at anal angle; edge brownish.

REGION 3. SUB-REGION 1. MASAKA, KATERA FOREST, W. SHORE OF LAKE VICTORIA

Charaxes anticlea f. *horatianus* Stoneham, 1936 : 3 ; 1964 : 115 [referred to trinomially as a subspecies, but no formal elevation in status given.]

MALES in this region exhibit some slight differences from topotypical *adusta* from eastern and central Uganda. *Upperside.* Fore wing, orange-red bar at hind angle tends to be wider at base and more graduated, the upper marks often extending to 5 as a series of separate spots. Hind wing, orange-red border rather broad, extending well up into costa at the upper angle, and at lower end the projection into the inner fold is wider; submarginal black spots are usually well developed. *Underside.* Generally similar to that of nominate *adusta*, the whole area being rufous, obscuring the darker bands and the satiny bars; the areas corresponding to the orange-red upperside are dull orange; the postdiscal lunules in the hind wing are rusty-red; the submarginals are only present in the region of the tails and anal angle. (Pl. 10, fig. 63.)

FEMALE. Fore wing length 28–30 mm. *Upperside.* Fore wing, disco-postdiscal band very wide 12 mm at 2, with a corresponding broadening of the spots in the discal and postdiscal rows, the marks in each row being confluent. Hind wing, band also broad, 11 mm at 4–5, the extension being on both borders. The marginal border is also wide above upper tail; tails 5 and 3 mm long. *Underside.* Dominated by the dull orange of the disco-postdiscal bands, which are somewhat satiny; the dark brownish bars defined distally; the hind wing band paler, defined proximally, but shading into the more rufous postdiscal zone, which is margined by the rufous lunules; the latter are strongly edged with black, especially in region of tails and anal angle; submarginal pale spots well developed in region of tails but obsolete above. (Pl. 10, fig. 64.)

REGION 3. SUB-REGION 2. KIGEZI, KAYONZA, IMPENETRABLE FOREST

MALE. Fore wing length 29 mm. *Upperside.* In this assemblage the fore wing orange bar is rather broad at the base with a consequent reduction in the outer black border, and the orange-red spots may extend up to 5. The hind wing orange-red border is broad and extends well along the costa at the upper angle; the submarginal black spots with white centres are strong, complete or interrupted in 5 where the spot is a mere dot. *Underside.* Compared with the previous series, this shows a general darkening, with less rufescent tone overall; the satiny bars are not strong and more restricted to the distal side of the dark bar and sub-apex of fore wing. On the hind wing the postdiscal row of rufous lunules is rather subdued by the rufous tinge to the border; submarginal pale spots restricted to tail region and anal angle; marginal rufous border subdued.

FEMALE. *Upperside.* Fore wing, disco-postdiscal conjoined orange band is more restricted than in Katera examples, slightly richer in colour and there is distinct indication of a row of dark scales denoting the line of junction of the two series; the upper discal spots are usually well separated from the mark in 3; the postdiscal spots well developed and separated, the third dot at subcosta, if present, is vestigial. The hind wing band is broad, but there is a paler inner zone on the discal line, the postdiscal being darker orange. Submarginal white spots strong in region of tails; marginal border broad above upper tail then narrow to anal angle. *Underside.* With a decidedly stronger pattern than in Katera examples, the dark brown bar on both wings stronger and wider; the interrupted row of postdiscal marks stronger; the rufous lunules in hind wing stronger and the submarginal white spots well developed.

REGION 3. SUB-REGION 3. TANZANIA, N.E. SIDE OF LAKE TANGANYIKA, KIGOMA DISTRICT

This population would appear to be an extension southward of that found in the Kagera district of Uganda.

MALE. Fore wing length 30–31 mm. *Upperside.* There is little difference on the upperside in males from the two areas, the fore wing orange-red bar shows the same slight variation, but narrower in some examples. On the hind wing, the only marked difference is the restricted development of the orange-red border at the upper angle, the upper submarginal black spots merging with the black costa, but this is variable; the submarginal spots are small, often without a white dot, and restricted to the upper angle and the area opposite the tails. *Underside.* Pattern more contrasty, the dark bars broader; the division between the discal and postdiscal satiny bars in fore wing clearer; on the hind wing the rufous lunules in the postdiscal line stronger. (Pl.10, fig. 65.)

FEMALE. *Upperside.* Very similar to those of the Katera area, but fore wing conjoined band narrower, the upper discal and postdiscal marks smaller and well-spaced; the hind wing orange band narrower, so that the black border is slightly wider; the submarginal white spots weak and only present in region of tails; marginal border brick-red and strong to upper tail then narrow to anal angle. *Underside.* The dark bar crossing both wings slightly wider, more curved on the distal side in the hind wing; pale bars satiny, but not strongly so; the rusty lunules in postdiscal line well developed, but submarginal lilac and black edged marks variable. (Pl. 10, fig. 66.)

***Charaxes anticlea reducta* ssp. n.**

(Pl. 10, figs 67, 68, Map 5)

This subspecies comes nearest to nominate *adusta* but averages smaller, and the orange-red areas are darker.

MALE. Fore wing length 25–27 mm. *Upperside.* Fore wing, orange-red at the submarginal border at hind angle somewhat narrowed, tapering to 2, with a small spot in 3, occasionally, the hind angle black border is thus broad. Hind wing, orange-red border goes through to the costa at upper angle; the submarginal black spots, with white centres opposite the tails, usually strong and complete. *Underside.* With a general rufous tone, thus obscuring the satiny bars which would otherwise be fairly strong; the dark bars are narrow, and rather obscured by the overall 'ruddy' tone; the rufous lunules in the postdiscal line of the hind wing clear, especially from the anal lobe to 5, where the rufous line bordering the lunules is 'stepped' proximally. The submarginal white spots, strong in the area opposite the tails and hind angle, fade out beyond. Tails very short and squat. (Pl. 10, figs 67, 68.)

FEMALE. Shape more falcate than other females of the eastern area, the outer margin more concave. Proportionately smaller than female *adusta*, fore wing length 28 mm. *Upperside.* Fore wing, ground colour brownish black, slightly darker on the border. Conjoined orange band paler, but broader in proportion the extension being toward the base; upper postdiscal spots, only three in number separate, the discal spots elongate. Hind wing, band pale proximally but stronger orange on outer border; submarginal white spots small and not extending further than the upper tail; marginal rufous border clear but narrowing in region of tails, ochre in anal angle. (Pl. 10, figs 69, 70.)

Holotype male. KENYA: Chepalungu, ix.1949 (*van Someren*), in B.M. (N.H.).
Allotype female. KENYA: S. Kavirondo, Suna (*van Someren*), in B.M. (N.H.).

RANGE. N. W. Kenya: Lower Sotik, Chepalungu Forest, Suna and Kisii area.

From the above comments, it will be noticed that the aggregates centred around ssp. *adusta* exhibit some local variation, the differences however being insufficient to warrant subspecific rank, except in the case of the small ssp. *reducta* from the Chepalungu Forest.

Biological Note

The species is noted as laying on *Acacia pennata* and *A. goetzii* (botanical material determined by Kew). The butterfly is a forest species, mostly found in clearings and roadways, where the males may be seen at damp mud or feeding on excreta of carnivores. They far outnumber females, which are usually seen in the vicinity of their food-plants.

SYSTEMATIC LIST

Charaxes anticlea (Drury)

Charaxes anticlea anticlea (Drury), 1782. Type locality, Sierra Leone.
  Range: Sierra Leone, Liberia, Ivory Coast, Ghana, ?W. Nigeria.
  anticlea proadusta ssp. n. Type locality, Central African Republic, Bangui.
    Range: E. Cameroun and Central African Republic.
  anticlea proadusta cline near *adusta*.
    Range: Central and east Congo.
  anticlea adusta Rothschild, 1900. Type locality, Uganda, Kampala. ♂.
    Range: Uganda, Masaka district, Katera Forest, west of L. Victoria; Kigezi Province, Kayonza Forest (Impenetrable Forest); Tanzania, Kigoma district, N. E. side of Lake Tanganyika.

anticlea reducta ssp. n. Type localities, Kenya, Chepalungu (♂), S. Kavirondo, Suna (♀).
Range: Kenya, Lower Sotik, Chepalungu Forest; Suna, Kisii district; S. W. Kavirondo.

6. *CHARAXES BAUMANNI* Rogenhofer and its subspecies

This small species appears to be limited in distribution to the eastern side of the Great Central Rift, ranging from Rhodesia and Malawi to southern Sudan.

The type of the species came from the Pare hills, north of the Usambara Range in Tanzania. The species was described in 1891, and it was also discovered in the mountains in the south of Malawi, at Zomba, and this insect was described and named *whytei* by Butler, in 1893, who apparently overlooked the description of *baumanni*. The species was again described in 1894, as *selousi* Trimen, the type coming from Mineni Valley in Manicaland. Here also there is no reference to *baumanni* Rogenhofer in the description. Aurivillius (1899) associated all named 'species' under the name *baumanni* Rogenhofer. Rothschild (1900) followed this lead, and Bryk (1939 : 497) accepted this view. There the matter rested.

That the species presents a complex problem can be seen at once if one views a collection from all parts of its range, but if this material is arranged in sequence from a geographical point of view, and with some knowledge of geological formations, general topography and ecological environments, what was apparent chaos resolves itself into a picture of regional groupings, each with definite characteristics. It will be noted, however, that in the male the upperside appearance, especially in regard to the development of the fore wing blue spots from area 2 to the sub-apex, is extremely variable even in one locality, but the underside characters are more stable. Females exhibit a greater degree of stability of characters, especially in regard to the formation and width of the white bar on both wings and this can be used as a basis for dividing the species into geographical races. As already mentioned, there is in addition, some degree of stability of underside pattern and coloration, particularly the white line which crosses the discs of both wings from costa to hind angle. Size in both sexes is somewhat variable, but there is some consistency even in this character when the grouping of the species is viewed as a whole.

On this basis, the species from definite areas can be divided, each group exhibiting a degree of stability warranting the recognition of subspecies.

The type of the species is a female, on deposit in the Vienna Museum, but it has been made available to me through the kindness of Dr Kasy.

The suggested grouping is as follows:—

Region 1. Tanzania: Pare Hills and Usambara Range: Nguru and Uluguru Hills and including Turiani and Morogoro districts.
Sub-region, Kenya: The Teita Range, including Sagala; the Shimba Hills.

Region 2. Tanzania: Mt Kilimanjaro, especially on the western side, Arusha and Mt Meru.

SUB-REGION, KENYA: Nairobi district and the Kikuyu Highlands to Mt Kenya and the Njombeni Hills. East of the Rift Valley.
REGION 3. KENYA: West of the Rift Valley, Mau, Elgon, Trans Nzoia, Sotik and Chepalungu Forest.
UGANDA: East and central and part of the western, but not including the Semliki Valley at Bwamba.
REGION 4. UGANDA: The Semliki Valley at Bwamba.
REGION 5. SOUTHERN SUDAN: Didinga Mts; UGANDA: Karamoja and Mt Labwor.
REGION 6. MALAWI, ZAMBIA, EAST RHODESIA.
SUBREGION, TANZANIA: country east of Lake Tanganyika; the Southern Highlands to north of the Rufigi River.

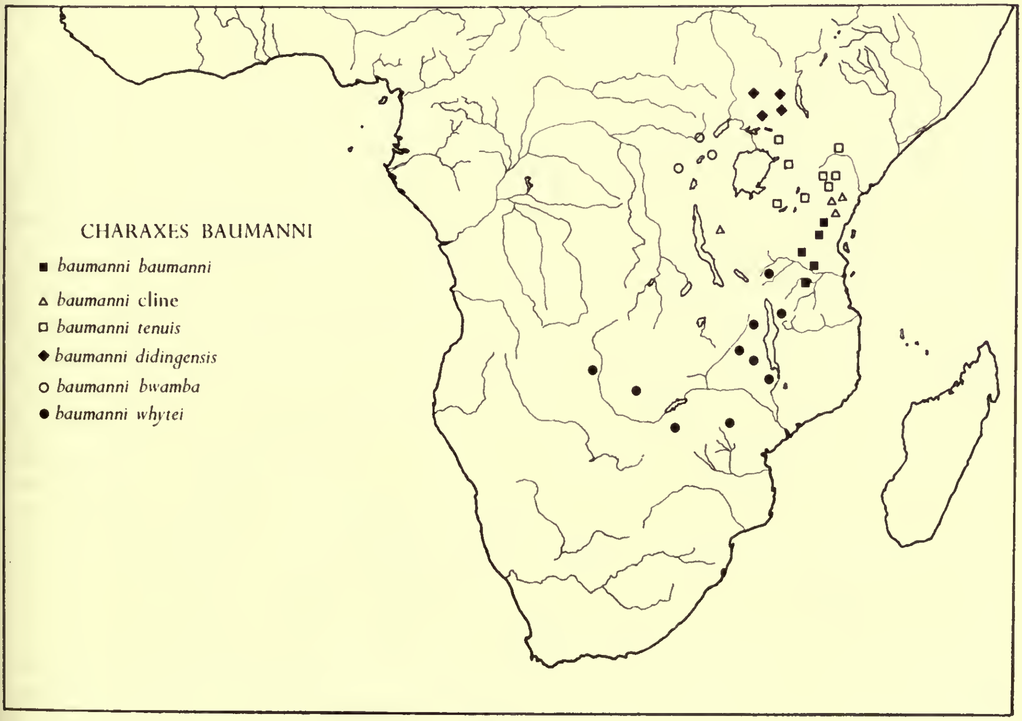
Charaxes baumanni baumanni **Rogenhofer**

(Pl. 10, figs 71–73, Map 6)

Charaxes baumanni Rogenhofer, 1891 : 564.

REGION 1. TANZANIA: Pare Hills and Usambara Range, Nguru and Uluguru Hills and including Turiani and Morogoro districts

MALE. Fore wing length 28–30 mm, majority 29. Fore wing rather pointed due to the inward curve of the margin at 3–4, the hind angle thus projecting at 2. *Upperside.* Fore wing,



MAP 6

ground colour black, the base of the costa slightly brownish (the black coloration in *baumanni* is rather fugitive, turning a brownish black in old specimens). The wing is immaculate except for a series of dull, rather pale blue spots in the postdiscal line, rather variable in size and number, the widest mark is at the hind margin in 1a, then tapering to 2 and smaller separated spots in 3–5, which may or may not be obscure or missing, the spots in the sub-apex in line and white in colour. Margin with very faint whitish scaling between veins. Hind wing, ground colour black, (but subject to fading), more greyish brown on the inner fold. A large bluish white disco-postdiscal patch, more bluish on the borders, is widest at 4, tapers toward, but does not reach, the costa, but may be represented by a small white subcostal dot in 6; the band tapers more acutely at its hind end to above the anal angle and may be represented on the inner fold by a pale spot. The submargin of wing with a complete row of small white spots, double at anal angle and bordered with lilac, distally. Tails thin, pointed, 4 and 3 mm long. *Underside*. Fore wing, ground colour light brownish, with a darker band crossing the disc of the wing from costa to hind margin; this in turn is crossed by a pale whitish line, outlined proximally in black, commencing from beyond the end of the cell and extending to about the mid-point on the hind margin. Cell with a black linear mark at sub-base, followed by two rounded spots, then by two complete black lines, almost straight or wavy at the cell end, these lines outlined in whitish; the long subterminal line is extended through the sub-bases of 2 and 1b. There is a slight satiny sheen over the wing as a whole. The postdiscal zone is slightly paler than the border, without any defined pattern, but with a darker tornal spot at hind angle, in 1b. Hind wing, ground colour as fore wing, the basal area with fine black lines at base and more conspicuously on the inner border of the darker satiny band and outlined in white proximally. The disc is crossed by a whitish line, similar to and continuous with that of the fore wing, crossing from the costa to above the anal angle and is accentuated proximally in black. In the postdiscal line is a series of somewhat obscure rusty lunules, extending from the costa to above the anal angle, with a variable amount of black edging; the submargin carries a series of whitish lilac spots, black distally, double at anal angle; margin with rusty red lunules turning olive at anal lobe. Edge black with slight whitish interneural fringe. (Pl. 10, fig. 71.)

FEMALE. Fore wing length 30–32 mm majority 31 mm. *Upperside*. Fore wing, ground colour black, usually not so black as in the male, and subject to fading toward the base of the wing. Wing crossed by a combined disco-postdiscal strong white bar, from hind margin to 3 where the two series divide up, the discal spots small and irregular in shape, the postdiscals, small in 3–4, are larger, more rounded and in line, two to three in number, at an angle to spots below. The outer margin of the wing less incurved at 3–4 and the hind angle less prominent than in the male. Hind wing basal triangle black, shading to a paler, more brownish colour on the inner fold, the border of the wing usually blacker. The disc of the wing is crossed by a white bar extending from the costa to above the anal angle, the postdiscal spots at the upper end of the bar in 5–6 sometimes free; the bar is widest at the end of the cell and tapers toward the inner fold, and may narrowly cross it. Submargin with narrow white lunules accentuated distally in black, which are conspicuous at upper angle, then almost fade out, but are strong again opposite the tails and double at anal angle and surrounded with lilac. Admargin rusty to above upper tail, then olive at anal angle; fringe narrowly white between the veins. Tails relatively long, bluntly ended, 6–5 mm long. *Underside*. Fore wing, ground colour brownish grey with a strong satiny sheen overall, and a darker band on proximal side of the discal white bar, and between the divided band at its upper part; this dark band crosses the end of the cell and is edged black on both sides. The cell has a sub-basal black dot and two beyond. The white bar, which is almost a replica of that on upper surface, has larger and more defined white spots at its upper part in both discal and postdiscal arms, its outer edge black; there is no distinct pattern on the outer border, but the tornal dark mark is enhanced by a paler surround; the margin of the wing slightly brown in the curve. Hind wing, ground colour as fore wing, but with less satiny sheen; the sub-base is crossed by a rather diffuse whitish line, distally outlined in black. The discal white bar slightly narrower than above, is otherwise of similar shape, but tapers more rapidly to the inner fold; the postdiscal white spots in 4 and 6 more separated and more visible in the browner ground of the border; the submarginal whitish and black spots well developed; the marginal border rusty reddish to upper tail, then olive at anal angle; edge black. (Pl. 10, figs 72, 73.)

RANGE. Tanzania, Pare Hills and Usambara Range; Nguru and Uluguru Mts and adjacent Turiani and Morogoro districts.

REGION 1. SUB-REGION 1. KENYA: Teita Range, including Sagala, Shimba Hills

The population in the Teita Hills and Mt Sagala in Kenya conform in the main to the nominate race, on the upper surface, with some degree of variation in the male, and some divergence on the underside. The females conform to the nominate race.

MALE. Fore wing length average 30 mm; shape similar to nominate race. *Upperside.* Fore wing ground colour similar; blue spots as variable, but sometimes well developed. *Underside.* Conforming in general ground colour to nominate *baumanni*, the white bars in fore and hind wing tend to be broader, but this is variable.

FEMALE. Fore wing length 30 mm on average. *Upperside.* Pattern is similar to nominate *baumanni*, as is also the underside.

RANGE. Kenya, on the Teita Hills and Mt Sagala.

Charaxes baumanni tenuis ssp. n.

(Pl. 10, figs 74–77, Map 6)

REGION 2. SUB-REGION, TANZANIA: W. Kilimanjaro

MALE. Fore wing length 27–31 mm, topotypical examples average 28 mm. Fore wing shape as in nominate race. *Upperside.* Fore wing, ground colour black; postdiscal blue to whitish spots variable in size and distribution from broad-based and incomplete to narrow base and complete. Hind wing, whitish blue patch generally slightly larger than in the nominate subspecies; submarginal white spots larger and complete; marginal border stronger reddish to upper tail, a mixture of red and olive between tails, then olive at angle; edge black. Tails longer and rather thin. *Underside.* Darker brown overall and the pattern submerged, the discal white line on both wings very thin. (Pl. 10, figs 74, 75.)

FEMALE. Fore wing length 30–31 mm. *Upperside.* Fore wing, ground colour black; the disco-postdiscal band very narrow, 3–4 mm, the upper separated spots incomplete in discal line and often so in the postdiscal row, the white band from hind margin to 3 also narrow. Hind wing, bar narrower and parallel-sided then tapers rapidly to inner fold but does not cross it, but is represented by a free spot. The submarginal spots sharply defined; the border lunules reddish, then olive, tend to be interrupted. (Pl. 10, figs 76, 77.)

Holotype male. TANZANIA: West Kilimanjaro, vii.1966 (*I. Grahame*), in B.M.(N.H.).

Allotype female. Same data as holotype.

RANGE. Tanzania, West Kilimanjaro and Moshi, Arusha and Ngorongoro.

REGION 2. SUB-REGION, KENYA : east of the Rift Valley

MALE. Fore wing length 28–29 mm; shape similar to nominate race. *Upperside.* Fore wing, ground colour black, more brownish when old. Postdiscal blue spots well marked up to 1b, subapical spots present but those of 3–4 often faint or missing. Hind wing ground colour black, shading to brownish on inner fold. The bluish white patch large, represented on the costa as a comparatively large spot, the band expands rapidly to its mid point at 4 and continues to the edge of the inner fold, crossing it above the anal angle. The submarginal white spots are well marked, as also is the marginal border, which is less reddish, being heavily mixed with bluish green scaling, but is olive at the anal angle; edge black. Tails slightly shorter and thinner than Kilimanjaro specimens. *Underside.* Fore wing, ground colour brownish, less dark than nominate race, so that the pattern is more visible, but the white discal lines on both wings are narrow and less sharply defined.

FEMALE. *Upperside.* Fore wing, ground colour black; the conjoined disco-postdiscal portion of the white bar in 1a–3 narrow, the divided spots in upper portion usually complete in postdiscal line, but spots in 4–5 in discal line often missing. Hind wing ground colour black; white bar narrow throughout, represented on the inner fold by a conjoined spot. Submarginal white spots less strong and marginal border less reddish, more greenish; edge black, tails as long as but thinner than nominate race. *Underside.* Fore wing, ground colour less dark than Kilimanjaro specimens, the general pattern stronger; the upper discal and postdiscal portions of the white bar wider but less defined, more diffuse and confluent; the lower portion is outlined distally by a black line which separates the postdiscal marks. Tornal dark mark well developed. Hind wing, pattern more clearly defined in the basal area; the discal white bar is strong and defined but narrow, and the irregular dark brownish zone on its distal side more invaded by the paler patches of the border. Marginal border less reddish.

This aggregate is clearly linked with that of the Kilimanjaro area.

RANGE. Kenya, East of the Rift Valley, Nairobi district, Aberdares, Mt Kenya and the Meru area, Njombeni Hills.

***Charaxes baumanni interposita* ssp. n.**

(Pl. 11, figs 78–81)

REGION 3. KENYA, west of the Rift Valley; UGANDA, East and Central

The population from this region presents an extremely complex problem. There is a strong similarity to the nominate *baumanni* above and below in the male, but the two groups are widely separated geographically.

MALE. Fore wing length 28–29 mm, majority 29. *Upperside.* Fore wing, ground colour black; post-discal blue to white spots variable, complete to incomplete in mid area; hind wing, bluish-white patch, rather variable in shape, represented in the subcosta by a discrete spot. *Underside.* Fore wing, ground colour brownish with strong satiny sheen, the dark discal zone through which the whitish discal line passes is stronger, but the line is thin to medium in width. On the hind wing, the dark zone on distal side of the white line is darker. (Pl. 11, figs 78, 79.)

FEMALE. *Upperside.* Fore wing, pattern very similar to some nominate *baumanni*, but the white bar is slightly narrower; this also applies to the bar on the hind wing. *Underside.* Fore wing, pattern is stronger, the dark patch between the divided discal and postdiscal upper spots of the white bar is narrower, as is also the main portion of the bar. Hind wing, the white bar is more even in width and the dark zone on distal side more divided up; the submarginal spots more distinct, the marginal border less reddish. (Pl. 11, figs 80, 81.)

Holotype male. KENYA: Kitale, ix.1932 (*van Someren*), in B.M.(N.H.).
Allotype female. KENYA: Soy, vii.1937 (*T. H. E. Jackson*), in B.M.(N.H.).

RANGE. Kenya, Trans Nzoia, Kitale and Elgon; Uganda, East and Central and western shores of Lake Victoria to the Kagera River.

Charaxes baumanni bwamba **ssp. n.**

(Pl. 11, figs 82–85, Map 6)

REGION 4. UGANDA, Bwamba Valley

A small race with rather pointed wings.

MALE. Fore wing length 27 mm. *Upperside.* Fore wing ground colour black; the postdiscal series of bluish white spots of almost even width from 1a–2, the spots in 5–6 whitish, the whole series complete or faintly indicated at the apical end. Hind wing, ground colour black, the whitish blue patch extending up to the costa and sometimes proximally along its edge, the patch is usually whitish on inner side but more bluish on distal border. The submarginal white spots well developed, but may be faint in mid area; border not reddish but more olive-red and not extending to upper angle, olive at anal angle, the upper tail with a bluish line running its length. Tails comparatively short and robust, 4–3 mm long. *Underside.* Fore wing, ground colour greyish brown, the darker median band not strong but within it, the discal white line is broad and distinct; the postdiscal paler markers are more in evidence, especially that of the proximal side of the dark tornal spot; the marginal border of the wing within the curve is darker. Hind wing, ground colour as fore wing; the pattern within the basal triangle distinct; the dark elongate triangle on the inner side of the discal white line extends almost to the inner fold; the discal white line is broad and extends to the inner fold and is outwardly bordered by a dark brownish zone flanked distally by rusty rufous lunules; the submarginal white and black spots clear, but the marginal border is not strongly rufous, and is heavily mixed with green, olive at the anal angle. (Pl. 11, figs 82, 83.)

FEMALE. Fore wing length 30 mm. *Upperside.* Fore wing, very similar to the central Uganda form, the white bar, from hind margin to 3, of medium width, 5 mm, and almost parallel-sided, the upper spots in the median line weak except for the subcostal one; the postdiscal series large, but subcostal one missing, or minute. Hind wing, band of almost even width to edge of inner fold, crosses it above anal angle; submarginal white spots small; marginal border only slightly reddish. *Underside.* General appearance and pattern very similar to the central Uganda form, the distal side of the dark brownish band demarcating the proximal border of the white bars on both wings; the outer border of the fore wing bar in postdiscal line rather diffuse, but the dark tornal spot in 1b is strong. The submarginal spots on hind wing rather weak. (Pl. 11, figs 84, 85).

Holotype male. UGANDA: Bwamba Valley, v.1954 (*van Someren*), in B.M.(N.H.). Allotype female. UGANDA: Bwamba Valley, v.1954 (*T. H. E. Jackson*), in B.M.(N.H.).

RANGE. Uganda, western boundary in Semliki Valley, Bwamba County.

Charaxes baumanni didingensis **ssp. n.**

(Pl. 11, figs 86–89, Map 6)

REGION 5. SOUTHERN SUDAN AND ADJACENT NORTHERN UGANDA

MALE. A small race, fore wing length 24–25 mm, apex rather pointed. *Upperside.* Fore wing, series of postdiscal bluish white spots complete and distinct, marks in 1b and 2 narrow, but the streak in 1a extended proximad, these marks strongly blue. Hind wing, whitish blue patch widest opposite the cell, tapering at both ends, the upper represented in the subcosta by a free white mark, at the hind end the patch ends at the inner fold but is here represented by a whitish spot. Submarginal white spots small; marginal border a mixture of reddish and olive, olive at anal angle. Tails relatively long and thin, 5–4 mm. *Underside.* This has a general rufous tinge overall, the satiny sheen reduced in most specimens, border of wing rufous in the curve; the dark discal band is defined on the inner border but more diffuse on outer, the median white line clear and of medium width. Hind wing, dark median band less clearly defined than in the Bwamba race, but extending further into the inner fold; the whitish median line clear and distally bordered by a rufous area with rusty contiguous lunules within; white and black submarginal spots distinct; marginal border rusty red, edge black. (Pl. 11, figs 86, 87.)

FEMALE. Fore wing length 26 mm. *Upperside.* Fore wing, base of white bar rather narrow and parallel-sided to 3, the subcostal spot in the discal line large, spot in 4 missing, the spots in the postdiscal row, complete, the three subapical well developed. Hind wing, ground colour black, darker on border; the discal white bar wider than bar in fore wing, tapers gradually to the inner fold and is there represented by a whitish spot. Submarginal linear white marks small but clear, the double spots at anal angle with lilac distally. Marginal border reddish to lower tail, then olive at anal angle. *Underside.* Fore wing, ground colour greyish brown, the median dark band rather strongly defined on proximal side and in space between the divided discal-postdiscal white spots; the white bar strongly represented below, but narrow, the postdiscal spots 1–3 represented by whitish lunules, a thin black line separating them from the discal. The tornal black spot distinct. Border of wing browner in curve. Hind wing, basal area greyish brown, the darker median band carried down toward the inner fold, sharply defining the inner edge of the white band, which is almost straight then crosses the inner fold at a slight angle. The white bar is distally defined by a thin black line, beyond which are three brownish patches, separated by greyish white which interrupts the series of rufous black-edged lunules of the postdiscal zone. Submarginal white-black linear marks well developed; marginal border slightly reddish to upper tail but olive at anal angle. (Pl. 11, figs 88, 89.)

Holotype male. S. SUDAN: Didinga Mts, xii.1925 (*G. D. H. Carpenter*), in Hope Dept., University Museum, Oxford.

Allotype female. Same data.

RANGE. Sudan, in southern district, Didinga Mts; also in adjacent area of Uganda, in Karamoja.

Charaxes baumanni whytei Butler

(Pl. 11, figs 90–93, Map 6)

REGION 6. MALAWI, ZAMBIA, RHODESIA

Charaxes whytei Butler, 1893 : 649.
Charaxes selousi Trimen, 1895 : 45.

MALE. Fore wing length 29–30 mm. Shape, slightly less pointed at apex, the costa slightly more curved. (Females especially, have a straighter outer margin). *Upperside.* Fore wing, ground colour black; blue postdiscal spots, widest at the hind margin where the mark is extended proximad, become progressively smaller in 2 and 1b, the spots above small and faint or even missing, the subapical spots, other than that in 6 or 5, usually missing. Hind wing, ground colour black, paler brownish on inner fold; the bluish white patch tapering at both ends rather strongly, represented at the subcosta by a free white mark, the lower border on the hind portion more strongly blue, the extension through the inner fold at an angle to the brownish of the inner fold. The submarginal white spots rather small; marginal border reddish or a mixture of red and greenish, somewhat broken, but olive at the anal angle; edge black. Tails comparatively short and robust, 4 and 3 mm. *Underside.* Greyish brown to brown, with satiny sheen overall; the brownish darker band in disc not very sharply defined but with a black line on inner edge of the whitish discal line, which is broad and well defined on its outer border by the brown of the discal band, the bar turning outward slightly toward the hind angle and the dark tornal spot; outer border of wing brown in the curve. Hind wing, basal area pale brown, defined from the darker brown discal triangle by a narrow white and black line; the discal white line clear and strong, defined on inner by black and on outer edge by the darker brown zone, which carries a series of black lunules abutting onto the rusty red lunules, which extend from the upper angle to above the anal angle; the submarginal white to lilac and black triangles clear, double in the anal angle on an olive ground; border rusty red; edge black. (Pl. 11, figs 90, 91.)

FEMALE. Fore wing length 30–31 mm, outer margin of wing not appreciably incised. *Upperside.* Fore wing, ground colour nearly black, darker on outer border. White discal bar broad, of about equal width from hind margin to 2–3, the inner edge slightly curved, the postdiscal spot in 2 contiguous, that in 3 more or less free, the rest of the spots large, extending to subcosta or in space below, the discal spots smaller. Hind wing brownish black at base, slightly paler on the inner fold; the white bar broad, 6 mm., the postdiscal spots in 5–7 contiguous to the bar or slightly separated from it, the hind end of the bar and its extension into the inner fold is sharply angled by the dark colour of the inner fold. The submarginal series of linear white marks may be complete and clear or reduced in size in mid area; the marginal border, a mixture of reddish and greenish, then olive at anal angle, is well marked; edge black. Tails black with a central greenish line, moderately long, 5–4 mm. *Underside.* Fore wing, pale greyish at the base, rather sharply defined from the darker brown median band by a white and black line; the fore wing white bar is more or less a replica of above, the postdiscal spots rather clearly defined in the somewhat greyish border; the tornal dark spot is strong and the slight curve of the wing is brown. Hind wing, the basal area grey as on the inner fold, rather sharply defined from the darker brown elongate triangle on the inner border of the white bar, which is similar to above, but the postdiscal white spots are more discrete on its outer border, where the ground colour is brown with rufous lunules outlined in black and interrupted by grey at the upper angle, and opposite the upper tail; submarginal white and black lunules well marked; marginal border red, outlined distally in white, anal angle olive; edge black. (Pl. 11, figs 92, 93.)

RANGE. Malawi, Zomba; Zambia, at Mumbwa in west; and Rhodesia, Manicaland, Umtali, Mashonaland.

REGION 6. SUB-REGION, TANZANIA, WESTERN AND SOUTHERN AREAS

This aggregate exhibits characters which suggest it is a cline between nominate *baumanni baumanni* and *baumanni whytei*, but nearer to the latter.

MALE. Fore wing length 29–30 mm. *Upperside.* Very similar to *whytei* but the underside more brownish, so that the dark discal band is less defined proximally; the whitish discal lines on both wings slightly narrower, but well defined and clear on the proximal side. The distal portion of the hind wing more brown, so that the rufous lunules are less distinct, but the submarginal spots are usually distinct, and clear.

FEMALE. Fore wing length 29–30 mm, rather smaller than *whytei*. *Upperside.* Fore wing, disco-postdiscal white bar broad, 5–6 mm at hind margin, widening slightly in 2, the upper spots complete. Hind wing, white bar proportionately broad. The submarginal white-black marks distinct. The marginal border less clear, a mixture of reddish and greenish scaling, rather narrow and somewhat broken, above the upper tail. Tails long, thin, 6–4 mm. *Underside.* Basal area usually dark brown, so that the dark discal band is less defined proximally, but this is variable. The white bar of the fore wing very similar to that of upperside, its outer border less defined; the dark tornal spot well marked, with some indication of dark marks in the submargin in some specimens. The discal white bar narrower than above; the submarginal white and black spots distinct; the marginal border olive and rufous, the edge black.

RANGE. Tanzania, Kungwe Peninsular, Mpanda district on east side of Lake Tanganyika; Southern Highlands to Newala, north of the Rufigi River.

SYSTEMATIC LIST

Charaxes baumanni Rogenhofer

Charaxes baumanni baumanni Rogenhofer, 1891. Type locality: Tanzania, Pare Hills, north of Usambara Range. ♀.
Range: Region 1, Tanzania, Pare Hills, Usambara Range, Nguru and Uluguru Mts, Turiani and Morogoro. Sub-region, Kenya, Teita Range and Mt Sagala, and the Shimba Hills.

baumanni tenuis ssp. n. Type locality: Tanzania, West Kilimanjaro.
Range: Region 2, Tanzania, Mt Kilimanjaro, on western side, Arusha Moshi and Mt Meru. Sub-region, Kenya, Nairobi district and Kikuyu Highlands, eastern Aberdares, to Mt Kenya and Njombeni Hills; east of the Rift Valley.

baumanni interposita ssp. n. Type locality: Kenya, Elgon, Kitale.
Range: Region 3, Kenya, west of the Rift Valley; Mau, Elgon, Trans Nzoia, Sotik and Chepalungu Forest. Uganda, eastern, central and part of western, but *not* including the Semliki Valley, Bwamba.

baumanni bwamba ssp. n. Type locality: Uganda, Bwamba Valley.
Range: Region 4, Uganda, Bwamba County in Semliki Valley.

baumanni didingensis ssp. n. Type locality: S. Sudan, Didinga Mts.
Range: Region 5, Sudan, south, in the Didinga Mts. Uganda, Northern District, Karamoja, Labwor.

baumanni whytei Butler, 1893. Type locality: Malawi, Zombe.
= *selousi* Trimen, 1894. Type locality: Manicaland.
Range: Region 6, Malawi, Zambia, and eastern Rhodesia, Manicaland. Sub-region Tanzania, eastern side of Lake Tanganyika at Kunhwe; the Southern Highlands to Newala.

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—— 1969. Part V. *Bull. Br. Mus. nat. Hist.* (Ent.) **23** (4) : 75–166, 29 pls, 31 text-figs., 8 maps.

—— 1970. Part VI. *Bull. Br. Mus. nat. Hist.* (Ent.) **25** (5) : 197–249, 11 pls, 6 maps.

INDEX

Synonyms in italics

Dr Victor Gurner Logan van Someren
The Sanctuary, Ngong
P.O. Box 24947
Karen, Kenya

PLATE 1

Charaxes castor castor Cramer

Upper & undersides

FIG. 1. ♂ (Sierra Leone).
FIG. 2. ♀ (Sierra Leone).
FIG. 3. ♂ (Uganda: W. Nile, W. Madi, Metu).
FIG. 4. ♀ (Uganda: Kibali Forest, Toro).
FIG. 5. ♀ (Uganda: Jinja). Aberration with very large blue spots on submargin of hindwing.

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PLATE 2

Charaxes castor Cramer

Upper & undersides

FIG. 6.	*castor* ♂ (N. W. Kenya: Kitale). Melanic aberration with large blue spots on submargin of hindwing. Near ab. *aginga* Stoneham.
FIG. 7.	*castor* ♂ (Uganda: Kibali Forest). Semi-melanic aberration.
FIG. 8.	*flavifasciatus* Butler ♂ (Tanzania: Njombe).
FIG. 9.	*flavifasciatus* Butler ♀ (Tanzania: Njombe).
FIGS 10 & 11.	*arthuri* ssp. n. ♂ Holotype (Tanzania: Pemba Island, ix.1963) (*A. Rydon*).

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PLATE 3

Charaxes

Upper & undersides

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Fig. 14.	*castor comoranus* Rothschild ♂ (Grande Comoro Island).
Fig. 15.	*castor comoranus* Rothschild ♀ Holotype (Comoro Islands, Mayotte Island).
Fig. 16.	*hansalii hansalii* Felder ♂ (W. Ethiopia; Shoa Prov.).
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PLATE 4

Charaxes hansalii Felder

Upper & undersides

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FIGS 21 & 22.	*kulalensis* ssp. n. ♀ Allotype (Kenya: S. E. of Lake Rudolf, Mt Kulal, v.1961) (*H. D. van Someren*).
FIG. 23.	*arabica* Riley ♂ Holotype (S. E. Arabia: Ain Qara Mts, 1500 ft, 8.xi.1930) (*B. S. Thomas*). Photos B.M.(N.H.) Nos 45999, 46000.
FIG. 24.	*arabica* Riley ♀ Allotype (S. E. Arabia: Qara Mts, Sahalnaut, 350 ft, 4.xi.1930) (*B. S. Thomas*). Photos B.M.(N.H.) Nos 46001, 46002.

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PLATE 5

Charaxes lucretius Cramer
Upper & undersides

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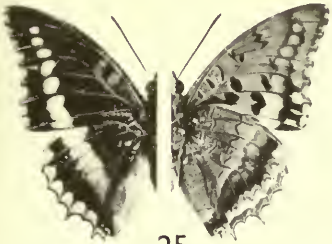
FIGS 29 & 30.	*intermedius* ssp. n. ♀ Holotype (Central African Republic: Bangui, xii.1967) (ex J. Plantrou coll.).
FIGS 31 & 32.	*maximus* ssp. n. ♂ Holotype (Uganda: Mawakota, Kamengo, vii.1953) (*van Someren*.)



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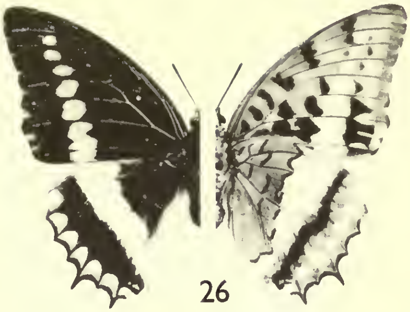

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PLATE 6

Charaxes

Upper & undersides

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Fig. 40.	*montieri* Staudinger & Schatz ♀ (São Thomé).

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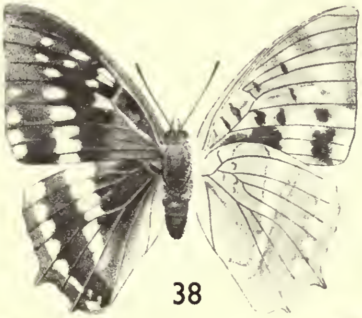

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PLATE 7

Charaxes protoclea Feisthamel

Upper & undersides

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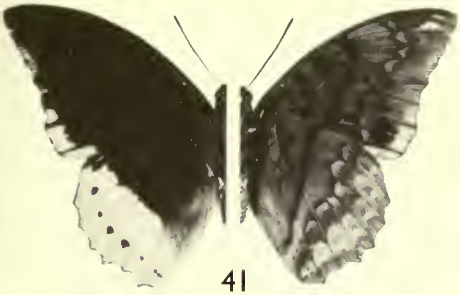

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PLATE 8

Charaxes

Upper & undersides

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PLATE 9

Charaxes

Upper & undersides

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PLATE 10

Charaxes

Upper & undersides

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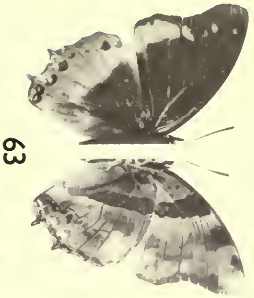
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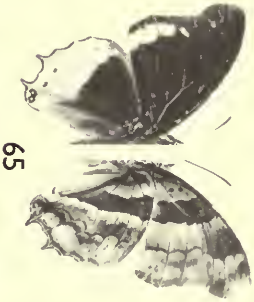
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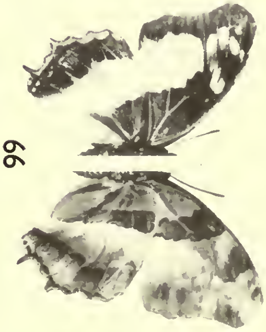
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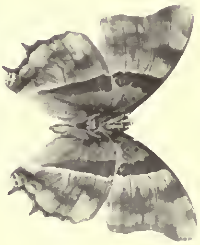
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PLATE 11

Charaxes baumanni Rogenhofer

Upper & undersides

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A REVISION OF THE AFRICAN GENUS *PHYLLOXIPHIA* ROTHSCHILD & JORDAN (LEPIDOPTERA: SPHINGIDAE)

A. H. HAYES

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ENTOMOLOGY Vol. 26 No. 5
LONDON: 1971

A REVISION OF THE AFRICAN GENUS *PHYLLOXIPHIA* ROTHSCHILD & JORDAN (LEPIDOPTERA: SPHINGIDAE)

BY

ALAN HENRY HAYES

Pp. 227–243; 11 *Plates*, 2 *Text-figures*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ENTOMOLOGY Vol. 26 No. 5
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THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three to four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 *a separate supplementary series of longer papers was instituted, numbered serially for each Department.*

This paper is Vol. 26, *No.* 5 *of the Entomological series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.*

World List abbreviation
Bull. Br. Mus. nat. Hist. (Ent.).

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 8 *November*, 1971 *Price* £1·60

A REVISION OF THE AFRICAN GENUS *PHYLLOXIPHIA* ROTHSCHILD & JORDAN (LEPIDOPTERA: SPHINGIDAE)

By A. H. HAYES

CONTENTS

SYNOPSIS

The genus *Phylloxiphia* Rothschild & Jordan is revised and an identification key to the species is given. Two generic and two specific synonyms are newly established. One species is recalled from synonymy.

INTRODUCTION

THE genus *Phylloxiphia* was erected by Rothschild & Jordan (1903) for the single new species *P. oberthueri* in their monumental revision of the Sphingidae. In the same work these authors placed *bicolor* Rothschild, known at that time only from the female holotype, in the Indo-Australian genus *Clanis* Hübner, and described a new species *karschi*, which they assigned to the genus *Pseudoclanis* Rothschild. They also mentioned *goodi* Holland, which they retained in *Polyptychus* Hübner although they had not examined the holotype. Since Rothschild and Jordan's work, many more specimens have been made available for study and over 200 have been examined during the preparation of the present paper.

The wing-measurements given in this paper were taken from the apex of the fore wing to the centre of the mesothorax. The bulk of the Carnegie Museum material has been identified from colour-transparencies taken by Mr A. Watson, deposited in the BMNH.

All the specimens figured are in the British Museum (Natural History) except the male of *Phylloxiphia karschi* Rothschild and Jordan, which is the property of the Mission Biologique au Gabon, and the holotype female of this species, together with the holotype male of *formosa*, which are deposited in the Museum für Naturkunde der Humboldt-Universität, Berlin.

A key is given for the identification of male specimens. Until the female of *P. formosa* Schultze is known a complete key to the females cannot be compiled.

ACKNOWLEDGEMENTS

In addition to acknowledging the advice given to me by my colleagues at the British Museum (Natural History), I should like to thank Dr R. H. Carcasson for his encouragement with this project. I am grateful also to workers at the institutions listed below for their kind help. My thanks are due to members of the Photographic section of this museum who took the photographs reproduced in the plates. The Department is indebted to the following for their generous donations to the national collection: Dr G. Bernardi, Mr J. Boorman, Mr & Mrs A. Forbes-Watson, Dr B. J. MacNulty, Prof. D. F. Owen, Dr E. C. G. Pinhey, Mr J. N. Pollock and Mr F. H. F. Schofield.

LOCATION OF MATERIAL STUDIED

All specimens are in the British Museum (Natural History) (often abbreviated to BMNH) unless otherwise stated. Material was obtained on loan from the following institutions, through the courtesy of the workers mentioned; the abbreviations used where the material is listed in detail are given in parentheses. Museum für Naturkunde der Humboldt-Universität, Berlin, Dr H. J. Hannemann (MNHU); National Museum of Rhodesia, Bulawayo, Dr E. C. G. Pinhey (NMR); Universitets Zoologiske Museum, Copenhagen, Dr S. L. Tuxen (UZM); Zoologisches Sammlung des Bayerischen Staates, Munich, Dr F. Daniel (ZSBS); National Museum of Kenya, Nairobi, Mr M. Clifton (NMK); University Museum, Oxford, Mr E. Taylor (UM); Muséum National d'Histoire Naturelle, Paris, Dr P. C. Rougeot (MNHN); Mission Biologique au Gabon, Paris, Dr G. Bernardi (MBG); Carnegie Museum, Pittsburgh, Dr H. K. Clench (CM); Transvaal Museum, Pretoria, Dr L. Vári (TM); Musée Royal de l'Afrique Centrale, Tervuren, Dr L. A. Berger (MRAC).

PHYLLOXIPHIA Rothschild & Jordan

Phylloxiphia Rothschild & Jordan, 1903 : 263. Type-species: *Phylloxiphia oberthueri* Rothschild & Jordan, by original designation.

Libyoclanis Rothschild & Jordan, 1906*a* : 180. Type-species : *Libyoclanis bainbridgei* Rothschild & Jordan (= *Phylloxiphia goodi* (Holland)), by original designation. **Syn. n.**

Typhosia Rothschild & Jordan, 1906*b* : 406. Type-species: *Typhosia illustris* Rothschild & Jordan, by original designation.

Acentropoclanis Strand, 1915 : 132. Type-species : *Acentropoclanis bicolor* Rothschild sensu Strand, 1915 [misidentification of *Phylloxiphia vicina* (Rothschild & Jordan)], by original designation. **Syn. n.**

GENERIC SYNONYMY. Although Strand cited *Acentropoclanis bicolor* Rothschild as the type-species of *Acentropoclanis*, he did question his determination of the specimen before him. I have compared this specimen with the holotype of *bicolor* and find it to represent *P. vicina* Rothschild & Jordan. This is a case of a misidentified type-species, which under the International Code of Zoological Nomenclature, Article 70(a), should be referred to the Commission. Kernbach (1963*b*: 327–332) illustrates the close affinities of the genera *Libyoclanis* and *Typhosia* with *Phylloxiphia* and I consider all the species included in these genera to be congeneric.

DIAGNOSIS. Proboscis short, when extended not reaching beyond hind coxa. Palp short, not protruding beyond front of head. Legs spinose and with a single pair of short tibial spurs on fore and middle legs, two pairs on hind legs. Pulvillus present, paronychium bilobed. Fore wing elongate, brown in colour; hind wing brown, reddish brown or pink. Abdominal tergites with spines. Male genitalia with uncus terminating in two teeth, or more deeply bifid; valva elongate. Female genitalia with prominent horseshoe-shaped signum.

AFFINITIES. *Leptoclanis* has a cryptic pattern on the fore wing and a red hind wing similar to those found in the majority of *Phylloxiphia* species; however, the fore wing is green and the male genitalia lack the elongate valve found in *Phylloxiphia* (see *Leptoclanis pulchra* Rothschild & Jordan, genitalia figure, Carcasson, 1968: pl. 12, fig. 4).

Species in the Indo-Australian genus *Clanis* have genitalia similar to *Phylloxiphia* species (see Rothschild & Jordan, 1903 : pl. 32, figs 7–11) but differ in the more complex harpe of the valve.

BIOLOGY. Little is known concerning the life-history of the species of this genus. The hind wing, which is brown in *oberthueri* but red or pink in other species, is concealed when the insects are at rest, and the cryptic pattern of the fore wing probably renders them inconspicuous on certain foliage. Dr B. J. MacNulty has reared *oweni* (Carcasson) at Port Harcourt, Nigeria (see Pl. 6, fig. 22). The foodplant is *Anthonotha macrophylla* P. Beauvois (Leguminosae), described and illustrated as *Macrolobium macrophyllum* in *Flore du Congo Belge*, **3** : 422, t. 31 (1952). Descriptions of the larvae of this and other West African hawkmoths have been published recently (see MacNulty, 1970 : 98). A female specimen of *oweni* from Eala, Congo (Kinshasa) in the Musée Royal de l'Afrique Centrale bears the data *Macrolobium palisoti* – Watsangila – this name is a synonym of *A. macrophylla*. Pinhey (1962 : 40) states under his description of *punctum*:

> "Duke says there are two forms of the full grown larva. The normal form is bluish-green above, (becoming bluer before pupation), tinted with yellow at the edges of this area; the sides dull green, faintly marked with oblique yellow stripes; a yellow mid-dorsal stripe. Surface of the body granular. Horn 'reddish, a quarter of an inch in length and slightly curved'. The other larval form is reddish pink above, 'pinkish fawn at the sides and the stripes are reddish'. Duke, in his notes sent to the Author, observes that this form appears in early autumn, when the leaves of the foodplant, *Ochna pulchra*, are turning orange-yellow, and he, therefore, concludes that it is an example of 'seasonal cryptic coloration'. He also thinks there may be three summer broods."

A pupal case of *metria* (Jordan) from Zambia (H. C. Dollman Collection) is figured (Pl. 5, fig. 21). This is the only preserved pupal case I have traced. The larva from which this specimen was reared is figured as *vicina* in the Dollman M.S. drawings deposited in the BMNH (see Pl. 6, fig. 23).

DISTRIBUTION. The maps on p. 241 (Text-fig. 2) show the distribution of each species opposite the vegetation map (Text-fig. 1) on p. 240.

SPECIES-GROUPS. *P. goodi, karschi* and *illustris* all exhibit a crenulate outer margin to the male fore wing. The process at the base of the valves is absent in the male genitalia of *goodi* and *karschi*, and the uncus terminates in two teeth; in both these species the females have an entire outer margin to the fore wing, which terminates in a falcate apex. In *oberthueri* the uncus is not so deeply bifid as in the remaining species, but the prominent band across the fore wing is shared with *illustris*. On the basis of these characters four-species groups are recognized, as shown in the following check-list.

goodi-group
- ***P. goodi*** (Holland) **comb. n.**
  - *Libyoclanis bainbridgei* Rothschild & Jordan **syn. n.**
- ***P. karschi*** (Rothschild & Jordan) **comb. n.**

illustris-group
- ***P. illustris*** (Rothschild & Jordan) **comb. n.**

oberthueri-group
- ***P. oberthueri*** Rothschild & Jordan
  - *Libyoclanis hollandi* Clark

vicina-group
- ***P. bicolor*** (Rothschild) **comb. n.**
- ***P. oweni*** (Carcasson) **comb. n.**
- ***P. formosa*** Schultze **comb. rev.**
  - *Libyoclanis major* Rothschild & Jordan
- ***P. vicina*** (Rothschild & Jordan) **comb. n.**
- ***P. metria*** (Jordan) **comb. n.**
  - *Libyoclanis noctivago* Kernbach **syn. n.**
- ***P. punctum*** (Rothschild) **comb. n.**

KEY TO THE MALES

1 Outer margin of fore wing crenulate 2
– Outer margin of fore wing entire 4
2 Dark band of fore wing extending from base of costa to end of cell, then curved towards apex (Pl. 2, fig. 5) (*illustris*-group) . . . . . . ***illustris*** (p. 234)
– No such band on fore wing (*goodi*-group) 3
3 Anal margin of hind wing cream, shading into prominent blackish brown band ***karschi*** (p. 234)
– Anal margin of hind wing buff . . . . ***goodi*** (p. 233)
4 Fore wing with blackish brown pre-apical marking not extending to apex (Pls 4 & 5) (*vicina*-group in part) 7
– Fore wing without blackish brown pre-apical marking 5
5 Fore wing with longitudinal dark band extending from base of costa to apex of wing (Pl. 2, fig. 7) (*oberthueri*-group) . . . . ***oberthueri*** (p. 235)
– Fore wing without longitudinal dark band (*vicina*-group in part) 6
6 Fore wing less than 47 mm. Genitalia with process at base of valve on large projection (Pl. 7, figs 32, 33) . . . . ***bicolor*** (p. 235)
– Fore wing more than 47 mm. Genitalia with process at base of valve on short projection (Pl. 8, figs 34, 35) . . . . ***oweni*** (p. 236)

7 Outer margin of fore wing concave towards apex (Pl. 4, figs 13–15) 8
– Outer margin of fore wing not or hardly concave (Pl. 5, figs 17, 19) 9
8 Fore wing less than 46 mm. Genitalia with base of uncus not constricted (Pl. 9, figs 40, 41) . . . . ***vicina*** (p. 238)
– Fore wing more than 46 mm. Genitalia with base of uncus constricted (Pl. 8, figs 36–39) . . . . ***formosa*** (p. 237)
9 Fore wing irrorate with dark brown . . . . ***metria*** (p. 239)
– Fore wing not irrorate with dark brown . . . . . . ***punctum*** (p. 240)

DESCRIPTIONS OF THE SPECIES

THE *GOODI*-GROUP

Male fore wing with crenulate outer margin. Female fore wing with entire outer margin terminating in blunt hook. No prominent band across fore wing from base of costa.

Phylloxiphia goodi (Holland) **comb. n.**

(Pl. 1, figs 1, 2; Pl. 6, figs 24, 25; Pl. 10, fig. 46; Pl. 11, fig. 54)

Polyptychus goodi Holland, 1889 : 64, fig. Holotype ♂ (not ♀, as stated by Holland), Gabon: Kangwé (CM, Pittsburgh) [colour-transparency examined].
Libyoclanis bainbridgei Rothschild & Jordan, 1906*a* : 180. Holotype ♀, Sierra Leone (BMNH) [examined]. **Syn. n.**
Libyoclanis karschi bainbridgei Rothschild & Jordan; Hering *in* Seitz, 1927 : 363.
Libyoclanis goodi (Holland) Darge, 1970 : 62 [♂ erroneously designated as neallotype].

♂. Fore wing with crenulate outer margin. Stigma of fore wing prominent. Genitalia with uncus terminating in two teeth; harpe well defined; no process at base of valve.

♀. Fore wing with entire outer margin terminating in blunt, falcate apex. Stigma prominent. Genitalia as in Pl. 10, fig. 46.

Wing-measurements. ♂ 47·8–53·7 mm; ♀ 64·9–70·4 mm.

Fore wing of both sexes without the prominent band extending across wing from base of costa, found in *illustris*. Hind wing of both sexes without blackish brown band found in *karschi*.

The BMNH possesses a colour-transparency of the holotype. The pectinations of the antennae show that it is a male and not a female as stated by Holland. This has been confirmed by Dr Clench, who has examined the frenulum, and the neallotype male described by Darge is therefore erroneously designated. Darge's specimen was previously mentioned and figured by Carcasson (1968 : 47), who also listed as a female a male from Irumu in the BMNH. Comparable sexual dimorphism in *karschi* provides sufficient evidence that the female holotype of *bainbridgei* is conspecific with the holotype of *goodi*.

MATERIAL EXAMINED.

Polyptychus goodi, holotype ♂, Gabon: Kangwe (*A. C. Good*), CM; *Libyoclanis bainbridgei*, holotype ♀, Sierra Leone (Major *Bainbridge*).

Liberia: Grassfield, Nimba, 1 ♂, ix-x. 1968 (*A. Forbes-Watson*); Cameroun: Bitje River, 2,000 ft, 1 ♀, x-xi. 1918, wet season (Ex. Joicey); Congo (Kinshasa): Uele, Paulis, 1 ♀, 31.v.1956 (*M. Fontaine*), MRAC; E. Ituri Valley, 30 miles south of Irumu, 3,000 ft, 1 ♂, vii. 1924 (*T. A. Barnes*).

Phylloxiphia karschi (Rothschild & Jordan) **comb. n.**

(Pl. 1, figs 3, 4; Pl. 6, figs 26, 27)

Pseudoclanis karschi Rothschild & Jordan, 1903 : 220. Holotype ♀, Cameroun: Kriegschiffshafen (Victoria) (MNHU, Berlin) [examined)].

Pseudoclanis karschi Rothschild & Jordan; Clark, 1919 : 103. [Description of ♂.)

♂. Fore wing with crenulate outer margin. Hind margin of hind wing white shading into prominent blackish brown band. Genitalia with uncus terminating in two teeth; harpe poorly defined; no process at base of valve.

♀. Fore wing with prominently falcate apex; outer margin otherwise entire. Hind margin of hind wing white, shading into prominent blackish brown band. Genitalia probably deformed, therefore not figured.

Wing-measurements. ♂ 51·8 mm; ♀ 75·7 mm.

Neither *goodi* or *illustris* possess the blackish brown band on the hind wing. This species exhibits interesting sexual dimorphism in the shape of the fore wing.

Material examined.

Holotype ♀, Cameroun: Kriegschiffshafen (Victoria) (*v. Grabczewski T.*), MNHU. Cameroun: Lolodorf, 1 ♂, 2. ii. 1915 (*A. I. Good*), CM; Lolodorf, 1 ♀, 4. v. 1914 (*A. I. Good*), CM; Gabon: Makokou-Colline, 1 ♂, 8. i. 1968 (*G. Bernardi*), MBG.

The *ILLUSTRIS*-Group

Fore wing with crenulate outer margin in both sexes. Prominent band across fore wing from base of costa.

Phylloxiphia illustris (Rothschild & Jordan) **comb. n.**

(Pl. 2, figs 5, 6; Pl. 7, figs 28, 29; Pl. 10, fig. 47; Pl. 11, fig. 55)

Typhosia illustris Rothschild & Jordan, 1906*b*: 407, LECTOTYPE ♂, Ghana (BMNH), here designated [examined].

Libyoclanis illustris (Rothschild & Jordan) Carcasson, 1968 : 47.

♂. Fore wing with crenulate margin and with dark band extending from base of costa to beyond end of cell, curved towards apex. Genitalia with bifid uncus; characteristic process at base of costal margin of valve.

♀. Larger and broader winged but similar to male. Genitalia as in Pl. 10, fig. 47.

Wing-measurements. ♂ 32·0–37·5 mm; ♀ 40·3–41·6 mm.

Smaller than *goodi* and *karschi*, sexual dimorphism is less extreme.

Material examined.

LECTOTYPE ♂, Ghana (labelled 'Gold Coast 1905–47 *Typhosia illustris* Type. 1906. Novit. Zool.'), here designated. (In the original description Rothschild & Jordan (1906*b* : 407) give the data as 'Obuassi, Ashanti (G. E. Bergmann)'; it appears that they have repeated the data of the previously described species, *Polyptychus poliades* Rothschild & Jordan 1906*b* : 406.)

Guinea: Nimba, 1 ♂, vii-xii.1951 (*R. Lamotte*); Sierra Leone: Bo, 1 ♂, 8.iv.1959 (*R. Taylor*); Ivory Coast: Man, 1,200 ft, 1 ♂, 26–30.vi.1926 (*C. L. Collenette*); Ghana: 1 ♂ (Paralectotype); Juaso, Forest Country E. of Ashanti, 1 ♂ (*G. S. Cansdale*), 2 ♂ (*G. H. Gibbs*); Kwadaeo, 1 ♂, 18.vi.1955 (*Dept. Agric.*); Nigeria: Sobo Plain, nr Sapele, 1 ♀, 5.iii.1957 (*B. J. MacNulty*); Cameroun: Efulan, 2 ♂ (*H. L.

Weber); GABON: Belinga, 700 m, Camp Central, 1 ♂, 14.v.1963 (*G. Bernardi*), BMNH, 1 ♂, 24.xi.1967 (*G. Bernardi*), MBG; Ipassa, 1 ♂, 27.x.1967 (*G. Bernardi*), MBG; Makokou-Colline, 1 ♂, 5–7.xi.1967 (*G. Bernardi*), MBG, 1 ♀, 16.i.1968 (*G. Bernardi*), MBG; CONGO (KINSHASA): Bafwasende, Lindi River, 2,000 ft, 1 ♂, vi.1921 (*T. A. Barnes*).

THE *OBERTHUERI*-GROUP

Fore wing with entire outer margin. Prominent band across fore wing from base of costa.

Phylloxiphia oberthueri Rothschild & Jordan
(Pl. 2, figs 7, 8; Pl. 7, figs 30, 31; Pl. 10, fig. 48; Pl. 11, fig. 56)

Phylloxiphia oberthueri Rothschild & Jordan, 1903 : 263, fig. Holotype ♂, CAMEROUN: Lolodorf (*L. Conradt*) ex Oberthuer Collection (CM, Pittsburgh).
Libyoclanis hollandi Clark, 1917 : 62, fig.

♂. Fore wing with entire, concave outer margin, and with a dark band extending from base of costa to beyond end of cell, curved towards apex of wing. Hind wing brown. Genitalia with bifid uncus; characteristic process at base of valve.

♀. Larger and broader-winged, but similar to male. Genitalia as in Pl. 10, fig. 48.

Wing-measurements. ♂ 46·5–48·6 mm; ♀ 58·3 mm.

This is the only known species with a dark brown hind wing.

MATERIAL EXAMINED.

LIBERIA: Grassfield, Nimba, 1 ♂, ii.1968, 1 ♂, ii.1968, 1 ♂, vii.1967, 2 ♂, vii-viii.1967 (*A. Forbes-Watson*); Gissi, 1 ♀, 20.iv.1909 (*A. Pearse*); CAMEROUN: Efulan, 2 ♂; GABON: Ipassa, 1 ♂, 6.xi.1967 (*G. Bernardi*).

THE *VICINA*-GROUP

Fore wing with entire outer margin. No prominent band across fore wing from base of costa.

Phylloxiphia bicolor (Rothschild) **comb. n.**
(Pl. 3, figs 9, 10; Pl. 7, figs 32, 33; Pl. 10, fig. 49; Pl. 11, fig. 57)

Clanis bicolor Rothschild, 1894 : 96 Holotype ♀, without data (BMNH) [examined].
[*Libyoclanis vicina* Rothschild & Jordan; Kernbach 1957 : 179. Misidentification.]

♂. Fore wing with entire, concave outer margin; pre-apical blackish brown marking absent. Genitalia with bifid uncus; characteristic process at base of valve.

♀. Larger and broader winged, but similar to male. Genitalia as in Pl. 10, fig. 49.

Wing-measurements. ♂ 35·5–44·0 mm; ♀ 43·8–47·0 mm.

Separated from *oweni* by its smaller size and the more strongly arcuate, proximal fascia on the ventral surface of the hind wing. Genitalic differences also separate this species from *oweni*.

MATERIAL EXAMINED.

Holotype ♀. This specimen is without data but closely matches West African females.

SIERRA LEONE: 1 ♀, ex Rothschild Collection; Freetown, 1 ♂, ix.1949 (*W. Peters*), 3 ♂, xii.1968 (*D. F. Owen*); Bo, 1 ♂, v.1967 (*J. N. Pollock*), 1 ♀, vi.1967 (*J. N. Pollock*); Murray Town, 1 ♂, 1911 (*C. A. Foster*), UM; LIBERIA: Grassfield, Nimba, 2 ♂, vii.1967 (*A. Forbes-Watson*), 1 ♂, viii-xi.1967 (*A. Forbes-Watson*), NMR; Marshall Terr., Harbel, 1 ♂, 8.v.1956 (*R. M. Fox*), CM; IVORY COAST: Azaguie, 1 ♂, vi.1964 (*Guerout*), MRAC, 1 ♂, vii.1964 (*Guerout*), MRAC, 2 ♂, viii.1964 (*Guerout*), MRAC, 1 ♂, ix.1964 (*Abdoulaye*), MRAC; Anguededou, 1 ♂, vii.1964 (*Guerout*), MRAC; Adiopodoumé, 1 ♂, ix.1963 (*P. Griveaud*), MNHN, 1 ♂, xi.1963 (*P. Griveaud*), MRAC; Barr. d'Aydmé, 1 ♂, i.1964 (*Piart & Griveaud*), MNHN; Bingerville, 1 ♂ (*R. Pujol*), MNHN; Lamto, 1 ♂, ii.1964 (*P. Griveaud*), MNHN; Divo, 1 ♂ (*R. Pujol*), MNHN, 1 ♂, 5.x.1962 (*R. Pujol*), MNHN, 2 ♂, 18.x.1962 (*R. Pujol*), MNHN; GHANA: Sekondi, 1 ♂; Adjahbippo, 46 miles inland from Sekondi, 1 ♂; Presten, 75 miles inland from Sekondi, 1 ♂, CM; Wassaw district, 45 miles inland from Sekondi, 1 ♂; Between coast and Kumasi, 1 ♂ (*C. H. McDowall*); Abossi, 1 ♂ (*J. L. Wilson*); Bibianaha, 700 ft, 1 ♂, 25.iv.1912 (*H. G. F. Spurrell*); NIGERIA: Lagos, 1 ♂ (*J. Boorman*), 1 ♂, vi.1957 (*J. Boorman*), 1 ♀, viii.1958 (*J. Boorman*); Ibadan, 1 ♂, viii-ix.1955 (*B. N. Alexander*), 3 ♂, ca i-vi.1954 (*H. Stenholt Clausen*). UZM; CAMEROUN: 1 ♂, ZSBS; Jaunde, 1 ♂, (*P. Ringler*), CM; GABON: Belinga, 700 m, Camp Central, 1 ♂, 15.iii.1963 (*G. Bernardi*), MBG, 1 ♂, 24.iii.1962 (*G. Bernardi*), 1 ♂, 25.iii.1962 (*G. Bernardi*), MBG, 1 ♂, 30.v.1963 (*G. Bernardi*), MBG; Belinga, 900 m, Grande Crête Sud, 1 ♂, 16.iii.1963 (*G. Bernardi*), MBG, 1 ♂, 29.iii.1963 (*G. Bernardi*), MBG, 1 ♂, 18.iv.1963 (*G. Bernardi*), MBG; Ipassa, 1 ♂, 6.xi.1967 (*G. Bernardi*), MBG, 1 ♂, 9.xi.1967 (*G. Bernardi*), MBG, 1 ♂, 27.xi.1967 (*G. Bernardi*), MBG, 1 ♂, 6.xii.1967 (*G. Bernardi*); Makokou Colline, 1 ♂, 7.iii.1962 (*G. Bernardi*), MBG, 1 ♂, 13.iii.1962 (*G. Bernardi*), MBG, 2 ♂, 13.xii.1967 (*G. Bernardi*), MBG, Savanes Mwadi, 1 ♂, 1.iv.1963 (*G. Bernardi*). MBG; plage face Mwadi, 1 ♂, 13.iii.1963 (*G. Bernardi*), MBG; Lastourville, 2 ♂, (*P. Rougeot*), MNHN; CENTRAL AFRICAN REPUBLIC: Boukoko, 1 ♀ (*R. Pujol*), MNHN; La Maboke, 1 ♂, 17.xii.1965 (*R. Pujol*), MRAC; CONGO (KINSHASA): Mbila (Mts du Chaillu), 1 ♂, xii.1963 (*A. Descarpentries & A. Villiers*), MNHN; Dimonika (*Mayumbe*) 1 ♂, i.1964 (*A. Descarpentries & A. Villiers*), MNHN; Kasai, Luluabourg, 1 ♂, 17.vi.1953 (*M. Fontaine*), MRAC; Sankuru, Lusambo, 1 ♂, 22.vii.1950 (*M. Fontaine*), MRAC, 1 ♀, 2.viii.1950 (*M. Fontaine*), MRAC; Uele, Paulis, 1 ♂, 7.iv.1956 (*M. Fontaine*), MRAC, 1 ♂, 11.vi.1958 (*M. Fontaine*), MRAC; ANGOLA: Dundo, 1 ♂, 28.x.1962 (*D. B. M.*), MNHN.

Phylloxiphia oweni (Carcasson) **comb. n.**

(Pl. 3, figs 11, 12; Pl. 6, fig. 22; Pl. 8, figs 34, 35; Pl. 10, fig. 50; Pl. 11, fig. 58)

[*Clanis bicolor* Rothschild; Rothschild & Jordan, 1903 : 219. Misidentification of ♀ from Sierra Leone.]

[*Libyoclanis major* Rothschild & Jordan, 1915 : 284. Misidentification of ♀ from Sierra Leone.]

[*Libyoclanis bicolor* Rothschild; Kernbach, 1957 : 179. Misidentification.]

[*Libyoclanis major* Rothschild & Jordan; Boorman, 1960 : 162, fig. Misidentification.]

Libyoclanis oweni Carcasson, 1968 : 45. Holotype ♂, SIERRA LEONE: Freetown (BMNH) [examined].

♂. Fore wing with entire, concave outer margin; pre-apical blackish brown marking absent.

Genitalia with bifid uncus, constricted at base; characteristic process at base of valve.

♀. Larger and broader winged than male. Genitalia as in Pl. 10, fig. 50.

Wing-measurements. ♂ 50·5–57·0 mm; ♀ 53·3–66·8 mm.

Larger than *bicolor*, it can be separated by the less strongly arcuate proximal fascia on the ventral surface of the hind wing. Genitalic differences also separate this species from *bicolor*.

MATERIAL EXAMINED.

Holotype ♂, SIERRA LEONE: Freetown, vi.1967 (*D. F. Owen*).

SIERRA LEONE: 1 ♀ (ex Rothschild Coll.), BMNH; 1 ♀, CM; Freetown, 2 ♂, iii.1969 (*D. F. Owen*), 1 ♂, xii.1968 (*D. F. Owen*), 1 ♀, 1966 (*D. F. Owen*); Bo, 1 ♂, 29.iv.1967 (*J. N. Pollock*), 2 ♂, v.1967 (*J. N. Pollock*), 1 ♂, vi.1967 (*J. N. Pollock*); LIBERIA: Harbel, Marshall Terr., 1 ♂, 9.x.1955, 1 ♂, 11.xii.1955, 1 ♂, 7.vi.1956, 1 ♂, 7.vi.1955, 1 ♂, 1.ii.1957 (all *R. M. Fox*), all CM; IVORY COAST: Adiopo, 1 ♂, iv.1964 (*P. Griveaud*), MBG; Mokta, 1 ♂, 5–14.vi.1964 (*P. Griveaud*), NMR; NIGERIA: Port Harcourt, 1 ♂, 22.xii.1957 (*B. J. MacNulty*), 1 ♂, 19.i.1958 (*B. J. MacNulty*), 1 ♂, bred – foodplant *Macrolobium macrophyllum* McBride (see larval photograph, Pl. 6. fig, 22), 3.ii.1958 (*B. J. MacNulty*); Omo, 1 ♂, vii.1960 (*J. Boorman*); Lagos, 1 ♀, v.1955 (*J. Boorman*); CAMEROUN: Bipindi, 1 ♀, MNHU; CONGO (KINSHASA): Eala, 1 ♀, bred – foodplant *Macrolobium palisoti* Watsanjila (see notes under Biology, p. 231), 3.iii.1938 (*J. Couteaux*), MRAC; Kasai, Luluabourg, 1 ♂, 11.v.1953 (*M. Fontaine*), MRAC; Uele, Bambesa, 1 ♂, vi.1938 (*J. Vrydagh*), MRAC; Katanga, Kapanga, 1 ♂, ii.1935 (Coll. le Moult), CM.

Phylloxiphia formosa Schultze **comb. rev.**
(Pl. 4, fig. 13; Pl. 8, figs 36–39)

Phylloxiphia formosa Schultze, 1914 : 125. Holotype ♂, CAMEROUN: Crossflussgebiet (MNHU, Berlin) [Examined].

Libyoclanis major Rothschild & Jordan, 1915 : 284. Holotype ♂, SIERRA LEONE (UM, Oxford) [examined].

[*Libyoclanis bicolor* Rothschild; Carcasson, 1968 : 45. Misidentification.]

♂. Fore wing with entire, concave outer margin and pre-apical blackish brown marking. Genitalia with bifid uncus constricted at base and ridged dorsally; characteristic process at base of costal margin of valve.

♀. The female is not known.

Wing-measurements. ♂ 46·5–61·5 mm; ♀ not known.

The male of this species can be separated from *P. vicina* Rothschild & Jordan by its larger size and on the ventral surface of the fore wing by the pale distal edge to the subterminal fascia. On the ventral surface of the hind wing the lunulate, distal fascia and the dense, red suffusion along the hind margin distinguish this species. Rarely one of these characters may be present in the smaller *vicina*, but in no example so far examined have two or more of these characters been noted. Structurally the dorsal surface of the uncus in *formosa* is ridged whilst that of *vicina* is smooth. The uncus is constricted at the base in *formosa*.

MATERIAL EXAMINED.

Phylloxiphia formosa, holotype ♂, CAMEROUN: N. W. Kamerun, Crossflussgebiet, cl. 29.vi.1906 (*Arnold Schultze*), MNHU. *Libyoclanis major*, holotype ♂, SIERRA LEONE, UM.

LIBERIA: Grassfield, Nimba, 1 ♂, vii-viii. 1967, 1 ♂, viii-ix.1967 (both *A. Forbes-Watson*); IVORY COAST: Barr. d'Aydmé, 1 ♂, i.1964 (*Piart & Griveaud*), MBG: GABON: Belinga, 700 m, Camp Central, 1 ♂, 19.v.1963 (*G. Bernardi*), MBG; Makokou-Colline, 1 ♂, 1–3.xi.1967 (*G. Bernardi*), MBG; CONGO (KINSHASA): Kibali – Ituri, Nia-Nia, 1 ♂, 20.ix.1955 (*M. Fontaine*), MRAC; UGANDA: Malabigambo Forest, Sango Bay, 5 ♂, ii.1968 (*A. L. Archer*), NMK, 2 ♂, same data BMNH; ZAMBIA: Musondo Falls, nr. Mansa, Fort Roseberry, 1 ♂, 7.xii.1969 (*F. H. F. Schofield*).

Phylloxiphia vicina (Rothschild & Jordan) **comb. n.**

(Pl. 4, figs 14–16; Pl. 9, figs 40, 41; Pl. 10, fig. 51; Pl. 11, fig. 59)

Libyoclanis vicina Rothschild & Jordan, 1915 : 285. Holotype ♂, NIGERIA: Cross River [examined].

[*Acentropoclanis bicolor* Rothschild; Strand, 1915 : 132. Misidentification.]

[*Libyoclanis punctum* Rothschild; Kernbach, 1957 : 176. Misidentification.]

[*Libyoclanis metria* Jordan; Kernbach, 1963*a* : 168 and 1963*b* : 330. Misidentifications.]

[*Libyoclanis punctum* Rothschild; Carcasson, 1968: Pl. 3, fig. 7. Misidentification.]

♂. Fore wing with entire, concave outer margin and pre-apical blackish brown marking. Genitalia with smooth dorsal surface to bifid uncus; no constriction at base of uncus. Some variation is evident in the medial plate of the gnathus which in the holotype is two-thirds as broad as that in specimens from Ruwe, Katanga, Congo (Kinshasa); Mt. Tonkoui, Ivory Coast; Umtali, Rhodesia; (ratio 24 : 38); in a specimen from Liberia the medial plate is intermediate in width, ratio 24 : 29. Characteristic process present at base of costal margin of valve.

♀. Larger and broader-winged but similar to male. Genitalia as in Pl. 10, fig. 51.

Wing-measurements. ♂ 33·0–45·5 mm; ♀ 36·9–52·2 mm.

This species is smaller than *formosa* and can be separated by other characters mentioned previously under *formosa*.

MATERIAL EXAMINED.

Holotype ♂, NIGERIA: Cross River (*F. G. Martell*).

LIBERIA: Harbel, Marshall Terr., 20 ♂. 22.iii., 4–27.v., 19–30.vi., 21.vii. and 7.xii.1955, 9.iii., 9.ix., and 7–13.vi.1956, 1.ii., 25.iii. and 7–25.iv.1957 (all *R. M. Fox*), all CM; IVORY COAST: Adiopodoumé, 1 ♂, iv.1964 (*P. Griveaud*), MNHN; Mt. Tonkoui, 1,150 m, 1 ♂, 9–14.iii.1964 (*Piart & Griveaud*), MNHN; NIGERIA: Opobo, Sud-Nigerien, 1 ♂ (*G. Schultze*), MNHU (Strand's specimen, misidentified as *bicolor*, upon which *Acentropoclanis* was based); CENTRAL AFRICAN REPUBLIC: Boukoko, 1 ♀ (*R. Pujol*), MNHN; GABON: Mt. Bengué, 1 ♂, 6.x.1961 (*G. Bernardi*), MBG; Belinga, 700 m, Camp Central, 1 ♂, 2.vi.1963 (*G. Bernardi*); CONGO (BRAZZAVILLE): Congo Francais, 1 ♀ (*Le Moult*), CM; CONGO (KINSHASA): Luluabourg, 1 ♀ (ex Rothschild); Sankuru, Katako Kombe, 1 ♂, 2.i.1952 (*M. Fontaine*) MRAC; Katanga, Ruwe, 2 ♂, ii.1957 (*V. Allard*) MNHN; Katanga, Kolwezi, Lualaba, 1 ♂, 6 iii.1961, MNHN; Elisabethville, 1 ♂, 3 ♀, 29.ii. – 8.iv.1936 (*Seydel*), CM; 4 ♂, 1 ♀, 1.ii.1936, 23.xi.1936, 14.iii.1950, 1.i.1952, 10.ii.1952 (*Seydel*), MRAC; Katanga, Zilo, 1 ♂, 1.iv.1968 (*V. Allard*), NMR; Katanga, 1 ♂, xii.1965, NMK; without further data, 1 ♂, 8.iv.1936 (*Seydel*), MNHU; 1 ♀, 21.iv.1936 (*Seydel*) MNHU; TANZANIA: Songea, S. Province, 1 ♂, iv.1962 (*C. H. McCleery*), NMK; Kigonsera, 1 ♀, ZSBS; ZAMBIA:

Chalimbana, 2 ♂, 22.ix.1966, 11.x.1966 (*F. H. F. Schofield*); Chisamba F. R., nr Lusaka, bred ♀, 20.xii.1968 (*F. H. F. Schofield*); Solwezi, 1 ♂, 28.xi.1917 (*H. C. Dollman*); Rhodesia: Umtali, 1 ♂, ii.1963 (*C. Morris*); Salisbury, 1 ♀ (*Stevenson*), NMR, 1 ♀, 15.ii.1925 (*J. A. O'Neil*), CM; Victoria Falls, 1 ♂, xii.1917, CM; Vumba, 5 ♂, 25.xi.1955 (*B. D. Barnes*), TM; 10.i.1956 (*B. D. Barnes*), NMR; 4.xii.1956 (*B. D. Barnes*), TM; 15.ii.1959 (*B. D. Barnes*), NMR; 2.iii.1967 (*B. D. Barnes*), NMR; Laurenceville, Vumba, 10 ♂, 11.i.1952 (*H. Cookson*), TM; 27.ix.1957 (*H. Cookson*), TM; 20.xi.1957 (*H. Cookson*), NMR; 25.ii.1958 (*H. Cookson*), TM; 11.i.1959 (*H. Cookson*), NMR; 11.i.1962 (*H. Cookson*), TM; 27.i.1962 (*H. Cookson*), NMK; 16.ii.1962 (*H. Cookson*), TM; 28.ii.1962 (*H. Cookson*), NMR; 23.ii.1963 (*H. Cookson*), TMP; 12.x.1963 (*D. M. Cookson*), TM; 25.iii.1963 (*D. M. Cookson*), 3.x.1964 (*D. M. Cookson*), NMR; 1 ♀, 30.i.1959 (*H. Cookson*), NMR.

Phylloxiphia metria (Jordan) **comb. n.**

(Pl. 5, figs 19–21; Pl. 6, fig. 23; Pl. 9, figs 42, 43; Pl. 10, fig. 52; Pl. 11, fig. 60)

Libyoclanis metria Jordan, 1920 : 167. Holotype ♂, Rhodesia: Emangeni, 18.i.1918 (*A. J. T. Janse*) (TM, Pretoria).

Libyoclanis noctivago Kernbach, 1957 : 176. Holotype ♂, Congo (Kinshasa): Elisabethville (MRAC, Tervuren) [examined]. **Syn. n.**

♂. Fore wing with entire, convex outer margin and pre-apical blackish brown marking; irrorate with dark brown. Genitalia with bifid uncus; characteristic process on costal margin at base of valve.

♀. Larger and broader-winged than male. Genitalia as in Pl. 10, fig. 52.

Wing-measurements. ♂ 35·8–44·0 mm; ♀ 43·6–51·8 mm.

Larger than *punctum*, the fore wing maculation distinguishes this species.

I have not examined the holotype, which is in poor condition, but Dr Vári has kindly sent me specimens compared with the holotype. The synonymy of *noctivago* with *metria* was anticipated by Carcasson (1968 : 46).

Material examined.

Libyoclanis noctivago, holotype ♂, Congo (Kinshasa): Elisabethville, ii.1952 (*Seydel*), MRAC.

Congo (Kinshasa): Elisabethville, 1 ♂, 1.ii.1952 (*Seydel*), MRAC; Tanzania: Ilonga, 1 ♂, v.1966 (*I. Robertson*); Zambia: Chalimbana, 1 ♂, 3.x.1966 (*F. H. F. Schofield*), 1 ♂, 4.i.1967 (*F. H. F. Schofield*), 1 ♂, 28.xi.1968 (*F. H. F. Schofield*); Mwenga, 75 miles West of N'dola, 1 ♂, 25.ix.1914 (*H. C. Dollman*), 1 ♀ with pupal case, 10.x.1914 (*H. C. Dollman*); Abercorn, 1 ♀, v.1964 (*D. Vesey Fitzgerald*), NMK; Livingstone, 1 ♂, 4.iii.1942 (*W. Eichler*), TM, 1 ♂, 15.iii.1942 (*W. Eichler*, TM; Malawi: Mt. Mlanje, 1 ♂, 19.iii.1913 (*S. A. Neave*); Nkula Falls, 1,200 ft., 4.xi.1965 (*J.O.H.*), NMR; Mozambique: Dondo, 1 ♂, 8.iv.1961 (*D. M. Cookson*), NMR; Amatongas, 1 ♂, 7.i.1962 (*D. M. Cookson*), NMR; Rhodesia: Bazely Br., 1 ♂, 28.i.1963 (*D. M. Cookson*), NMR, 2 ♂, 13.xii.1963 (*D. M. Cookson*), TMP; Victoria Falls, 1 ♀, xii.1917, TM; Vumba, 1 ♂, 25.xii.1962 (*B. D. Barnes*), NMR; Laurenceville, 1 ♂, 31.i.1963 (*H. Cookson*), NMR; Penkridge, Melsetter Distr., bred from pupa, 1 ♀, 10.xi.1928 (*R. H. R. Stevenson*), NMR; Khami, 1 ♂, 24.xii.1954, MNHN, 1 ♂, x.1955; Marandellas, 1 ♂, ii.1961, NMR;

Gwelo Airport, 1 ♂, 22.iv.1969 (*P. Pile*), NMR; Nyanyadzi, 1 ♂, 30.ix.1962 (*D. M. Cookson*), NMR; Bindura, 1 ♂, 15.i.1938 (*E. W. Lannin*), NMR; Telukwe, 1 ♂, 25.x.1941 (*R. H. R. Stevenson*), NMR.

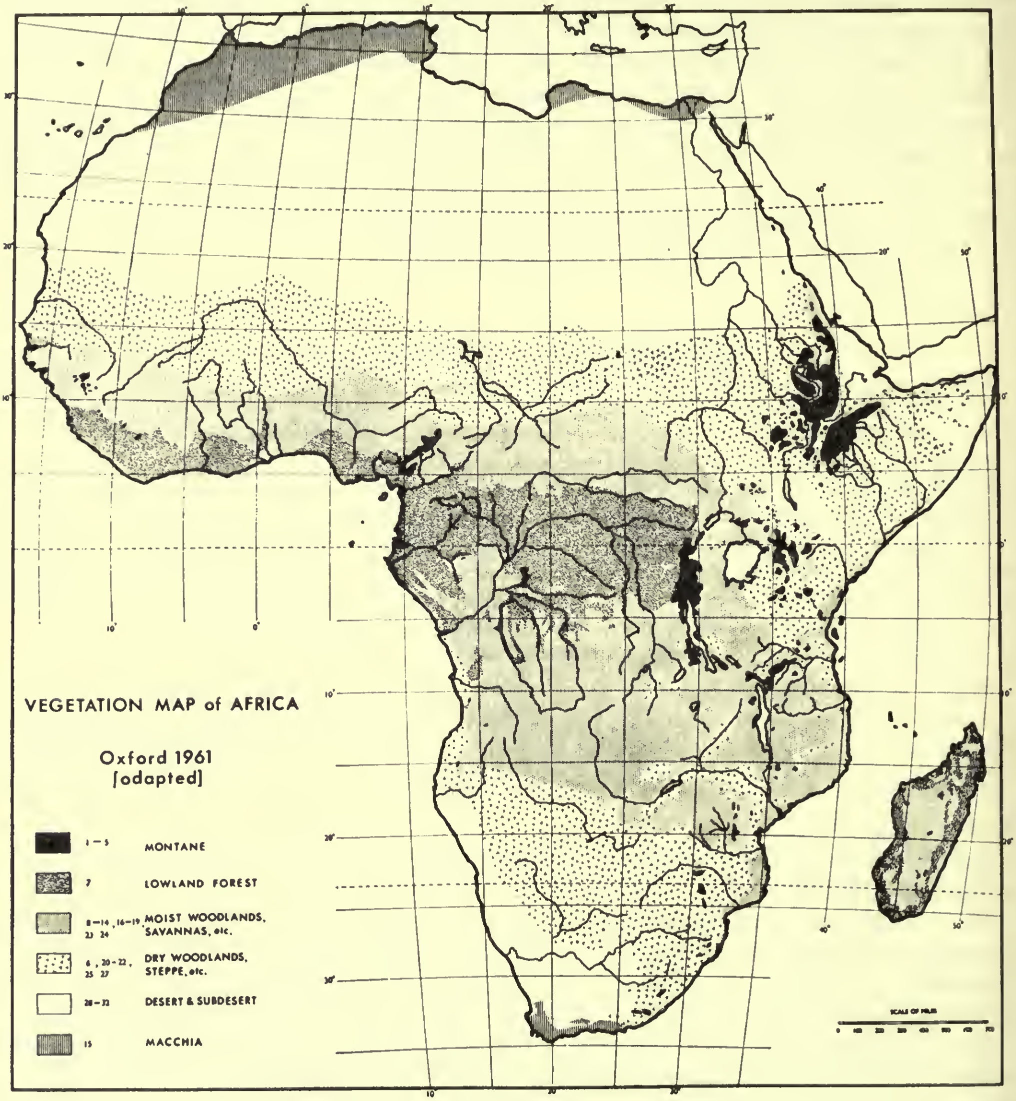

FIG. 1. Vegetation Map of Africa.

Phylloxiphia punctum (Rothschild) **comb. n.**

(Pl. 5, figs 17, 18; Pl. 9, figs 44, 45; Pl. 10, fig. 53; Pl. 11, fig. 61)

Libyoclanis punctum Rothschild 1907 : 507. Holotype ♂, RHODESIA: Salisbury (BMNH) [examined].

♂. Fore wing entire, with convex outer margin and pre-apical blackish brown marking;

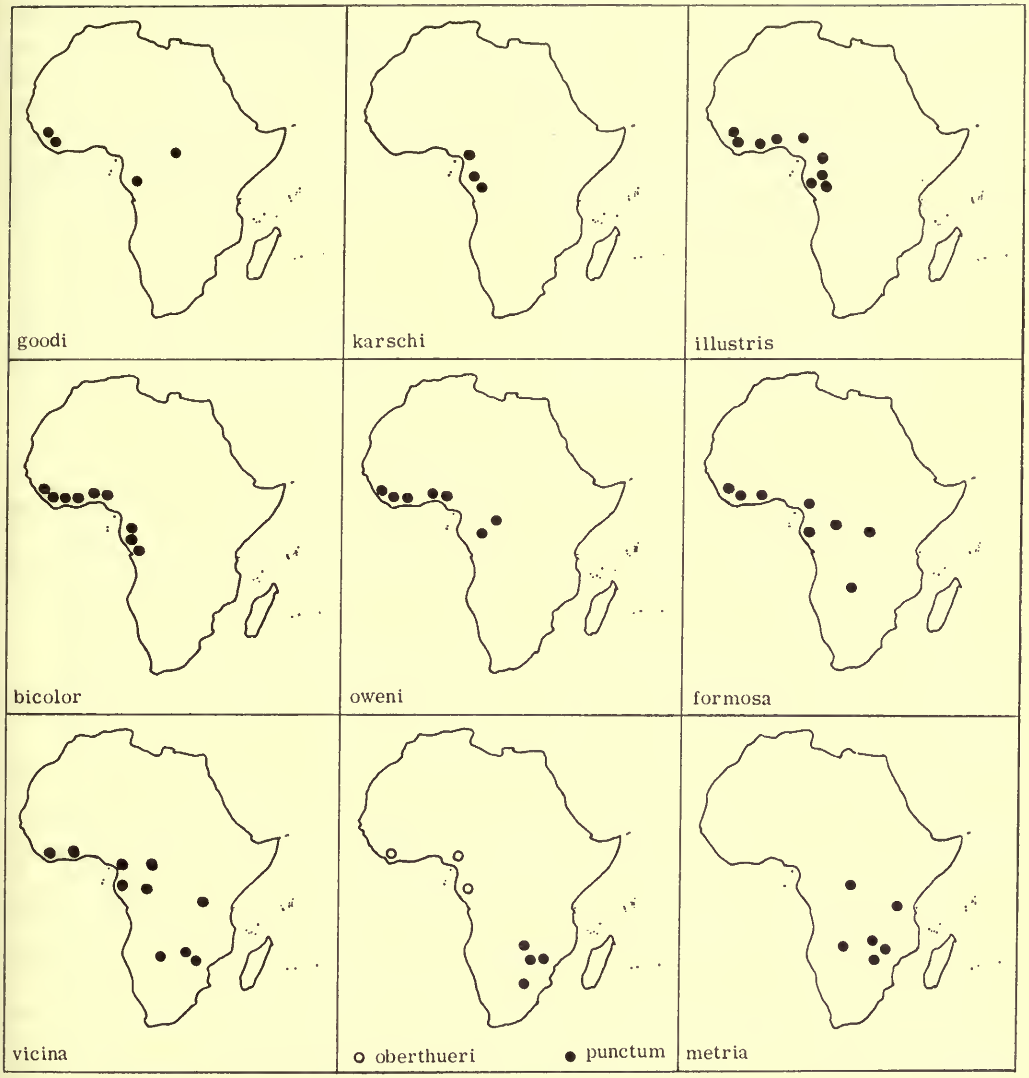

Fig. 2. Distribution Maps of *Phylloxiphia* species.

maculation absent. Genitalia with bifid, rounded uncus; very characteristic complex process at base of valve.

♀. Larger and broader-winged than male. Genitalia as in Pl. 10, fig. 53.

Wing-measurements. ♂ 29·5–37·7 mm; ♀ 31·3–41·8 mm.

Smaller than *metria* and devoid of fore wing maculation. The genitalia also separate this species from *metria*.

MATERIAL EXAMINED.

Holotype ♂, RHODESIA: Salisbury, iii.1904 (*G. A. K. Marshall*).

RHODESIA: Salisbury, 1 ♀ reared on *Ochna* sp., 8.xii.1959 (*A. J. Duke*), 1 ♀ reared

9.v.1960 (*A. J. Duke*), NMR; Sawmills, 1 ♂, 10.ii.1923 (*Swinburne & Stevenson*), CM; Wankie, 1 ♀, xi.1961, NMR; Devuli, 1 ♂, 12.xi.1965, NMR; Khami, nr Bulawayo, 1 ♂, xi.1955, NMR; Nyamandlovu, 1 ♂, 23.xi.1963, NMR; SOUTH AFRICA: Johannesburg, 1 ♂, CM; Pretoria, 1 ♂, 1.ix.1915 (*A. J. T. Janse*), 1 ♂, xi.1946 (*G. van Son*), NMR, 1 ♂, 19.x.1915 (*A. J. T. Janse*), TM, 1 ♀, iii.1909 (*A. J. T. Janse*), TM, 1 ♂, ix.1946 (*G. van Son*), TM, 1 ♀, 30.x.1947 (*G. van Son*), TM, 2 ♀, 23.ix.1918, TM, 1 ♂, 11.xii.1911 (Lord *Gladstone*), TM, 1 ♂, xi.1946 (*G. van Son*), TM, 1 ♂, 16.x.1939 (*G. van Son*), TM.

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INDEX

(Invalid names in italics)

A. H. Hayes
Department of Entomology
British Museum (Natural History)
London, SW7 5BD

PLATE 1

Phylloxiphia

Fig. 1, *goodi*, ♂. Fig. 2, *goodi*, ♀. Fig. 3, *karschi*, ♂. Fig. 4, *karschi*, ♀ holotype. (All two-thirds natural size.)

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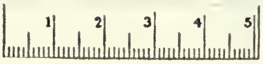

PLATE 2

Phylloxiphia

Fig. 5, *illustris*, ♂ Lectotype. Fig. 6, *illustris*, ♀. Fig. 7, *oberthueri*, ♂. Fig. 8, *oberthueri*, ♀. (All natural size.)

5

6

7

8

PLATE 3

Phylloxiphia

FIG. 9, *bicolor*, ♂. FIG. 10, *bicolor*, ♀ holotype. FIG. 11, *oweni*, ♂ holotype. FIG. 12, *oweni*, ♀. (All natural size.)

9

10

11

12

PLATE 4

Phyloxiphia

FIG. 13, *formosa,* ♂ holotype. FIG. 14, *vicina,* ♂ holotype. FIG. 15, *vicina,* ♂ Rhodesia. FIG. 16, *vicina,* ♀. (All natural size.)


13


14


15


16

PLATE 5

Phylloxiphia

FIG. 17, *punctum*, ♂ holotype. FIG. 18, *punctum*, ♀. FIG. 19, *metria*, ♂. FIG. 20, *metria*, ♀. FIG. 21, *metria*, pupal case of ♀ (natural size).


17


18


19


20


21

PLATE 6

Phylloxiphia

FIGS 22, 23, larvae. FIGS 24–27, ♂ genitalia. FIG. 22, *oweni*. FIG. 23, *metria*. FIG. 24, *goodi*. FIG. 25, idem, cilia at base of valve magnified. FIG. 26, *karschi*. FIG. 27, idem, cilia at base of valve magnified.


22


23


24


25


26


27

PLATE 7

Phylloxiphia

♂ genitalia

Fig. 28, *illustris*. Fig. 29, idem, costal margin at base of valve magnified. Fig. 30, *oberthueri*. Fig. 31, idem, costal margin at base of valve magnified. Fig. 32, *bicolor*. Fig. 33, idem, costal margin at base of valve magnified.


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PLATE 8

Phylloxiphia

♂ genitalia

Fig. 34, *oweni*, holotype. Fig. 35, idem, costal margin at base of valve magnified. Fig. 36, *formosa*. Fig. 37, idem, costal margin at base of valve magnified. Fig. 38, *formosa*, holotype. Fig. 39, idem, costal margin at base of valve magnified.


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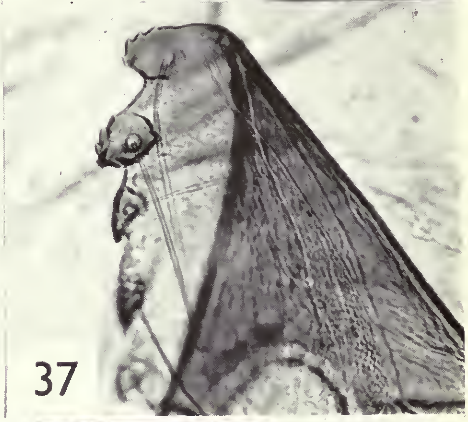
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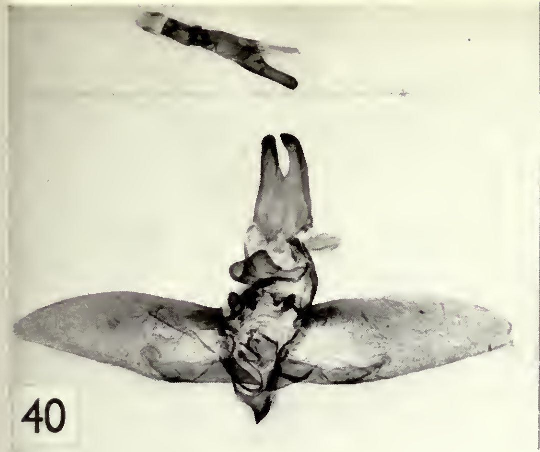
PLATE 9

Phylloxiphia

♂ genitalia

Fig. 40, *vicina*. Fig. 41, idem, costal margin at base of valve magnified. Fig. 42, *metria*. Fig. 43, idem, costal margin at base of valve magnified. Fig. 44, *punctum*. Fig. 45, idem, basal area of valve magnified.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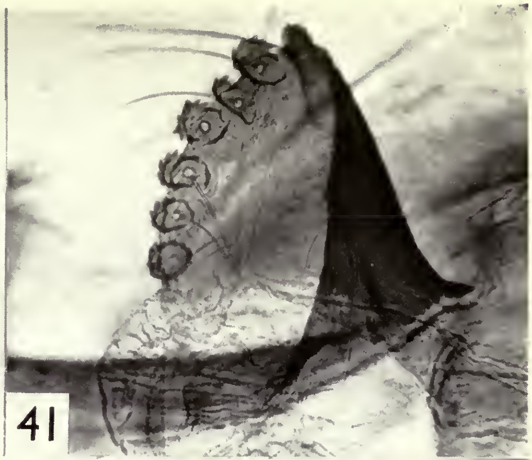
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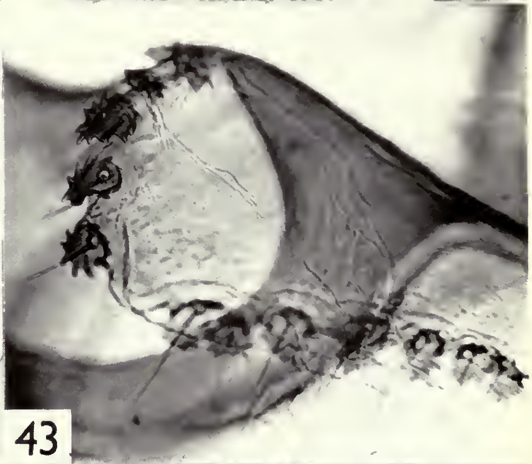
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PLATE 10

Phylloxiphia
♀ genitalia

FIG. 46, *goodi*. FIG. 47, *illustris*. FIG. 48, *oberthueri*. FIG. 49, *bicolor*. FIG. 50, *oweni*. FIG. 51, *vicina*. FIG. 52, *metria*. FIG. 53, *punctum*.

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PLATE 11

Phylloxiphia

Signum of ♀ genitalia

Fig. 54, *goodi*. Fig. 55, *illustris*. Fig. 56, *oberthueri*. Fig. 57, *bicolor*. Fig. 58, *oweni*. Fig. 59, *vicina*. Fig. 60, *metria*. Fig. 61, *punctum*.


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THE ELMIDAE (COLEOPTERA) OF TRINIDAD AND TOBAGO

H. E. HINTON

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ENTOMOLOGY Vol. 26 No. 6
LONDON: 1971

THE ELMIDAE (COLEOPTERA) OF TRINIDAD AND TOBAGO

BY

HOWARD EVEREST HINTON

Department of Zoology, University of Bristol

Pp. 245–265; 9 *Plates,* 17 *Text-figures*

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THE ELMIDAE (COLEOPTERA) OF TRINIDAD AND TOBAGO

By H. E. HINTON

CONTENTS

SYNOPSIS

The Elmidae of Trinidad and Tobago are revised and a key is given to all of the species known to occur in the Lesser Antilles. A key to the larvae is included with the key to the adults, and the larvae of all species known to occur in the Lesser Antilles may now be distinguished. One new species and one new subspecies are described. The biology and continental relationships of the species are discussed.

INTRODUCTION

This revision of the Elmidae of Trinidad and Tobago was begun over 30 years ago, but other interests prevented its completion until now. Although a detailed revision of the larvae is not presented here, larvae of all species are included in the key to the adults. All of the Elmidae known from the Lesser Antilles are found on the two islands except *Hexanochorus caraibus* (Coquérel). This species was described from Martinique and Guadeloupe, and I have seen specimens from St. Vincent. I have little doubt that in due course it will be found on Trinidad and Tobago, and it is therefore included in the key. Three of the six species now known to occur on Trinidad and Tobago have previously been recorded from these islands: *Hexacylloepus smithi* (Grouvelle) (Darlington, 1936), *Elsianus clypeatus* Hinton (Hinton, 1936), and *Microcylloepus carinatus* Hinton (Hinton, 1940*b*).

MATERIALS AND METHODS

This revision is based upon 5,329 specimens from the islands of Trinidad and Tobago, most of which were collected by me in October and November of 1937.

The number of each species is as follows:

Phanocerus congener Grouvelle	54
Elsianus clypeatus Hinton	661
Neoelmis pusio sp. n.	189
Microcylloepus carinatus Hinton	645
Hexacylloepus smithi (Grouvelle)	1913
Heterelmis simplex codrus subsp. n.	1867
Total	5,329

The holotypes and duplicate series have been deposited in the British Museum (Natural History); the remainder of the material is in my own collection.

All of my collecting in Trinidad was done in the northern mountainous part. Sometimes two quite different rivers on the island bear the same name, e.g. Oropuche. In order to avoid confusion and for ease in identifying the rivers and streams from which collections were made, they are here listed according to wards:

- *Diego Martin*
  - Maraval
- *St Ann's*
  - St Ann's
  - Curumpalo
  - Curucaye
  - Cimaronero
  - St Cruz
- *Tacarigua*
  - Tacarigua
  - St Joseph
  - Maracas
  - Garden
- *Valencia*
  - Cuare
- *Arima*
  - Arima
  - Mausica
- *Blanchisseuse*
  - Marianne
- *Manzanilla*
  - Cunapo
  - Oropuche

The species were described for the most part under a magnification of × 75. The drawings were made with the aid of a camera lucida. By the term microscopic punctures is meant punctures that are half or less than half as wide as the facets of the eyes. The electron micrographs, e.g. Pl. 3, fig. 14, clearly show that what has previously been referred to as asperate in the Elmidae is a recticulate microsculpture. Subjectivity in describing the size of punctures is generally removed by comparing their diameter to that of some other structure, such as the eye facets. Even so, however, a large element of subjectivity may remain. This is particularly true of descriptions of the strial punctures of the elytra, which often have their top sides gradually sloping (see Pl. 5, fig. 22), and their apparent size varies with the part of the slope taken as the beginning of the puncture, which in turn depends upon the angle of the incident light. The geometry of the surfaces and the types of setae and microtrichia are particularly well shown by scanning electron micrographs. One difficulty was encountered with these: when the specimen is sufficiently well coated with metal to prevent undue charging of the setae, many of the finer punctures may be filled in by the metal so that the surface then appears to be less densely punctate than in fact it is. In the figures of the male genitalia, the setae are only approximately indicated. The term pronotal disk refers to the whole of the area between the sublateral carinae. The abdominal sternites are numbered according to the externally visible ones, and no account is taken of externally concealed sternites.

BIOLOGY

Adult Elmidae belong to two quite different groups according to their biology and structure. The first and more primitive group includes the subaquatic species that lack a plastron but have the body fairly densely clothed with long, hydrofuge hairs. When these beetles are covered by water, for instance when they enter water to oviposit, the hairs on the body hold a film or bubble of air that acts as a temporary or collapsible physical gill. As oxygen is removed from the bubble, equilibrium tends to be restored by oxygen entering it from the surrounding water rather than by nitrogen leaving because nitrogen is much less soluble than oxygen and so passes through the water-air interface of the bubble more slowly. Nevertheless, a little nitrogen is continually leaking out, and in due course the bubble becomes too small to be effective as a gill and the beetle has to come to the surface to renew its bubble.

The second and more specialised group are the wholly aquatic plastron-breathers. These normally remain beneath the surface of the water all of their lives. On much of the ventral surface and often also on the epipleura, legs, and sometimes even on the dorsal surface they have a plastron. This consists of an air film of constant volume and an extensive water-air interface. The air film is held in position by very fine and dense hair-like or scale-like hydrofuge microtrichia. The microtrichia prevent wetting of the plastron under the hydrostatic pressures to which the beetles are normally subjected. The plastron-breathers can remain under water indefinitely and extract through their plastron all of the oxygen they require providing the water is well-aerated.

The Elmidae that are now plastron-breathers have been independently evolved on a number of occasions from different stocks of the subaquatic forms. Only a relatively slight morphological change need take place in order to alter the structures that will support a gas bubble that behaves as a collapsible physical gill into structures that will hold a gas film against a pressure difference; the setae or microtrichia only have to become a little denser (Hinton, 1969).

Both adults and larvae feed on aquatic plants, probably chiefly on algae. The larvae have anal retractile tracheal gills. The early instars are apneustic, but in the final larval instar the first pair of thoracic spiracles and all eight pairs of abdominal spiracles are functional. Pupation occurs in moss or soil close to but above the water line. The primitive groups are active fliers throughout adult life. The plastron-breathers often fly after emergence from the pupal cuticle, and they are occasionally collected at light at night. However, once they have entered the water and begun living there, the flight muscles degenerate and they are no longer capable of flying.

CONTINENTAL RELATIONSHIPS

The islands of Trinidad and Tobago, like the other islands of the Lesser Antilles, are on the continental shelf. Trinidad is less than 14 miles from the Venezuelan mainland, and between it and the mainland are several islands, so that the greatest stretch of open sea between the mainland and Trinidad is less than 8 miles. The sea between Trinidad and the mainland is no more than about 15 metres deep, and Trinidad has evidently been connected with the mainland until relatively recently. Many writers, e.g. Darlington (1957), have drawn attention to the fact that, zoogeographically, Trinidad and associated islands are part of the mainland. Trinidad has a continental fauna of all of the main classes of vertebrates, and many of the species are the same as those on the mainland.

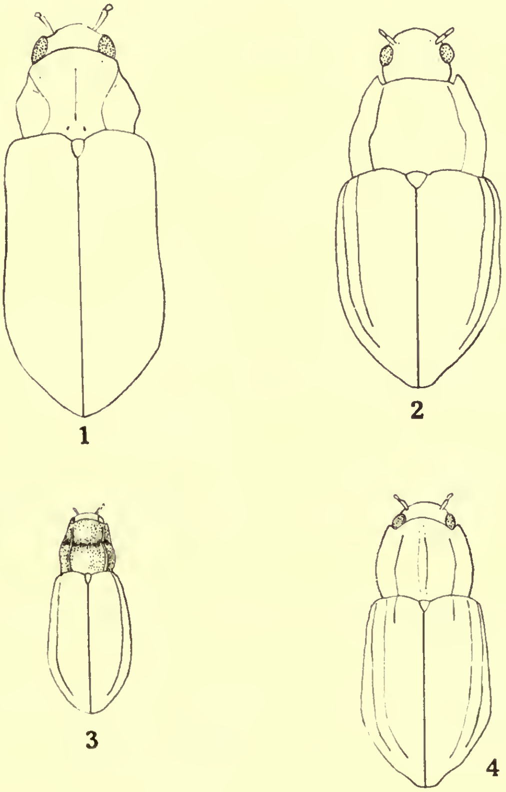
Two of the six species of Elmidae found in Trinidad and Tobago also occur on the mainland. *Elsianus clypeatus* Hinton has been found in Caracas, and *Heterelmis simplex* Sharp was first described from Guatemala. Very little is now known of the Venezuelan Elmidae, but it may be supposed that all of the species of the islands will be found in due course in Venezuela. As might be expected, the Elmidae of the Lesser Antilles are much more closely related to those of Central and South America than they are to those of the Greater Antilles. Because of the very narrow stretch of open water between Trinidad and the mainland, it is not certain whether the island species arrived after land connections with Venezuela were broken or were left behind when such connections disappeared, but the latter hypothesis seems more likely.

All of the species in Trinidad and Tobago belong to genera that are well-represented on the mainland. Five species of *Phanocerus* Sharp have been described, and of these *P. congener* Grouvelle appears to be most closely related to *P. clavicornis* Sharp of Central and South America. About 34 species of *Elsianus* Sharp are known. *Elsianus clypeatus* Hinton belongs to a species-group that includes only two other known species, *E. tarsalis* Hinton of Costa Rica and Ecuador and *E. isus* Hinton of Brazil. Some 25 species of *Neoelmis* Musgrave have been described. Of these, *N. pusio* Hinton most closely resembles *N. apicalis* (Sharp), which occurs from Mexico to Peru. The Brazilian species of *Neoelmis* have been revised (Hinton, 1940*c*), but none of these are closely related to *N. pusio*. About 23 species of *Microcylloepus* Hinton are known, but *M. carinatus* (Hinton) is not closely related to any of them. It is certainly not closely related to any of the Brazilian species (see Hinton, 1940*a*). Some 22 species of *Hexacylloepus* Hinton are known. *H. smithi* (Grouvelle) belongs to the *H. ferruginea* (Horn) species-group, and its nearest relative appears to be *H. abditus* (Hinton) of Mexico. No less than 18 species of *Heterelmis* have been described, and, as already noted, the form in the islands is no more than subspecifically distinct from the Guatemalan *H. simplex simplex* Sharp. Full diagnoses of the six genera are given in my monograph of the Mexican Elmidae (Hinton, 1940*b*) and need not be repeated here.

KEY TO THE ELMIDAE OF TRINIDAD AND TOBAGO

1 Dorsal surface (Pl. 1, fig. 3) densely clothed with long hairs that are often erect; ventral surface (Pl. 1, figs 1–2, 4–6) somewhat similarly clothed. Body without a plastron. Tibiae without grooming fringes. Front coxae strongly transverse. Adults subaquatic but do not remain for long periods beneath the surface of the water. *Larva* flattened and onisciform but if cylindrical propleura of each side are divided into three parts 2

– Dorsal surface not densely clothed with long hairs; ventral surface with a plastron. Tibiae with one or two apical grooming fringes. Front coxae more or less round. Adults normally live entirely beneath the surface of the water. *Larva* cylindrical and propleura on each side entire or divided into only two parts 3



FIGS 1–4. (1) *Phanocerus congener*. (2) *Heterelmis simplex codrus*. (3) *Neoelmis pusio*. (4) *Hexacylloepus smithi*.

2 Pronotum on each side without a longitudinal sulcus on basal two-fifths; with a deep transverse depression that is on apical third at middle and apical fifth or sixth at sides. Length 3·0–3·5 mm. *Larva* cylindrical, not flattened; propleura of each side divided into three parts. Martinique, Guadeloupe, St Vincent, Trinidad (?) ***Hexanochorus caraibus*** (Coquérel) (p. 247)

– Pronotum (Text-fig. 1) on each side with a longitudinal sulcus on basal two-fifths; without an apical transverse depression. Length 1·8–2·4 mm. *Larva* onisciform and flattened; propleura on each side divided into two parts. Grenada, Tobago, Trinidad . . . . ***Phanocerus congener*** Grouvelle (p. 253)

3 Each elytron with a short accessory stria at base between first and second striae. Each testis composed of three sperm tubes. Length 3·0–3·5 mm. *Larva* with segments 2–7 of abdomen with three longitudinal sutures between sternum and middle of tergum. Venezuela, Trinidad, Tobago . ***Elsianus clypeatus*** Hinton (p. 254)

– Elytra without accessory striae. Each testis composed of two sperm tubes. Length less then 2·5 mm. *Larva* with segments 2–7 of abdomen with two longitudinal sutures between sternum and middle of tergum 4

4 Pronotum (Text-fig. 3) with a broad and deep transverse depression; pronotal disk without a median longitudinal depression. Eacy elytron (Text-fig. 3) with a single sublateral carina. Length 1·4–1·7 mm. *Larva* with ninth abdominal segment approximately four times as long as wide. Prosternum behind coxae three times as wide as long. Meso- and meta-pleura on each side divided into two parts; meso- and meta-sternum with middle of posterior margin only moderately produced, not forming a conspicuous tubercle. Trinidad, Tobago ***Neoelmis pusio*** sp. n. (p. 256)

– Pronotum without a distinct transverse depression or if one is present there is also a median discal depression (Text-fig. 12). Each elytron with two sublateral carinae. Length 1·7–2·4 mm. *Larva* with ninth abdominal segment less than three times as long as wide; prosternum behind coxae not twice as wide as long; meso- and meta-pleura on each side often divided into three parts; meso- and metasternum with middle of posterior margin strongly produced to form a narrow tubercle about half as long as a tarsal claw 5

5 Pronotum with a deep transverse depression at apical third (Text-fig. 12). Hypomera and elytra epipleura without a plastron. Elytra with third interval at base strongly carinate (Text-fig. 12). *Larva* without a row of small teeth or tubercles on anterior margin of head and thoracic and abdominal tergites without very well-defined rows of erect, cylindrical, spinose tubercles. Trinidad, Tobago ***Microcylloepus carinatus*** Hinton (p. 259)

– Pronotum without a transverse depression on apical third. Hypomera and elytral epipleura with extensive plastrons. Elytra with third interval at base flat. *Larva* with teeth or projecting tubercles along anterior margin of head or with tergites of thorax and abdomen with very well-defined rows of erect, cylindrical, spinose tubercles 6

6 Pronotum (Text-fig. 4) with a median longitudinal depression extending from base nearly to apex. Elytra with fourth interval at base subcarinate. Surface of pronotum and elytra with numerous granules. Hypomera with a transverse plastron strip that reaches edge of pronotum. Front tibia with a single grooming fringe. *Larva* with a row of teeth or projecting tubercles along anterior margin of head; tergites of thorax and abdomen without very-well defined rows of erect, cylindrical, spinose tubercles. Grenada, Tobago, Trinidad ***Hexacylloepus smithi*** (Grouvelle) (p. 261)

– Pronotum without a large, median longitudinal depression. Elytra with fourth interval at base flat. Surface of protonum and elytra punctate, not granulate. Hypomera with plastron strip longitudinal and everywhere far from edge of pronotum.

Front tibia with two grooming fringes. *Larva* with a tooth on each antero-lateral angle of head but without a row of teeth or projecting tubercles along middle of anterior margin; tergites of thorax and abdomen with very well-defined rows of erect, cylindrical, spinose tubercles. Trinidad, Tobago
Heterelmis simplex codrus subsp. n. (p. 263)

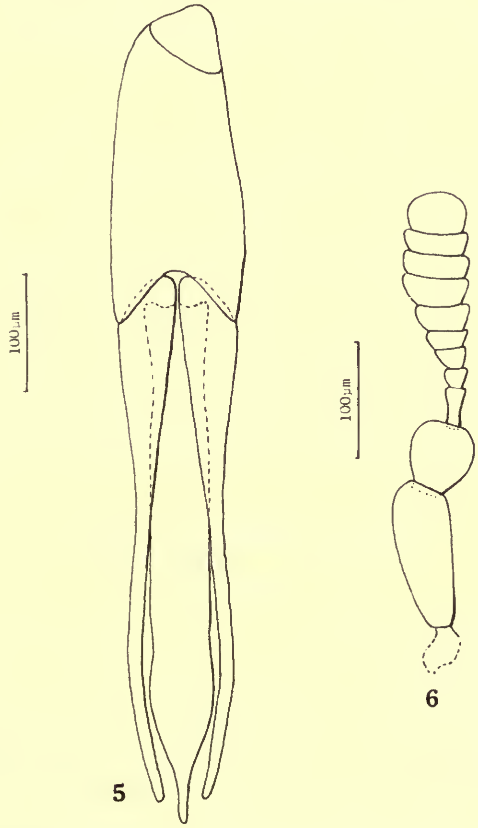
DESCRIPTIONS OF THE SPECIES

Phanocerus congener Grouvelle

(Pl. 1; Text-figs 1, 5, 6)

Phanocerus congener Grouvelle, 1898, *Notes Leyden Mus.* **20** : 46. Holotype, GRENADA: Balthazar (BMNH) [examined].

♂. Length 1·8–2·4 mm; breadth 0·8–1·0 mm. Body subparallel, moderately convex. Cuticle brownish, moderately shining; eyes black. Dorsal surface densely clothed with fine, suberect to erect, brownish setae that on head and pronotum are about a third as long as eyes but on elytra (Pl. 1, fig. 3) are more often more than half as long as eyes; between long setae with numerous much shorter, semi-recumbent hairs (Pl. 1, fig. 3). Ventral surface with long,



FIGS 5–6. *Phanocerus congener*. (5) Dorsal view of male genitalia. (6) Antenna.

semi-erect to erect hairs between which are much shorter and more recumbent hairs (Pl. 1, figs 4–6). *Head* with apical segments of antenna forming a distinct club (Text-fig. 6). Clypeus with anterior margin truncate; angle on each side broadly rounded. Labrum with anterior margin feebly and broadly, arcuately emarginate, angle on each side broadly rounded; anterior margin with transverse fringe of fine, golden hairs; on each side just behind angle with a dense tuft of longer golden hairs. *Pronotum* with broadest point, which is just in front of base, broader than long (0·84 mm: 0·63 mm) and base broader than apex (0·79 mm: 0·58 mm). Base in front of scutellum not distinctly gibbous. Sublateral impressions as shown in Text-fig. 1. Base in front of scutellum not distinctly gibbous. *Elytra* with discal strial punctures often subquadrate, usually one-half as broad as intervals, and separated longitudinally usually by a little more than their diameters; beyond basal two-fifths strial punctures become much smaller and more shallow towards apex. *Genitalia* (Text-fig. 5) with median lobe abruptly narrowed near apex and extending a little beyond apices of parameres.

♀. Externally similar to male.

SPECIMENS EXAMINED.

Holotype, sex undetermined, GRENADA: (windward side) Balthazar (*H. H. Smith*). In the British Museum (Natural History).

TRINIDAD: 4 ex., St Anns' River, 45 ex., Maracas Valley, 1 ex., Cuare River, 1 ex., Marianne River, all 28.x.–5.xi. 1935 (*H. E. Hinton*); 1 ex., Arima River, 16. xii. 1969 (*H. B. N. Hynes*). TOBAGO: 1 ex., Providence River, 1 ex., Courland River, both 6.xi. 1937 (*H. E. Hinton*).

COMPARATIVE NOTES. This is closely related to *P. clavicornis* Sharp, 1882, which is widely distributed in Central America and northern South America. The male genitalia of the two species are very similar (cf. Hinton, 1940*b*, fig. 50). In *P. clavicornis* the base of the pronotum in front of the scutellum is strongly gibbous and the sublateral impression on each side of the pronotum is bent outwards almost at right angles, so that it reaches the edge of the pronotum just beyond the middle of its length instead of near its apex as in *P. congener* (Text-fig. 1). In *P. clavicornis* the base of the head behind the posterior third of the eyes has a paler band when viewed in certain lights, owing to the different arrangement of the fine setae, which reflect the light differently to those on the anterior part of the head. In *P. congener* no distinct paler band appears on the base of the head as the specimen is turned in a beam of light.

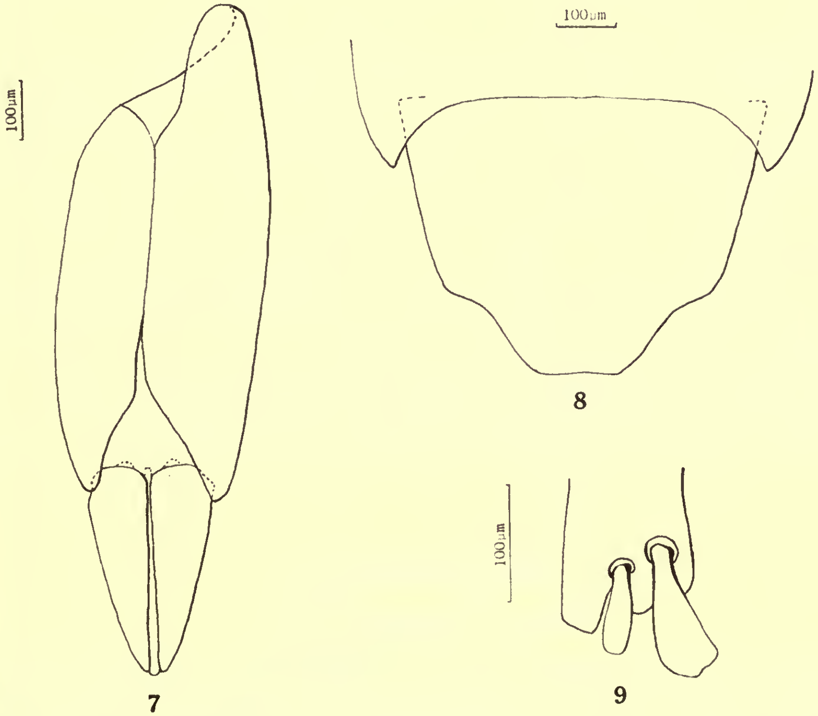
Elsianus clypeatus Hinton

(Pl. 2; Text-figs 7, 9)

Elsianus clypeatus Hinton, 1936, *Trans. R. ent. Soc. Lond.* **85** : 424. Holotype ♀, TRINIDAD: Maracas (BMNH) [examined].

♂. Length 3·0–3·5 mm; breadth 1·2–1·5 mm. Cuticle feebly shining and rufo-piceous to black with antennae, mouth-parts, and legs paler; if black, femora are usually also black. *Head* with granules like those of pronotal disk but slightly denser. Clypeus with anterior margin moderately strongly bisinuate; angle on each side obtuse, rounded, and sides near anterior angles feebly dilated. Labrum with a transverse fringe of fine, golden setae about as long as first two tarsal segments together. *Pronotum* at broadest point, which is at about basal third, about as broad as long (1·0 mm) and base broader than apex (0·92 mm : 0·73 mm). Sublateral carinae broad, prominent, extending from base to about apical fifth;

inner (dorso-mesal) margins of carinae sharp. Disk without a median longitudinal depression but with a scarcely defined median longitudinal line (Pl. 2, fig. 7) that extends from a short distance in front of scutellum to apical third; without a distinct transverse impression. Surface granulate as shown in Pl. 2, fig. 7. *Hypomera* without plastron-free areas. *Elytra* with apices conjointly broadly produced for a short distance and then individually obliquely truncate to apex; at extreme distal end the apices are feebly divergent. Epipleura with plastron absent only on extreme apex. Intervals flat or nearly so; sublateral carinea absent; surface of discal intervals (Pl. 2, fig. 9) granulate like pronotal disk. Strial punctures as shown in Pl. 2, fig. 9, but on middle of disk subquadrate, about as wide as intervals, and separated longitudinally by about their diameters. *Scutellum* moderately convex. *Prosternum* with plastron on sides except near apex; when seen from side with anterior two-thirds (not including process) moderately strongly bent ventrally. Metasternum (Pl. 2, fig. 10) with a distinct, irregularly oval depression on each side which is nearer hind than middle coxa. *Abdomen* with plastron absent on discal area of first four sternites and anterior three-fifths of disk of fifth sternite. Disk of first sternite strongly depressed; sublateral carinae low, broad, not distinctly extending to hind margin of segment. Second sternite with anterior discal area slightly depressed. Fifth sternite with apex strongly convex; with numerous long, golden setae on apical margin and apical sides as far back as flanges that fit into elytra. *Legs* with femora entirely clothed with a plastron; tibiae with plastron indistinct but usually evident on front tibiae; front tibia with a single grooming fringe on anterior ventral face; middle tibiae with grooming fringes on both anterior and posterior faces; hind tibiae with a single grooming fringe on posterior ventral side. Hind tibia with inner or posterior spur dilated (Text-fig. 9).



FIGS 7–9. *Elsianus clypeatus*. (7) Dorsal view of male genitalia. (8) Fifth abdominal sternite of male. (9) Inner view of apex of hind tibia of male.

♀. Externally similar to male except as follows: (1) clypeus with anterior margin less strongly bisinuate; (2) golden hairs of transverse fringe of labrum much shorter than labrum instead of longer than labrum; (3) metasternum with oval depression on each side of disk absent or scarcely noticeable; (4) disk of first abdominal sternite much less strongly depressed; (5) anterior part of disk of second abdominal sternite not distinctly depressed; (6) fifth abdominal sternite not gibbous at apex and without the apical and postero-lateral fringes of very long, golden setae; and (7) inner spur of hind tibia only very slightly broader than outer spur.

SPECIMENS EXAMINED.

Holotype ♀, TRINIDAD: Maracas, 28.v.1924 (*C. L. Withycombe*). In the British Museum (Natural History).

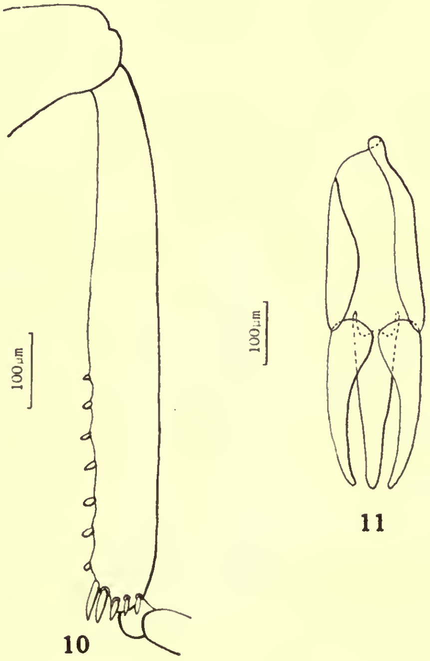
VENEZUELA: 3 ex., Caracas. TRINIDAD: 18 ex., Maraval River, 2. xi. 1937 (*H. E. Hinton*); 47 ex., St Ann's. at light, 28.x.1937 (*H. E. Hinton*); 16 ex., Curumpalo River, 2. xi. 1937 (*H. E. Hinton*); 1 ex., Curucaye River, 2. xi. 1937 (*H. E. Hinton*); 2 ex., Cimaronero River, 2. xi. 1937 (*H. E. Hinton*); 200 ex., St Cruz River, 2. xi. 1937 (*H. E. Hinton*); 84 ex., Tacarigua River, 31. x. 1937 (*H. E. Hinton*); 3. ex, St Joseph River, 16. xii. 1969 (*H. B. N. Hynes*); 26 ex., Garden River, 31. x. 1937 (*H. E. Hinton*); 186 ex., Maracas Valley, 29–31. x. 1937 (*H. E. Hinton*); 3 ex., Cuare River, 5. xi. 1937 (*H. E. Hinton*); 58 ex., Mausica River, 31. x. 1937 (*H. E. Hinton*); 14 ex., Arima River, 16. xii. 1969 (*H. B. N. Hynes*). TOBAGO: 1 ex., Providence River, 2 ex., Hillsborough West River, both 6. xi. 1937 (*H. E. Hinton*).

COMPARATIVE NOTES. In the key to the Brazilian species (Hinton, 1946) this traces to *E. isus* Hinton, to which it is very closely related. These two species, together with *E. tarsalis* Hinton (1936), which occurs from Costa Rica to Ecuador, constitute a species-group characterised by having the apices of the elytra dehiscent, each elytron being separately rounded at the extreme apex, and by the unusual (for *Elsianus*) secondary sexual characters of the male. *E. isus* is much the largest of the three species (4.0–4·9 mm). The secondary sexual characters of the male are identical to those of *E. clypeatus*, and the male genitalia of the two are very similar. Apart from its larger size, *E. isus* may be distinguished by the shallow and broad median longitudinal depression on the pronotal disk. *E. tarsalis* is a much smaller species (2·8 mm long), and the male has the inner spur of the hind tibia strongly flexed inwards so that it is normal to the major axis of the tibia. The male of *E. tarsalis* has a long and conspicuous spine on the ventral apex of the first segment of the middle tarsus, whereas neither *E. clypeatus* nor *E. isus* has such a spine.

***Neoelmis pusio* sp. n.**

(Pls 3, 4; Text-figs 3, 10, 11)

♂. Length 1·4–1·7 mm; breadth 0·57 mm–0·63 mm. Body subparallel, feebly convex (Text-fig. 3). Cuticle moderately shining, rufo-piceous; antennae, mouth-parts and legs yellowish brown; ventral surface sometimes nearly colour of appendages; top of head sometimes nearly black. *Head* with a reticulate microsculpture (Pl. 3, fig. 13). Clypeus with anterior margin when seen from front truncate; angle on each side broadly rounded; surface with microscopic punctures often separated by two to three diameters. *Pronotum* across broadest point, which is at about basal third, about as broad as long (0·47 mm) and base broader than apex (0·45 mm: 0·37 mm). Sublateral carinae (Pl. 3, figs 13, 14) prominent, inner margins sharp, extending from base very nearly to apex. Base in front of scutellum without carinae or gibbosities. Surface with reticulate microsculpture more distinct than that of head and distributed as shown in Pl. 3, figs 13–14; surface of disk in front of transverse depression with punctures about half as coarse as facets of eyes and usually separated by two to three diameters; posterior part of disk behind transverse depression similarly but more densely punctate and middle of posterior half of disk with a reticulate microsculpture. *Hypomera* without a plastron. Surface everywhere with a reticulate microsculpture. *Elytra* with sublateral carinae prominent. Apices moderately produced and broadly, conjointly rounded. Humeri moderately prominent. Lateral margins feebly crenate, nearly smooth. Striae absent or scarcely impressed on about apical third of middle area; discal striae (Pl. 3, fig. 15) with punctures of basal half nearly as broad as intervals between striae and separated longitudinally by about their diameters; surface of intervals with microscopic punctures separated by three or more diameters. Epipleura without plastron-free areas. *Scutellum* flat. *Prosternum* with a very narrow (about half as wide as second antennal segment) strip of plastron along sterno-notal suture that can only be seen from certain angles so that at most angles the prosternum appears to be without a plastron. When seen from side with anterior three-fifths (not including process) moderately strongly bent ventrally. Sublateral carinae indistinct to moderately prominent and parallel, not distinctly diverging anteriorly; on each side between carina and sterno-notal suture with a thick ridge. Surface with a reticulate microsculpture except on discal area in front of process, which is



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FIGS 10–11. *Neoelmis pusio.* (10) Hind tibia of male showing the inner row of short spines. Other setae are omitted. (11) Dorsal view of male genitalia.

punctate like anterior half of pronotal disk. -Metasternum(Pl. 4, fig. 17) with median longitudinal line complete; feebly impressed on about anterior fourth but on posterior three-fourths about as broad as basal tarsal segment; on each side of disk behind middle with a distinct oval depression separated from hind coxa by a distance equal to its diameter; bottom of oval depression with a reticulate microsculpture; surface on either side of median line strongly shining and sparsely, microscopically punctate. *Abdomen* with plastron-free areas on disk of first and second sternites except for a very thin strip of plastron on posterior margin of each; third sternite often with a small, discal, plastron-free area near anterior margin. First sternite with anterior (basal) half of disk depressed; sublateral discal carinae confined to anterior half of sternite; surface of anterior part of disk with a reticulate microsculpture. *Legs* with plastron absent on ventral surface of coxae, trochanters, and all of dorsal and sublateral parts of tibiae; plastron covering entire femora and ventral half of tibiae. Middle and hind (Text-fig. 10) tibiae with a row of fine teeth on inner margin. *Genitalia* (Text-fig. 11) with median lobe very slightly longer than parameres. Parameres evenly narrowed to apices.

♀. Externally similar to male but (1) with basal half of disk of first abdominal sternite much less strongly depressed and (2) without a row of teeth on inner margin of middle and hind tibiae.

Holotype ♂, TOBAGO: Courland River, 6.xi.1937 (*H. E. Hinton*). In the British Museum (Natural History).

Paratypes. 122 ex., with same data as holotype; TOBAGO: 4 ex., Providence River, 6. xi. 1937 (*H. E. Hinton*). TRINIDAD: 1 ex., Maracas River, 31. x. 1937 (*H. E. Hinton*); 1 ex., Maracas Valley, Constabulary, 30. x. 1937 (*H. E. Hinton*); 4 ex., Mausica River, 31. x. 1937 (*H. E. Hinton*); 2 ex., St Cruz River, 2. xi. 1937 (*H. E. Hinton*); 55 ex., Maraval River, 2. xi. 1937 (*H. E. Hinton*).

COMPARATIVE NOTES. Of the known species this is most nearly related to *N. apicalis* (Sharp) which occurs from Mexico to Peru (subspecies *N. apicalis angusta* Hinton). From both *N. apicalis apicalis* and *N. apicalis angusta* it may be distinguished by its smaller size and the reticulate microsculpture of the posterior half of the pronotal disk. The key to the subspecies given by me (Hinton, 1939) may be modified to include the new species as follows:

1 Pronotal disk with a reticulate microsculpture on surface of middle of posterior half. Trinidad, Tobago . . . . **Neoelmis pusio** sp. n
– Pronotal disk with punctures about half as coarse as facets of eyes and usually separated by three to five diameters on surface of middle of posterior half 2
2 Prosternal carinae distinct. Metasternum with depression on each side nearly round and separated by a distance equal to two-thirds of its diameter from hind coxa. Male genitalia with margins of parameres contiguous mesally. Mexico, Guatemala **Neoelmis apicalis apicalis** (Sharp, 1882)
– Prosternal carinae indistinct. Metasternum with depression on each side about a third longer than broad and separated by a distance equal to its diameter from hind coxa. Male genitalia with basal margins of parameres not contiguous mesally. Peru, Bolivia . . . . . . **Neoelmis apicalis angusta** Hinton, 1939

The teeth on the inner (ventral) side of the middle and hind tibiae of the male of *N. pusio* are very difficult to see with a binocular microscope, and the sexes are more easily distinguished by the degree to which the basal part of the disk of the first abdominal sternite is depressed.

Microcylloepus carinatus Hinton

(Pls 5, 6; Text-figs 12–14)

Microcylloepus carinatus Hinton, 1940b, *Novit. zool.* **42** : 304, figs 199–203. Holotype ♂, TRINIDAD: St Cruz River (BMNH) [examined].
Microcylloepus carinatus Hinton, 1945, *Entomologist*, **78** : 57–59, fig. 1.

♂. Length, 1·9–2·0 mm; breadth 0·76 mm. Cuticle shining and black or very dark rufopiceous; antennae, mouth-parts, and legs reddish brown. *Head* with punctures about a third as coarse as facets of eyes, very dense to confluent; at sides near anterior margin with an occasional low and very indistinct granule. Clypeus with anterior margin, when seen from front, scarcely noticeably, arcuately emarginate from its entire breadth; angle on each side more or less rectangular but rounded; surface sculptured like anterior region of head and also with a few low granules. Labrum on basal third at middle or basal two-thirds at sides with a transverse microsculpture; elsewhere with a few microscopic punctures. *Pronotum* across broadest point, which is at about basal two-fifths, as broad as long (0·63 mm) and base broader than apex (0·55 mm : 0·44 mm). Shape as shown in Pl. 5, fig. 23 and Text-fig. 12. Surface of disk with reticulate microsculpture distributed as shown in Pl. 5, fig. 23; surface of apical fourth of disk except near anterior margin, bottom of median depression, and basal fourth between median and sublateral carinae with punctures about half as coarse as facets of eyes and separated by two to five diameters. *Hypomera* without a plastron; surface with a reticulate microsculpture that in some lights appears to be a very dense and uniform punctation. *Elytra* with sublateral carinae very prominent (Text-fig. 12); inner carinae extending to middle. Third interval carinate on basal fifth (Pl. 5, fig. 22; Text-fig. 12). Apices broadly produced and conjointly rounded; each elytron near apex when seen from side with a conspicuous cavity for the reception of the projection of the fifth abdominal sternite. Humeri feebly gibbous. Epipleura without a plastron. Discal striae broad and feebly impressed; strial punctures on middle of disk round to subquadrate, very deep, and one-half to two-thirds as broad as scutellum; beyond middle of elytra

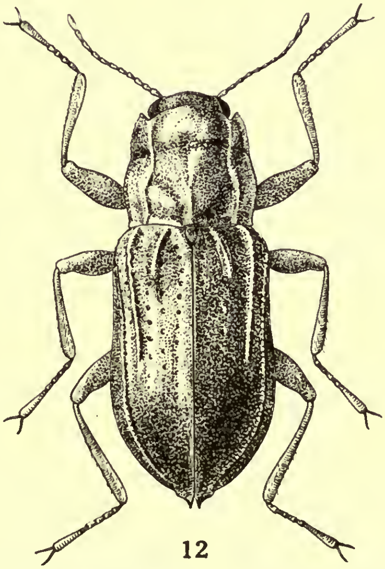

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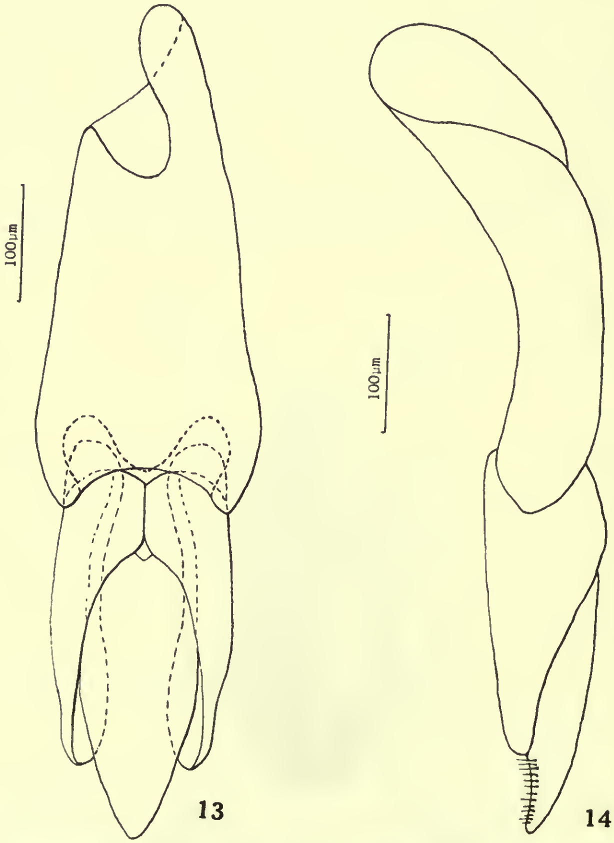
FIG. 12. *Microcylloepus carinatus*, female.

strial punctures abruptly become much finer. Surface of intervals with sparse, microscopic punctures. *Scutellum* moderately convex. *Prosternum* with plastron present everywhere between sublateral carina and sterno-notal suture except for a small oval or triangular area touching sublateral carina and coxal cavity and a small area at apex by sublateral carina; when seen from side with anterior five-sixths (not including process) gradually and feebly bent ventrally; prosternal carinae present on basal two-thirds to three-fourths, not prominent, and very feebly converging anteriorly, process with sides strongly raised so that it has a broad, deep, median longitudinal channel. Mesosternum with sides moderately strongly raised; with a deep, median, caudal pit. Metasternum with disk strongly depressed; median longitudinal impression about as broad as basal segment of middle tarsus and extending to anterior fifth; lateral discal carina sinuate and extending obliquely outwards very nearly to hind coxa; surface of disk with punctures as coarse as facets of eyes and usually separated by about one to three diameters; basal side of disk with two irregularly shaped small depressions near lateral carina. *Abdomen* with plastron absent on disk of first three sternites, but occasionally present on extreme posterior margin of third; fourth sternite with a narrow, anterior area of disk plastron-free. First sternite with disk steeply sloping downwards (ventral view) from caudal to anterior margin;



FIGS 13–14. *Microcylloepus carinatus.* (13) Dorsal view of male genitalia. (14) Male genitalia as seen from left side.

sublateral carinae prominent, nearly parallel, and nearly extending to posterior margin. Surface of disk of first sternite with punctures which are about as coarse as facets of eyes and are confluent to separated by two diameters; plastron-free areas of other sternites more sparsely and finely punctate than disk of first sternite. *Legs* with a plastron on distal part of front and middle trochanters; hind trochanters without a plastron except for a very narrow strip near anterior distal margin; femora with plastron absent only on distal half of ventral side of front and middle legs and all of ventral side of hind legs; tibiae without a plastron but each with grooming fringes, anterior and posterior grooming fringes on front and middle tibiae and only a posterior fringe on hind tibiae. Front tibia with a broad, prominent, acutely pointed tubercle on inner apex arising from a broadly oval depression; middle tibia (Pl. 6, figs 28–29) with a similar but less prominent tubercle; hind tibia (Pl. 6, figs 30–31) with inner apex like that of middle tibia but with tubercle less prominent.

♀. Externally similar to male except as follows: (1) elytra with sutural interval moderately strongly convex from basal two-thirds nearly to apex, whereas in the male the sutural interval is only feebly convex on apical third; (2) apex of each elytron (Text-fig. 12) acutely produced, and in some specimens the spine thus formed is slightly bent laterally, whereas in the male the apices of the elytra are broadly and conjointly rounded; (3) metasternal disk less strongly and extensively concave than that of male; (4) fifth abdominal sternite strongly gibbous so that apical third is nearly vertical; and (5) tibiae without tubercles near inner apices.

SPECIMENS EXAMINED.

Holotype ♂, TRINIDAD: St Cruz River, 2. xi. 1937 (*H. E. Hinton*). In the British Museum (Natural History).

TRINIDAD: 171 ex., with same data as holotype; 16 ex., Maraval River, 2. xi. 1937 (*H. E. Hinton*); 22 ex., St Ann's River, 28. x. 1937 (*H. E. Hinton*); 10 ex., Curumpalo River, 2. xi. 1937 (*H. E. Hinton*); 4 ex., Curucaye River, 2. xi. 1937 (*H. E. Hinton*); 9 ex., Cimaronero River, 2. xi. 1937 (*H. E. Hinton*); 22 ex., Tacarigua River, 31. x. 1937 (*H. E. Hinton*); 103 ex., streams in Maracas Valley, 29–31. x. 1937 (*H. E. Hinton*); 46 ex., Garden River, 31. x. 1937 (*H. E. Hinton*); 19 ex., Cuare River, 5. xi. 1937 (*H. E. Hinton*); 2 ex., Arima River, 16. xii. 1969 (*H. B. N. Hynes*); 133 ex., Mausica River, 31. x. 1937 (*H. E. Hinton*). TOBAGO: 41 ex., Providence River, 1. ex, Craig Hall River, 41 ex., Courland River, 4 ex., Hillsborough West River, all 6. xi. 1937 (*H. E. Hinton*).

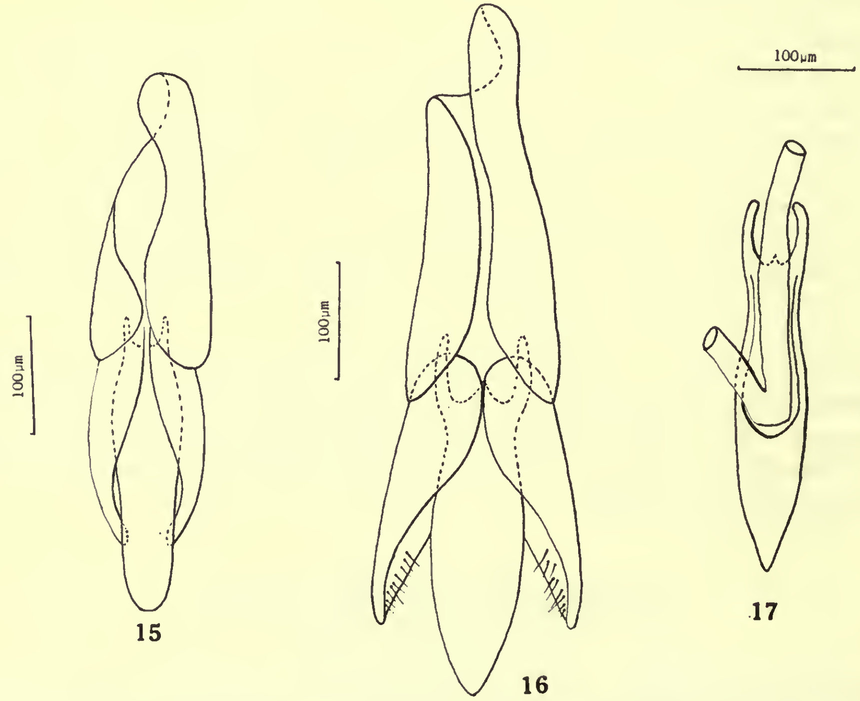
COMPARATIVE NOTES. The structure of the pronotum together with the absence of a plastron on the elytral epipleura place this in the *M. inaequalis* (Sharp, 1882) species-group. The tubercles on the inner apices of the male tibae and the spinose apices of the elytra of the female will serve to distinguish this species from all other known members of the genus.

Hexacylloepus smithi (Grouvelle)

(Pl. 7; Text-figs 4, 15)

Helmis Smithi Grouvelle, 1898, *Notes Leyden Mus.* **20** : 47. 3 syntypes, GRENADA: Mount Gay Estate (1 in BMNH, 2 in Muséum National d'Histoire Naturelle, Paris) [1 syntype examined].

♂. Length 1·7–2·0 mm; breadth 0·71–0·78 mm. Cuticle feebly shining and moderately pale yellowish brown to black; in dark specimens antennae, mouth-parts, and tarsi are distinctly paler than body. *Head* with round to oblong granules about three-fourths as coarse as facets of eyes and usually separated by two to three diameters. Clypeus granulate like head. Labrum with microscopic punctures that are often separated by about their diameters. *Pronotum* across broadest point, which is at about basal third, broader than long (0·60 mm : 0·53 mm) and base broader than apex (0·58 mm : 0·45 mm). Median discal depression about as broad or a little broader than scutellum and extending from near base to about apical fourth where it is strongly narrowed and very shallow to apex. Basal third near each sublateral carina shallowly, indistinctly depressed. Surface (Pl. 7, figs 33–34) with flat-topped granules and punctures as illustrated. *Hypomera* with transverse plastron belt reaching edge of pronotum and extending anteriorly along the edge in a gradually narrowing strip that nearly reaches apex. Plastron-free areas with a reticulate microsculpture and a few low granules. *Elytra* with apices feebly produced and conjointly, broadly rounded. Epipleura with plastron extending almost to extreme apex. Sublateral carinae moderately prominent. Fourth interval (Pl. 7, fig. 33) on basal fifth nearly as elevated as sublateral carinae. Discal strial punctures one-half to two-thirds as wide as intervals and separated longitudinally by about their diameters. Surface of intervals with granules and punctures as shown in Pl. 7, fig. 33. *Prosternum* with plastron belt extending from margin of coxal cavity and gradually becoming wider anteriorly and almost reaching sublateral carina. Metasternum (Pl. 7, fig. 32) with granules somewhat coarser and sparser than those of pronotal disk. *Abdomen* everywhere with a plastron except on disk of first sternite. Disk of first sternite moderately depressed; surface sculptured like pronotal disk except near posterior margin where granules are absent. *Legs* with trochanters, femora, and



FIGS 15–17. (15) *Mexacylloepus smithi*, dorsal view of male genitalia. (16–17) *Heterelmis simplex codrus*. (16) Dorsal view of male genitalia. (17) Ventral view of median lobe. The median lobe varies somewhat in thickness, and the extremes are shown in these figures.

tibiae entirely clothed with plastron microtrichia. Front tibia with a single apical grooming fringe; middle tibia with two apical grooming fringes; hind tibia with a single apical grooming fringe. Middle tibia with a row of 10 small, stout spines on inner or ventral edge (Pl. 7, fig. 37). *Genitalia* (Text-fig. 15) with median lobe broad and extending well beyond apices of parameres.

♀. Externally similar to male but with disk of first abdominal sternite slightly less depressed and inner edge of middle tibia without a row of stout spines.

SPECIMENS EXAMINED.

Syntype, sex undetermined, GRENADA: (leeward side) Mount Gay Estate (*H. H. Smith*). In the British Museum (Natural History).

GRENADA: 1 ex., St John's River (*H. H. Smith*); TRINIDAD: 37 ex., Maraval River, 281 ex., St Ann's River, 5 ex., Curumpalo River, 2 ex., Curucaye River, 108 ex., Cimaronero River, 185 ex., St. Cruz River, 351 ex., Tacarigua River, 68 ex., Garden River, 572 ex., Maracas Valley, 24 ex., Cuare River, 255 ex., Mausica River, all 28. x.–5. xi. 1937 (*H. E. Hinton*); 1 ex., St Joseph River, 16. xii. 1969 (*H. B. N. Hynes*); 23 ex., Arima River, 16. xii. 1969 (*H. B. N. Hynes*); TOBAGO: 1 ex., Providence River, 6. xi. 1937 (*H. E. Hinton*).

COMPARATIVE NOTES. This species belongs to the *H. ferruginea* (Horn, 1870) group. It is closely related to *H. abditus* (Hinton) of Mexico but differs in the structure of the male genitalia (cf. Hinton, 1937, figs 13–14). In *H. abditus* the transverse plastron belt of the hypomera does not extend forwards close to the edge of the pronotum as it does in *H. smithi*.

Heterelmis simplex codrus subsp. n.

(Pls 8, 9; Text-figs 2, 16, 17)

♂. Length 1·7–2·1 mm; breadth 0·8–1·0 mm. Body obovate. Cuticle moderately shining and brownish to black; in dark specimens antennae, mouth-parts, and legs are paler and reddish brown. *Head* with low granules about two-thirds as coarse as facets of eyes and usually separated by two or more diameters; surface between granules densely, microscopically punctate. *Pronotum* at broadest point, which is at about basal third, broader than long (0·73 mm : 0·60 mm) and base broader than apex (0·71 mm : 0·50 mm). Sublateral carinae prominent, complete from base to apex, and inner or dorso-mesal margins sharp; at about third carinae slightly bent where they meet the oblique, subbasal depression on each side; subbasal oblique depression usually shallow and indistinct. Disk usually without a transverse depression just behind middle; some specimens with a wide and very shallow depression; usually with a shallow, oval, median, discal depression that is about half as wide as scutellum. Surface of middle of disk with punctures slightly finer than facets of eyes and usually separated by one to three diameters; in Pl. 8, fig. 41, punctures appear sparser than they are because some have been filled in by metal. *Hypomera* with plastron belt above coxal cavity less than half as wide as hypomera above coxae; plastron extends to anterior margin as a very narrow strip (half as wide as basal tarsal segment) against sterno-notal suture. Surface with low granules and dense, microscopic punctures. *Elytra* with extreme apices feebly dehiscent. Epipleura with plastron extending close to apex. Sublateral carinae moderately prominent, other intervals flat. Strial punctures as shown in Pl. 8, fig. 38. *Prosternum* with plastron complete on side between sterno-notal suture and sublateral carina except for a very small patch at apex against carina. Metasternal disk (Pl. 8, figs 39–40) feebly convex; plastron not extending mesally beyond a point opposite middle of middle coxal cavities. *Abdomen* with discal area of all sternites plastron-free; disk of first two sternites with punctures about as coarse as facets of eyes and separated by one to three diameters; disk of sternites 3–5 with punctures distinctly finer and sparser. First sternite with sublateral discal carinae prominent and extending to hind margin of sternite. *Legs* with plastron present on front and middle trochanters but absent on hind trochanter (Pl. 9, fig. 48). Front and middle femora with plastron absent on distal third; hind femora with plastron absent on distal half of top and sides and all of ventral side. Tibiae without a plastron but with two apical grooming fringes on front and middle tibiae and a single grooming fringe on hind tibiae. *Genitalia* (Text-fig. 16) with median lobe evenly narrowed and extending beyond apices of parameres.

♀. Externally similar to male.

Holotype ♂, TRINIDAD: Maracas Valley, 29. x. 1937 (*H. E. Hinton*). In the British Museum (Natural History).

Paratypes. TRINIDAD: 732 ex., with same data as holotype; 47 ex., Maraval River, 674 ex., St Ann's River, 45 ex., Curumpalo River, 118 ex., Curucaye River, 2 ex., Cimaronero River; 143 ex., St Cruz River, 19 ex., Garden River, 38 ex., Cuare River, 5 ex., Marianne River, all 28. x.–5. xi. 1937 (*H. E. Hinton*); 1 ex., St Joseph River, 16. xii. 1969 (*H. B. N. Hynes*); 15 ex., Arima River, 16. xii. 1969 (*H. B. N. Hynes*); TOBAGO: 14 ex., Providence River, 7 ex., Courland River, 6 ex., Hillsborough West River, all 6. xi. 1937 (*H. E. Hinton*).

COMPARATIVE NOTES. *H. simplex* Sharp, 1882 has not been recorded outside Guatemala. Fifteen specimens of *H. simplex* taken in Guatemala near Escuintla in March 1970 by Dr H. B. N. Hynes have been compared with the series from Trinidad and Tobago. The distribution of the plastron in *H. simplex simplex* and *H. simplex codrus* is identical in all respects. However, the median lobe of the male genitalia of *H. s. codrus* is slightly but distinctly broader than that of *H. s. simplex* and the setae on the parameres are shorter and less numerous. When populations from further south on the mainland are examined, it may well be that all gradations between the two subspecies will be found in the structure of the male genitalia.

ACKNOWLEDGEMENTS

I am grateful to the Managers of the Balfour Fund and the Worts Fund of the University of Cambridge for grants that enabled me to collect in Trinidad and Tobago in 1937. My thanks are due to the Science Research Council for providing me with a scanning electron microscope.

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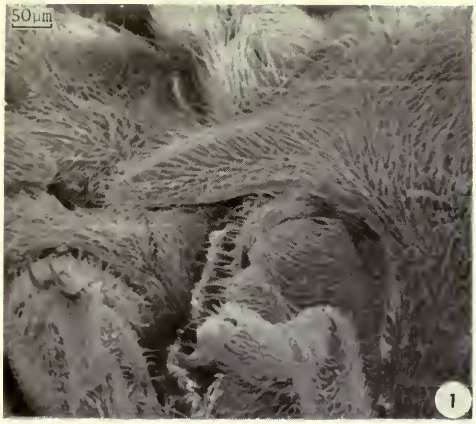
Professor H. E. HINTON, Ph.d., Sc.D., F.R.S.
Department of Zoology
UNIVERSITY OF BRISTOL
WOODLAND ROAD
BRISTOL, BS8 1UG

PLATE 1

Figs 1–6. *Phanocerus congener*. (1) Prosternal process and the cavity for its reception in the mesosternum. (2) Posterior part of metasternal disk and anterior middle part of first abdominal sternite. (3) Disk of elytra near base. (4) Hind tarsi and abdominal sternites. (5) Area near median line of fourth and fifth abdominal sternites. (6) Fourth and fifth abdominal sternites. In some specimens, especially males, the middle hind margin of the fifth abdominal sternite is arcuately emarginate, whereas in others it is often more or less truncate.



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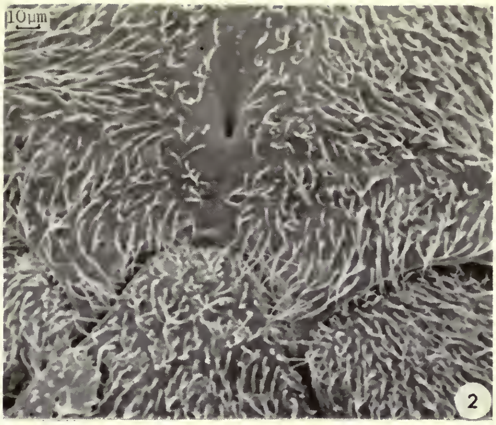

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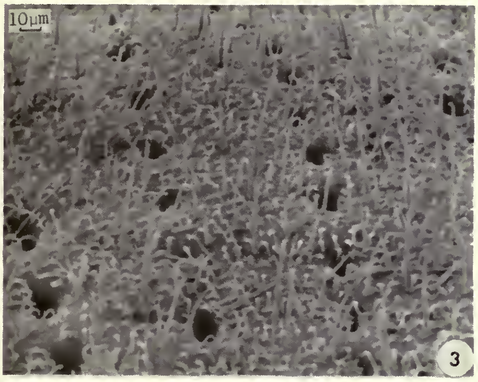

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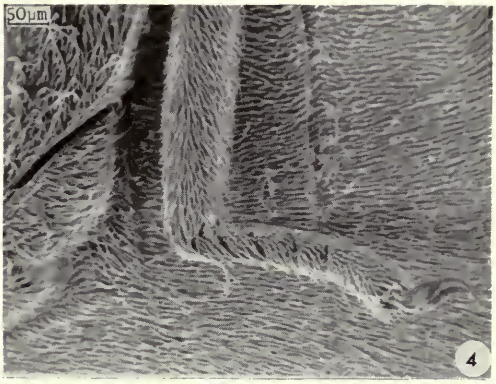

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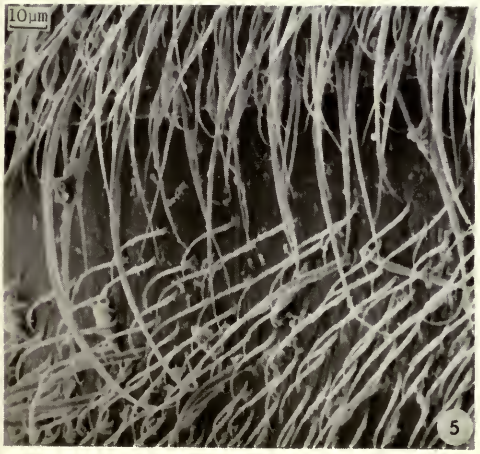

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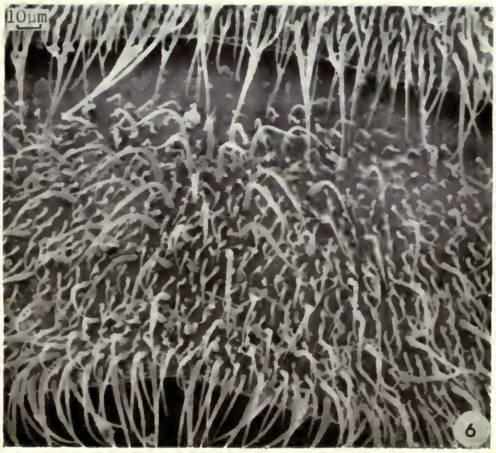
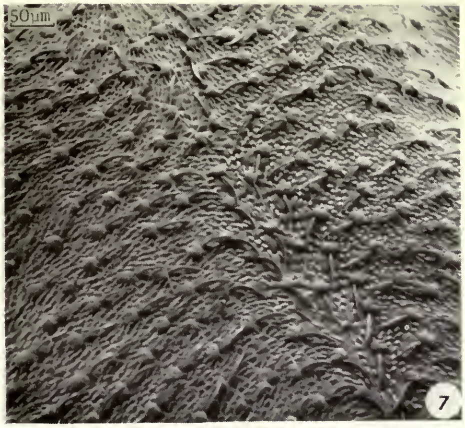


6

PLATE 2

FIGS 7–12. *Elsianus clypeatus.* (7) Middle of pronotal disk. (8) Granules of middle of pronotal disk. (9) Base of elytra showing the accessory stria between the first and second striae. (10) Metasternal disk. (11) Grooming fringe of middle tibia of female. The tibial grooming fringes are used to smear over the surface of the plastron any bubbles of gas that may come into contact with the body until the gas is absorbed by the plastron. The grooming fringes are probably also used to keep the hairs of the so-called "macroplastron" evenly spaced. (12) Basal side of prosternum.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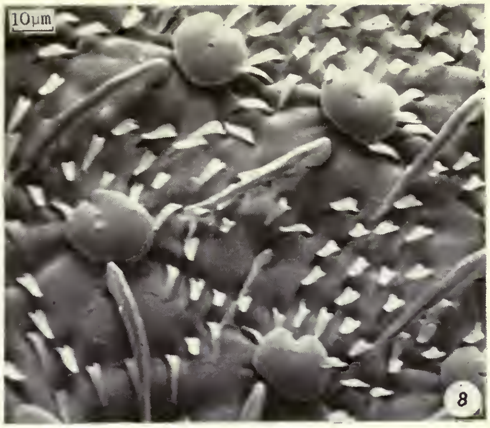
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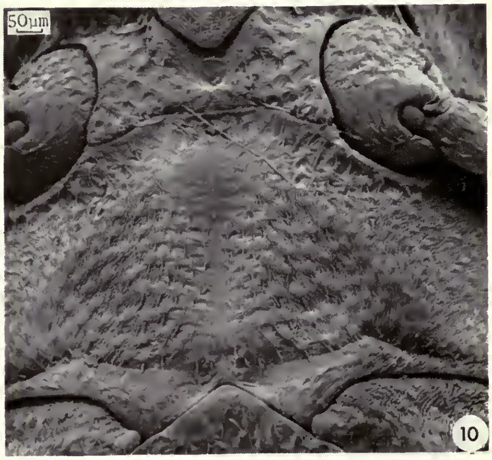
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10µm
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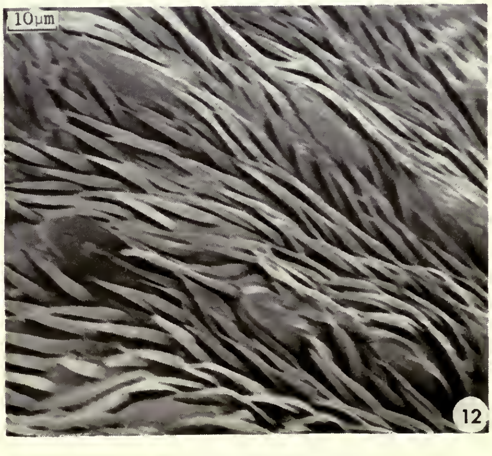
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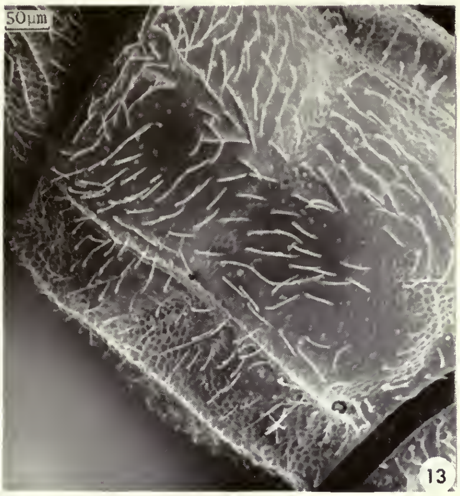
PLATE 3

Figs 13–16. *Neoelmis pusio.* (13) Pronotum showing the distribution of the asperate microsculpture. *Neoelmis* is the only genus of Elmidae in the Lesser Antilles that has a deep pit at the base and another at apical two-fifths close to the inner side of the sublateral carina. (14) Middle side of pronotum. (15) Disk of elytra near the base. (16) Apical segments of antenna.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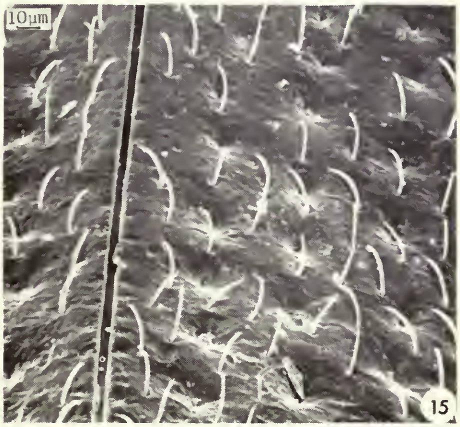
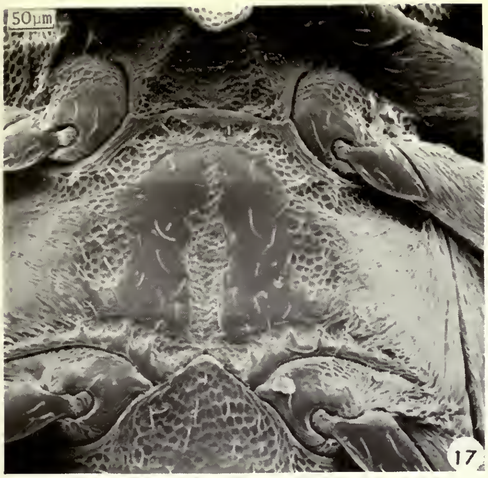
10μm
14


10μm
15


10μm
16

PLATE 4

Figs 17–21. *Neoelmis pusio.* (17) Metasternum. (18) First three abdominal sternites near middle showing both the plastron and part of the plastron-free areas. (19–20) Plastron of second sternite near middle. In Fig. 19 four of the setae of the "macroplastron" are shown. (20) Apex of hind tibia. (21) Apical fourth of hind tibia showing the plastron.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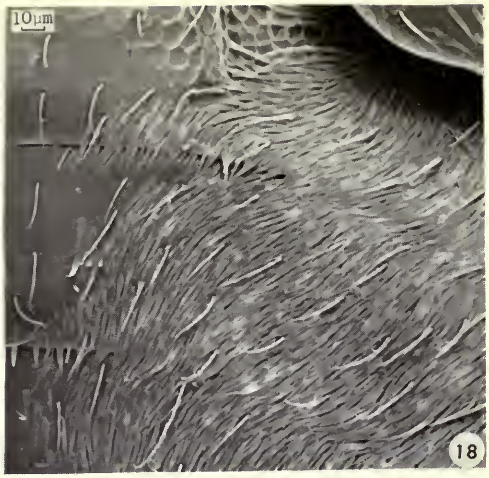
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18


5µm
19


1µm
20

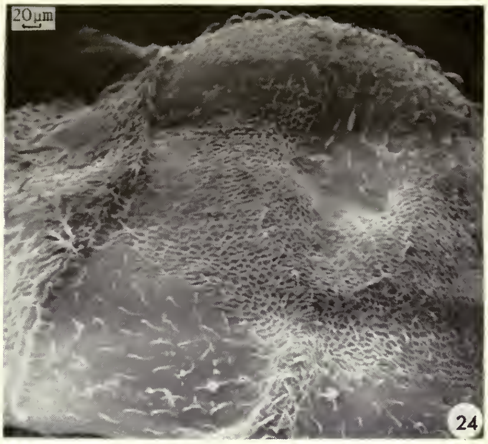

5µm
21


5µm
22

PLATE 5

Figs 22–27. *Microcylloepus carinatus.* (22) Base of elytra. (23) Pronotum showing the distribution of the reticulate microsculpture. (24) Front trochanter showing the plastron on the distal part of the trochanter. (25) Side of prosternum near anterior margin. (26) Plastron of side of metasternum. (27) Posterior area of first and anterior area of second abdominal sternites. The type of abdominal plastron is seen on the anterior part of the first sternite and the posterior part shows the microtrichia of the plastron-free areas.


20µm
23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10µm
25


10µm
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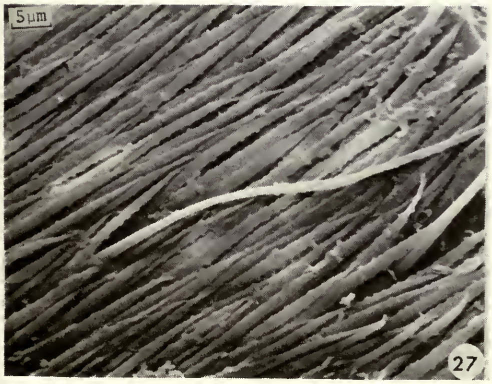

5µm
27


5µm
28

PLATE 6

Figs 28–31. *Microcylloepus carinatus.* (28) Middle tibia of the male showing one of the two grooming fringes and the erect tubercle on the inner apex. (29) Tubercle on inner apex of middle tibia of the male. (30–31) Tubercle on inner apex of the hind tibia of the male.

29

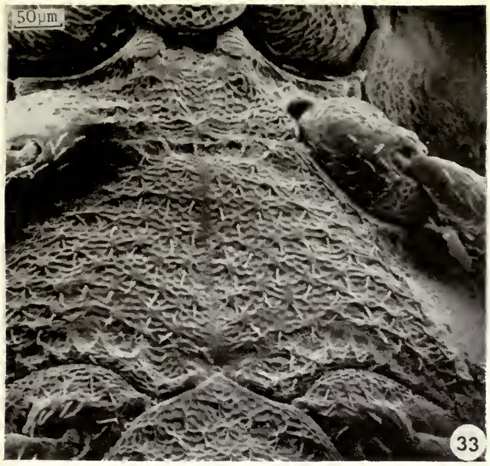
30

31

32

PLATE 7

Figs 32–37. *Hexacylloepus smithi* (32) Metasternum. (33) Base of pronotum and elytra. (34) Middle of pronotal disk. The granules are best seen if this micrograph is reversed so that what is now the bottom becomes the top. (35) Plastron of second abdominal sternite showing the setae of the "macroplastron" arising from flattened tubercles. (36) Plastron of posterior face of hind tibia. (37) Inner or ventral side of middle tibia of the male showing one of the two grooming fringes, part of the plastron, and part of the row of short, stout spines that is present in the male but absent in the female.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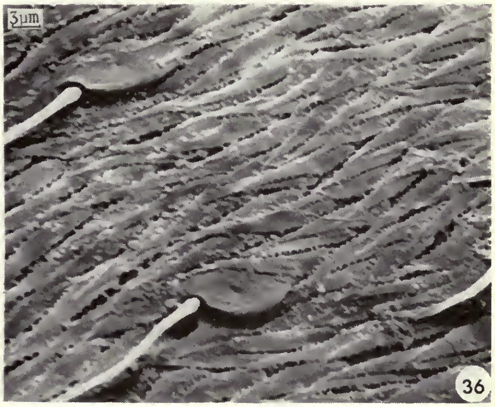
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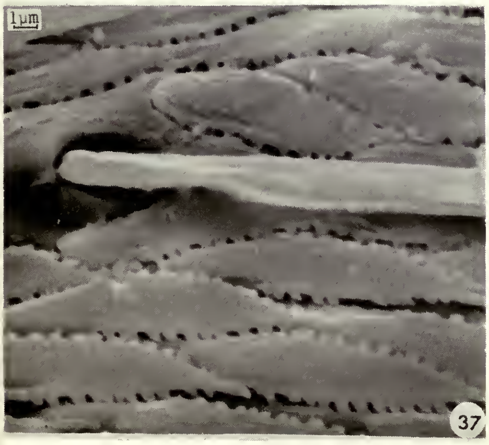
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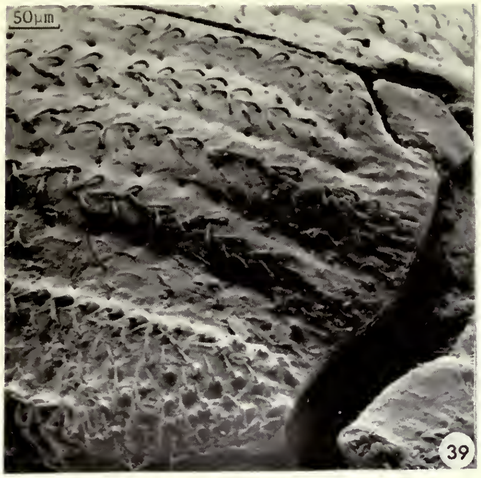
37


5µm
38

PLATE 8

Figs 38–43. *Heterelmis simplex codrus.* (38) Base of elytra. (39) Metasternum. (40) Metasternal disk. (41) Pronotum. (42) Posterior end of elytron showing end of inner sublateral carina. (43) Inner and outer sublateral carinae of elytra at about middle of its length.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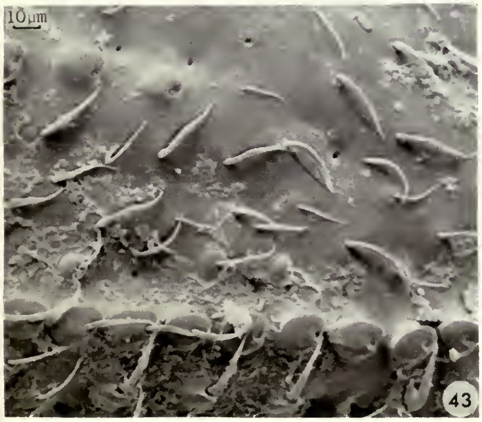
42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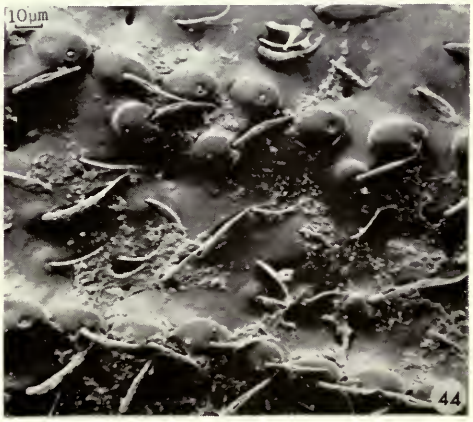

10µm
44

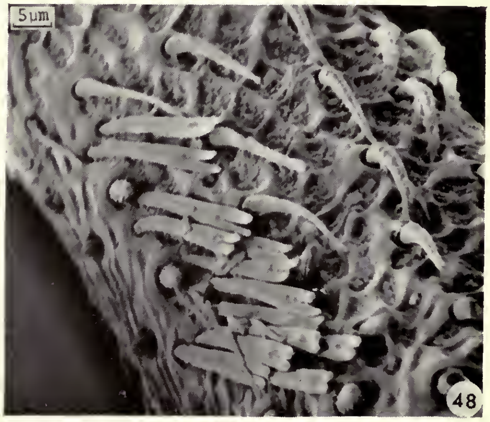
PLATE 9

Figs 44–49. *Heterelmis simplex codrus.* (44) Maxillary palp and anterior margin of labrum. (45) Apex of maxillary palp showing the numerous peg-like sensory organs. (46) Posterior face of middle tibia showing the setae of the apical grooming fringe. (47) Front tibia showing the smaller of the two grooming fringes which has only about 13 setae, each of which is divided at the apex. (48) Plastron at base of femur of hind leg. (49) Plastron of third abdominal sternite near middle.


10µm
45


3µm
46


10µm
47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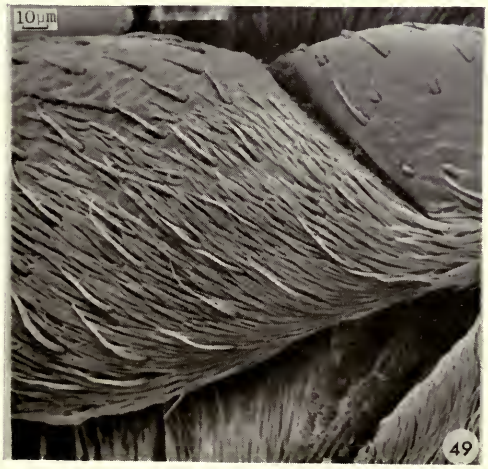
10µm
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3µm
50

A PRELIMINARY REVISION OF THE GENUS *OXYA* AUDINET-SERVILLE (ORTHOPTERA : ACRIDOIDEA)

BY

DAVID HOLLIS

Pp. 267–343; 269 *Text-figures*

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THE BRITISH MUSEUM (NATURAL HISTORY)
ENTOMOLOGY Vol. 26 No. 7
LONDON : 1971

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This paper is Vol. 26, *No.* 7 *of the Entomological series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.*

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TRUSTEES OF
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Issued 7 December, 1971 *Price £2·90*

A PRELIMINARY REVISION OF THE GENUS *OXYA* AUDINET-SERVILLE (ORTHOPTERA : ACRIDOIDEA)

By D. HOLLIS

CONTENTS

SYNOPSIS

The genus *Oxya* is redescribed and defined; keys are given to the 18 species and six subspecies included in the genus. Two of the species are described as new and the remainder are redefined; 24 new synonyms are proposed, and a junior synonym is removed from the genus.

INTRODUCTION

SPECIES of the genus *Oxya* are widely known to be pests of rice, sugar cane and other crops, from Pakistan, throughout the Oriental region, China, S. E. Russia, the Australian region, and the genus was introduced to Hawaii last century. The insects are well adapted to the marshy conditions in which they live as the hind tibia and tarsus are expanded and 'oar-like', enabling the insect to swim (Uvarov, 1928: 319); the female is able to oviposit in soil in drier conditions and, in flooded fields, to cement egg-masses between grass stems, in leaf axils or on stones, an inch or two above the water-level.

The systematic state of the genus was in such disarray that it has been almost impossible to identify specimens with stable names or, in many cases, to separate one species from another. The need became obvious for some form of revisionary work and this was undertaken.

During the course of preliminary investigations two important points emerged, these being that the species at present included in the genus are not sufficiently similar in their male phallic complex morphology to be of monophyletic origin, and that the scope and definition of the whole subfamily Oxyinae would have to be reassessed. These points presented a practical dilemma, in that a comprehensive revision of the genus *Oxya* would involve a lengthy study of all the genera included in the subfamily. The economic entomologists, however, required a more immediate means of identifying *Oxya* species with an element of stability. The following course of action was therefore adopted. The genus *Oxya* was to be treated as a taxonomic entity with the species diagnosed, their synonymy clarified and keys erected for purposes of identification. The interrelationships of the species are briefly discussed but any decisions on the 'naturalness' of the genus and its position within the subfamily Oxyinae are deferred to a later paper.

The genus was last revised by the late C. Willemse (1925) and he recognized thirty species. History prior to his revision need not be quoted here. Uvarov (1926) published a few minor corrections to Willemse's revision, synonymized three of the species that Willemse recognized, added three more species which Willemse omitted (as he was unable to make type-examinations) and altered some points of nomenclature. Since then a further 11 species and three subspecies have been added; of the former, two have been sunk into synonymy, and of the latter, one has been given full specific status and another synonymized. Thus up to now the genus was thought to contain forty species and one subspecies.

A basic fault in Willemse's revision was his misapplication or exclusion of the names *Gryllus velox* Fabricius, *Gryllus japonicus* Thunberg and *Gryllus chinensis* Thunberg, and this arose because the relevant type-specimens were not examined or were interpreted incorrectly. Authors following Willemse, e.g., Chang (1934), Tinkham (1940) and Mishchenko (1951 and 1952), accepted his interpretations with slight deviations and consequently the systematic and economic literature on the genus has become extremely confused. Where an author has added a description to a reported name, the species he was dealing with can normally be identified and these references are now added in the synonymy lists below. Unfortunately many of these records are in name only, making positive identification impossible.

During the course of this work all the available types of *Oxya* species were studied, but if a type was unavailable this is stated. Lectotypes have been designated where appropriate. In two cases, *O. yezoensis* Shiraki and *O. hyla* Serville, it has been reliably ascertained that the types are irretrievably lost and, as nomenclatorial problems could arise and have arisen, neotypes are erected.

It is suggested here that the genus contains 18 species, two of which are described as new and a further three are each divided into two subspecies. The recognized species and subspecies are diagnosed, their synonymy stated and distribution quoted only from material to hand, as many previous records are doubtful owing to misidentification and misapplication of names. The synonymy given under each species includes all primary synonymy and combinations, references where the original author's interpretation is known or deduced, and biological references again only where the specific interpretation is known.

Type-depositories are given in abbreviated form as follows:

MNHU, Berlin – Museum für Naturkunde der Humboldt-Universität, Berlin.
BMNH – British Museum (Natural History), London.
UZM, Copenhagen – Universitetets Zoologiske Museum, Copenhagen.

DEI, Eberswalde – Deutsches Entomologisches Institute, Eberswalde, DDR.
MHN, Geneva – Muséum d'Histoire Naturelle, Geneva.
RNH, Leiden – Rijksmuseum van Natuurlijke Historie, Leiden.
ZI, Leningrad – Zoological Institute, Academy of Sciences of USSR, Leningrad.
NM, Maastricht – Natuurhistorisch Museum, Maastricht.
MNHN, Paris – Muséum d'Histoire Naturelle, Paris.
ZIHU, Sapporo – Zoological Institute, Hokkaido University, Sapporo.
NR, Stockholm – Naturhistoriska Rijksmuseum, Stockholm.
ZIUU, Uppsala – Zoologiska Institutonen, Uppsala.
NM, Vienna – Naturhistorisches Museum, Vienna.
coll. Willemse – Dr F. Willemse, Eygelshoven, Laurastraat 67, Netherlands.

Measurements and abbreviations of measurements in the work follow those of Dirsh (1953). The figures given for the ranges of measurements are based on a deliberate choice of the largest and smallest specimens that could be found in the available material. The ratios of measurements given for each species are based on samples of thirty specimens of each sex, or less if fewer were available, but these samples included the largest and smallest specimens measured and therefore were not entirely random.

Abbreviations used in the figures of the male phallic complex (mostly as in Dirsh, 1956*a*) are:

A	ancorae of epiphallus	Ejs	ejaculatory sac
Ac	arch of cingulum	Gpr	gonopore process
Anp	anterior process of epiphallus	Il	inner lophus of epiphallus
Ap	apical valve of penis	Lfl	lateral fleshy lobe of cingulum
Apd	apodeme of cingulum	Ol	outer lophus of epiphallus
B	bridge of epiphallus	Os	oval sclerite of epiphallus
Bp	basal valve of penis	Pp	posterior process of epiphallus
Cv	cingular valve	Ppc	posterior process of cingulum
Ectm	ectophallic membrane	Rm	ramus of cingulum
Ects	ectophallic sheath	Sps	spermatophore sac
Ejd	ejaculatory duct	Vpc	valvular plate of cingulum

I take this opportunity to thank the Keeper of Entomology, British Museum (Natural History) for allowing me to study the material in his care; Dr N. D. Jago for criticising the typescript; and the following colleagues for lending type and other material for study: Professor Max Beier, Vienna; Dr M. Descamps, Paris; Dr P. H. van Doesburg, Leiden; Dr N. Fukuhara, Tokyo; Dr K. K. Günther, Berlin; Dr B. Hauser, Geneva; Dr L. Hedström, Uppsala; Dr N. D. Jago, formerly of Philadelphia; Dr C. A. W. Jeekel, Amsterdam; Dr P. I. Persson, Stockholm; Dr B. Petersen, Eberswalde, DDR; Professor R. E. Pfadt, Laramie; Monsieur R. Roy, Dakar; and Dr T. Yamasaki, Tokyo.

Special thanks are due to Dr Fer Willemse and family for making my brief study of material deposited in the Netherlands so productive and pleasant.

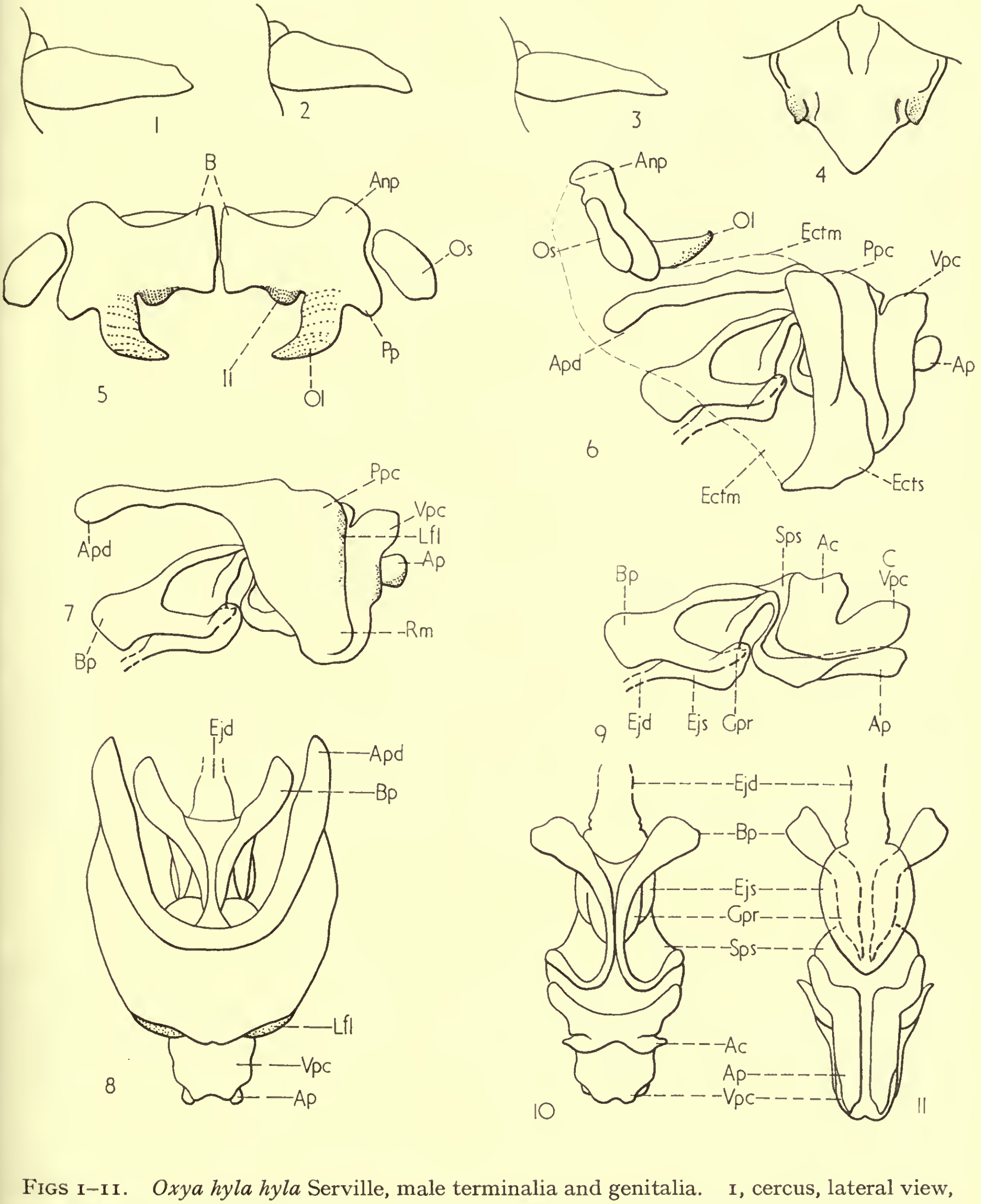
TAXONOMIC TREATMENT

OXYA Audinet-Serville, 1831

Oxya Audinet-Serville, 1831: 286. Type-species: *Oxya hyla* Audinet-Serville, by monotypy.
Oxya Audinet-Serville; Burmeister, 1838: 634, partim.
Acridium (*Oxya*) Audinet-Serville, 1839: 678, pl. 12, fig. 4.
Oxya Audinet-Serville; de Haan, 1842: 155, partim.
Oxya Audinet-Serville; Stål, 1873: 81.
Oxya Audinet-Serville; Brunner von Wattenwyl, 1893: 151.
Oxya Audinet-Serville; Kirby, 1910: 393, partim.
Oxya Audinet-Serville; Kirby, 1914: 198.
Oxya Audinet-Serville; I. Bolívar, 1918: 14.
Oxya Audinet-Serville; Sjöstedt, 1921: 92.
Oxya Audinet-Serville; Willemse, 1925: 8.
Oxya Audinet-Serville; Uvarov, 1926: 45.
Oxya Audinet-Serville; Willemse, 1930: 119.
Oxya Audinet-Serville; Willemse, 1931: 236.
Oxya Audinet-Serville: Sjöstedt, 1935; 71.
Oxya Audinet-Serville; Tinkham, 1940: 291.
Oxya Audinet-Serville; Mishchenko, 1951 : 163.
Oxya Audinet-Serville; Mishchenko, 1952: 139.
Oxya Audinet-Serville; Willemse, 1955: 142.
Oxya Audinet-Serville; Johnston, 1956: 250, partim.
Oxya Audinet-Serville; Johnston, 1968: 172.

Description. Medium size. Integument usually finely rugulose and shiny but in one species more coarsely rugulose and matt. Fastigium of vertex, from above, short, with widely rounded or obtuse apex, with shallow longitudinal concavity and without median longitudinal carinula. Antenna filiform, longer than, as long as, or shorter than combined lengths of head and pronotum. Frons, in profile, oblique, straight or weakly convex; frontal ridge sulcate along whole length with distinct carinulae extending to clypeus; facial carinae distinct. Eyes large, ellipsoid. Pronotum subcylindrical, usually with slightly flattened dorsum, median carina very weak, lateral carinae absent, dorsum crossed by three fine sulci; metazona shorter than prozona, with rounded or widely obtuse-angular posterior margin; prosternal process conical with rounded or subacute apex, often slightly bent backwards and sometimes with weakly flattened posterior surface; mesosternal interspace much narrower than long. Tegmina fully developed or shortened but mostly (not in one species) touching in the mid dorsal line; anterior margin, in the female, densely, weakly or not at all spined; hind wing usually with dense hairs on dorsal surface of basal parts of anal veins. Hind femur slender, upper 'knee' lobes rounded, lower 'knee' lobes extended into acute spine-like projections; hind tibia expanded in apical two-thirds with upper outer margins acute, external apical spine present; first segment of tarsus dorso-ventrally compressed. Abdomen with distal segments having dense clusters of hairs ventrally.

Male supra-anal plate rounded triangular, with rounded or angular apex, or weakly trilobate with apical part extended posteriorly; cercus conical or compresssed with rounded, acute, truncate or bifurcate apex; subgenital plate short, conical, with obtuse or weakly truncate apex; epiphallus usually with narrow divided bridge, ancorae usually absent but present in some species, with two pairs of lophi, an outer hook-like pair and an inner, short, tooth-like pair; cingulum with horse-shoe-shaped apodemal structure and a large posterior process which extends backwards over cingular valves; on each side of this process is a fleshy 'lateral lobe', cingular valves fused dorso-medially to form a plate which covers apical penis valves dorsolaterally. This plate often has a postero-apical emargination which may be deep or shallow; endophallus with narrow but complete flexure between basal and apical valves of penis, latter long or short, slender or fleshy.



Figs 1–11. *Oxya hyla hyla* Serville, male terminalia and genitalia. 1, cercus, lateral view, of specimen from Brazzaville; 2, same, from Madagascar; 3, same, from S. Africa; 4, supra-anal plate, dorsal view; 5, epiphallus, with oval sclerites; 6, phallic complex, entire, lateral view; 7, same, lateral view, epiphallus and ectophallic membrane removed; 8, same, dorsal view; 9, endophallus, lateral view; 10, same, dorsal view; 11, same, ventral view.

Female subgenital plate on visible hind margin often with apical and/or subapical teeth or tubercles, ventral surface often with longitudinal ridges and/or furrow; ovipositor valves long and slender, with spined or toothed external edges; spermatheca with long sinuous preapical and short sac-like apical diverticulum.

Colouration within the genus is fairly uniform and there are two basic colour forms: Green form – Dorsum of head, pronotum and folded tegmina from hind margin to medial vein green-yellow; behind the eyes, the upper half of the lateral plate of the pronotum and the tegmina from the costal margin to the medial vein brown; lower part of head, lateral plate of pronotum and pleurae, green-yellow. Brown form – as green form but dorsum of head, pronotum and folded tegmina, brown.

An intermediate form exists which is similar to the brown form but there are lateral longitudinal yellow stripes running from between the eyes along the lateral margins of the dorsum of the pronotum to the posterior margin of the metazona.

The hind femora are usually green-yellow and the hind tibia are dirty greenish blue or ochraceous.

As the genus is here considered to be an unnatural grouping of species and is retained as a taxonomic unit in its present state for purely practical purposes, it is difficult to discuss its phylogenetic position. However using the morphology of the phallic complex as a basis, the genus may be related along various lines to the rest of the subfamily. *O. hyla* Serville is close to the purely African genus *Zulua; O. japonica* (Thunberg) is similar to the genus *Bumacris* which is known only from the Solomon Is.; *O. paravicina* Willemse relates to *Caryanda* in the Oriental region and the African genera *Dibastica* and *Austeniella; O. diminuta* Walker seems to be close to *Racilia, Tauchira* and possibly *Fer;* and *O. fuscovittata* (Marschall) relates to the Ceylonese genera *Cervina* and *Ochlandriphaga.*

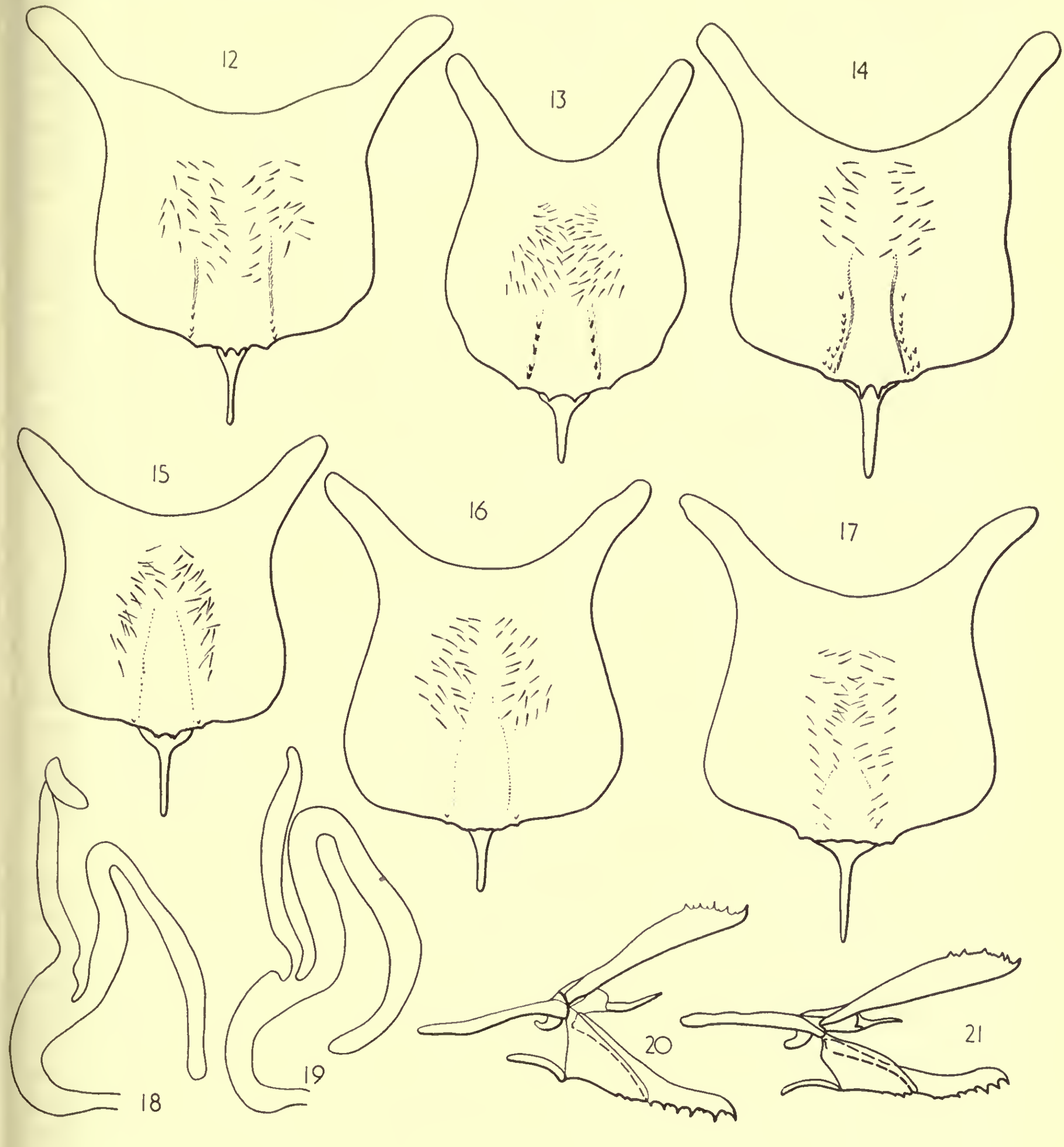
The following characters, both positive and negative, will serve to identify *Oxya* in its present context: external apical spine of the hind tibia present; hind tibia expanded with acute dorso-lateral margins; dorsum of pronotum smooth or finely rugulose, with fine transverse sulci; fastigium or vertex without median longitudinal carinula; prosternal process conical; tegmina fully developed or shortened but never reduced to lobiform condition and without parallel transverse veinlets.

Specific characters and groupings

Willemse (1925), in his revision of the genus and, later (1955), in his work on the Indo-Malayan species, placed great diagnostic emphasis on the number, size and placing of the teeth (or spines) on the visible ventral margin of the female subgenital plate, and the presence or absence and placing of the lateral posterior projections on the hind margins of the female abdominal tergites. No attempt was made in either work to provide identification keys for male specimens.

It has been found that the projections on the female abdominal tergites are without value in identification as they vary tremendously, being present or absent within a species and even varying in size and placing on either side of the abdomen of a single specimen.

The female subgenital plate can be used in diagnosis if its overall structure is considered. The spines on the visible posterior margin are subject to wear during



Figs 12–21. *Oxya hyla* subspp. female terminalia. *O. h. hyla* Serville, subgenital plate, ventral view of specimens from: 12, Ghana; 13, S. India; 14, Madagascar; 18, spermatheca; 21, ovipositor, lateral view; *O. h. intricata* (Stål), subgenital plate, ventral view of specimens from: 15, Burma; 16, China, 17, Moluccas; 19, spermatheca; 20, ovipositor, lateral view.

the life span of an adult female, due to oviposition but the absence or presence or indicated presence and placing of these spines is of diagnostic use when coupled with the presence or absence of a concavity and/or accompanying lateral longitudinal ridges on the ventral surface of the plate (Text-figs 25, 26).

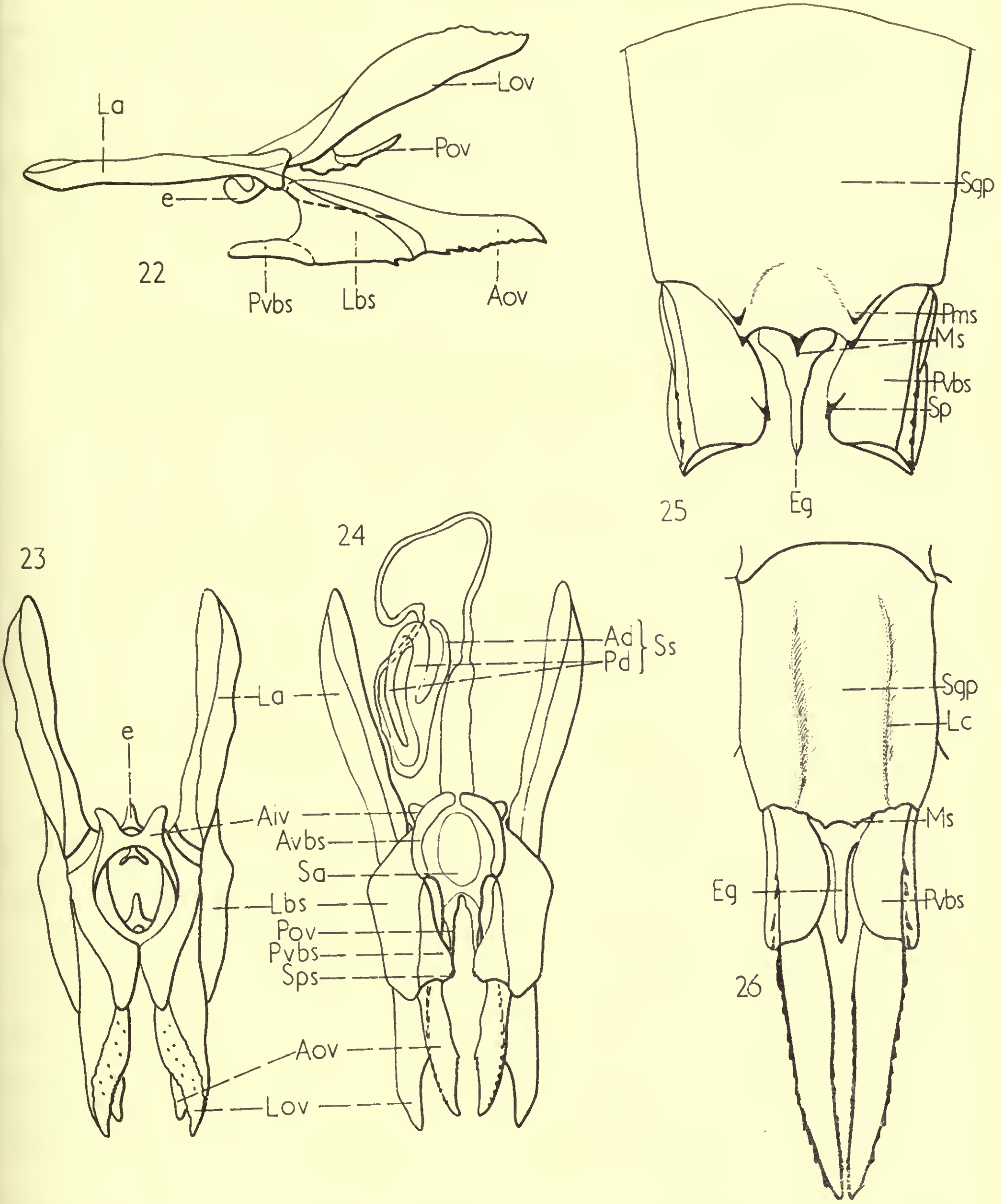
There are two basic types of ovipositor valve in the genus; those with longer, hook-like marginal spines (Text-fig. 20), and those with short, tooth-like marginal spines (Text-fig. 22). The posterior ventral basivalvular sclerite of the ovipositor may be one of three types; the inner ventral margin may have one or two large, tooth-like spines (Text-fig. 25), or a row of small spinelets (Text-fig. 24), or may be completely unarmed (Text-fig. 26).

Mishchenko (*in* Bei-Bienko and Mishchenko, 1951) introduced some characters of the male supra-anal plate and cercus in his key to the species of *Oxya* but placed great emphasis on differences which are here considered to be individual variations. Such general characters of the supra-anal plate as the presence or absence of basi-lateral folds (Text-figs 124, 191), the presence or absence of subapico-lateral tubercles (Text-figs 4, 62, 74) and the general shape or the plate are useful. The cercus seems to vary quite considerably within a given species and in one instance (Text-figs 117–121) is known to vary from acutely pointed to truncate apically. Again however, if considered in general terms, i.e., clearly bifid apically (Text-fig. 216) against truncate or subacute apically (Text-figs 1–3); laterally flattened (Text-fig. 61) against conical, then some diagnostic value is obtained.

The male phallic complex (simplified in Text-figs 5–11) seems to provide the most stable and specifically diagnostic features in the genus. The most readily available characters being in the epiphallus, e.g., its general shape (Text-figs 5, 218, 248), the presence or absence of ancorae (Text-figs 5, 260), and the shape and number of lophi (Text-figs 206, 248). Further characters are found in the ectophallus, e.g., the shape of the posterior process of the cingulum (Text-figs 76, 86, 97), and the shape and position of the lateral fleshy lobes on this projection (Text-figs 142, 153); and the form of the valvular plate of the cingulum (Text-figs 10, 64). In the endophallus the form of the apical penis valves is often useful.

Because of its heterogeneous content not a great deal should be said at this stage on the specific groupings within the genus. However, on the basis of the present study, the following general observations can be made. Using the morphology of the phallic complex and particularly the epiphallus as a guide, *O. bidentata* Willemse, *O. sinobidentata* sp. n. and *O. javana* Willemse form a distinct group, all having a plate-like epiphallus with ancorae and a broad bridge. Similarly *O. paravicina* Willemse and *O. diminuta* (Walker) may be grouped together, as in these two species the epiphallus has ancorae but a narrow bridge and the hind margin of the tenth abdominal tergite bears a pair of short median projections. This leaves a more homogeneous assemblage of species with simple epiphalli without ancorae and their groupings are less well defined.

O. hyla Serville with its tuberculate male supra-anal plate, boot-like outer lophi of the epiphallus, densely spined leading edge of the female tegmen and long spined ovipositor valves, seems quite distinct but has links through *O. fuscovittata* (Mar-



FIGS 22–26. *Oxya* spp. female terminalia. *O. fuscovittata* (Marschall), 22, ovipositor, lateral view; 23, same, dorsal view; 24, same, ventral view; *O. bolaangensis* sp. n. 25, subgenital plate and posterior ventral basivalvular sclerite, ventral view (from dry specimen); *O. grandis* Willemse, 26, subgenital plate and ovipositor, ventral view (from dry specimen). Ad – apical diverticulum of spermatheca; Aiv – anterior intervalvula; Aov – anterior (ventral) ovipositor valve; e – apodeme bearing sclerite; Eg – egg guide; La – lateral apodeme; Lbs – lateral basivalvular sclerite; Lc – lateral longitudinal ridge; Lov – lateral (dorsal) ovipositor valve; Ms – marginal spine; Pd – preapical diverticulum of spermatheca; Pms – premarginal spine; Pov – posterior (inner) ovipositor valve; Pvbs – posterior ventral basivalvular sclerite; Sa – spermathecal aperture; Sgp – subgenital plate; Sp – spine; Sps – spinelet; Ss – spermathecal sac.

schall), its closest relative, *O. minuta* Carl and *O. grandis* Willemse to *O. velox* (Fabricius) and *O. ningpoensis* Chang; the latter two species having an extraordinary development of aedeagal tip. In all these species the posterior ventral basivalvular sclerite of the female ovipositor is not at all or only very weakly spined.

The remaining species, *O. japonica* (Thunberg), *O. nitidula* (Walker), *O. bolaangensis* sp. n., *O. stresemanni* Ramme, *O. agavisa* Tsai, *O. chinensis* (Thunberg) and *O. yezoensis* Shiraki, are grouped together simply as no clearer groupings emerge at present. *O. chinensis* and *O. yezoensis* have similar forms of phallic complex, male supra-anal plate and female subgenital plate; and for similar reasons *O. japonica*, *O. nitidula*, *O. stresemanni* and *O. bolaangensis* could be grouped together; *O. agavisa* appears intermediate between *O. chinensis* and *O. japonica*.

Keys to the Species and Subspecies

Great care should be taken when using the specific identification keys. It was found more practical to key the sexes separately as the females had more obvious external characters. With many species the only reliable diagnostic characters in the male are in the phallic complex but these characters can usually be seen in fresh specimens by pushing down the subgenital plate and examining the exposed phallic complex with a hand lens. Dried specimens have to be relaxed or dissected before these characters can be studied.

At any point in the keys where a species could possibly give difficulty it is keyed out twice, e.g. *O. fuscovittata* and *O. yezoensis*.

Wherever possible figures are referred to with the key characters. These figures were usually drawn after dissection of the relevant part, slight maceration in 10% KOH solution and soaking in distilled water. When this was not possible and the figure was drawn from a dry specimen, this is stated in the figure-legend.

Males

1 Supra-anal plate with a tubercle on each side of a median apical process, making the plate appear weakly trilobate (Text-figs 4, 62) 2

– Supra-anal plate without lateral tubercles (Text-figs 74, 84) 4

2 Cercus laterally compressed, hardly narrowing towards apex, which is weakly bifurcate (Text-fig. 61) . . . . . . **fuscovittata** (Marschall) (p. 289)

– Cercus conical or if compressed then narrowing towards apex, which is obtuse or truncate (Text-figs 1–3) 3

3 Inner tooth-like pair of lophi of epiphallus usually well developed (Text-figs 27–32). Africa, Madagascar, Oriental region west of Indo-Burmese border **hyla hyla** Serville (p. 282)

– Inner tooth-like pair of lophi of epiphallus usually poorly developed (Text-figs 33, 36–40). Oriental region east of Indo-Burmese border **hyla intricata** (Stål) (p. 287)

4 Lower inner area of hind femur and the hind tibia bright red; integument more rugulose, giving matt appearance . . . . . . **diminuta** Walker (p. 336)

– Lower inner area of hind femur ochraceous green; hind tibia bluish green or ochraceous (some populations from Australasian region may be pale orange); integument less rugulose, giving shiny appearance 5

5 Strongly brachypterous species (almost to micropterous condition), tegmina barely touching along mid dorsal line; 10th abdominal tergite with a pair of small rounded projections on the posterior margin on either side of the mid line (Text-fig. 247) **paravicina** Willemse (p. 333)

– Macropterous species, but if brachypterous, then tegmina touching one another for some distance along the mid dorsal line; 10th abdominal tergite without small rounded projections on the posterior margin 6

6 Epiphallus with broad plate-like bridge, ancorae present, lophi lobiform and situated almost at division of bridge (Text-fig. 218); cerci bifurcate with both upper and lower branches conical with subacute apices (Text-fig. 216) 7

– Epiphallus with narrow bridge, without ancorae and with outer pair of hook-like lophi and an inner pair of tooth-like lophi (Text-fig. 206); cercus with subacute (Text-fig. 94), truncate (Text-fig. 121), or weakly bifurcate apex (Text-fig. 106) and if latter then upper branch with rounded apex 9

7 Chinese populations; hind femur orange-brown in apical quarter ***sinobidentata*** sp. n. (p. 330)

– Javan or W. Pakistani populations; hind femur unicolourously green or ochraceous 8

8 Tegmina long, extending well beyond apices of hind femora. W. Pakistan and surrounding area . . . . ***bidentata*** Willemse (p. 328)

– Tegmina shorter, not at all or hardly surpassing apices of hind femora. Java ***javana*** Willemse (p. 333)

9 Valvular plate of cingulum very long, upcurved, rolled almost into a cylinder, with an expanded apex (Text-fig. 99) . . . . . . ***velox*** (Fabricius) (p. 297)

– Valvular plate of cingulum either in the form of a curved plate (Text-figs 88, 89) or short and fleshy (Text-fig. 111) 10

10 Valvular plate of cingulum short and fleshy, with complicated folds (Text-figs 109–112) . . . . ***ningpoensis*** Chang (p. 300)

– Valvular plate of cingulum simple, curved, plate-like (Text-fig. 88) 11

11 Supra-anal plate, when flat, with the apical part lobe-like and extended posteriorly (Text-figs 74, 84), never with basal folds 12

– Supra-anal plate, when flat, triangular or rounded triangular (Text-figs 140, 151), apical part not extended posteriorly, but if so then basal folds clearly present (Text-fig. 124) 13

12 Small species (15·6–19·2 mm); tegmina shortened, not extending beyond 4th abdominal tergite; cercus simple, conical with subacute apex . ***minuta*** Carl (p. 293)

– Large species (over 30 mm); tegmina fully developed and extending beyond apices of hind femora; cercus with bifid apex, upper lobe rounded (Text-fig. 83) ***grandis*** Willemse (p. 294)

13 Cercus with bifid apex (Text-fig. 122). Ceram eastwards to New Hebrides ***japonica vitticollis*** (Blanchard) (p. 307)

– Cercus with rounded, truncate or pointed apex (Text-figs 117–121). West of Ceram except Hawaii 14

14 Supra-anal plate relatively flat, without basilateral folds (Text-fig. 140) . . . 15

– Supra-anal plate with well developed basilateral folds (Text-fig. 151) 17

15 Apical valves of penis very sinuous (Text-fig. 145). Celebes only ***stresemanni*** Ramme (p. 310)

– Apical valves of penis simply curved, not at all sinuous. China, S. E. Russia, Japan 16

16 Apical valves of penis slender; valvular plate of cingulum slender (Text-fig. 177) ***chinensis*** (Thunberg) (p. 322)

– Apical valves of penis stout; valvular plate of cingulum broad (Text-figs 208, 209) ***yezoensis*** Shiraki (p. 326)

17 Posterior process of cingulum (excluding lateral lobes), when viewed from above trapezoid (Text-figs 176, 207) 18

– Posterior process of cingulum (excluding lateral lobes), when viewed from above, rounded triangular (Text-figs 125, 163) 20

18 Apical penis valves relatively large and fleshy (Text-fig. 209); inner pair of lophi or epiphallus relatively large (Text-fig. 206) . . . . ***yezoensis*** Shiraki (p. 326)

– Apical penis valves slender (Text-fig. 186); inner pair of lophi of epiphallus relatively small (Text-fig. 184) 19

19 Brachypterous populations ***agavisa tinkhami*** Uvarov (p. 319)

– Macropterous populations ***agavisa agavisa*** Tsai (p. 317)

20 Posterior process of cingulum divided dorsally in posterior half (Text-fig. 163); inner lophi of epiphallus relatively long and slender (Text-fig. 162) 21

– Posterior process of cingulum not divided dorsally in posterior half (Text-fig. 153); inner lophi of epiphallus relatively short and stubby (Text-fig. 152) ***bolaangensis*** sp. n. (p. 312)

21 Posterior process of cingulum, when viewed from above broadly triangular (Text-fig. 125) 22

– Posterior process of cingulum, when viewed from above, narrowly triangular (Text-fig. 163) ***nitidula*** (Walker) (p. 315)

22 Cercus with truncate or subacute apex (Text-figs 117–121). Populations from Halmahera westwards to Ceylon, Hawaii ***japonica japonica*** (Thunberg) (p. 302)

– Cercus with bifid or strongly truncate apex (Text-fig. 122). Populations from Ceram eastwards to New Hebrides ***japonica vitticollis*** (Blanchard) (p. 307)

Females

1 Anterior margin of tegmen (leading edge) with a dense row of short bristles extending from costal bulge almost to apex of tegmen; ovipositor valves with long teeth, the apical ones curved (Text-fig. 20) 2

– Anterior margin of tegmen only weakly or not at all spined or bristled; valves of ovipositor with short teeth (Text-fig. 22) 4

2 Visible ventral surface of subgenital plate almost completely flat or weakly concave, appearing to widen posteriorly (Text-fig. 70) ***fuscovittata*** (Marschall) (p. 289)

– Visible ventral surface of subgenital plate flat or concave only in median posterior half, not widening posteriorly (Text-figs 12–17) 3

3 Ventral surface of subgenital plate with two longitudinal ridges extending forwards from posterior margin, these ridges often toothed (Text-figs 12–14). Africa, Madagascar, Oriental region west of Indo-Burmese border ***hyla hyla*** Serville (p. 282)

– Ventral surface of subgenital plate without longitudinal ridges or with only slight traces of them apically and they are not at all spined (Text-figs 15–17). Oriental region east of Indo-Burmese border ***hyla intricata*** (Stål) (p. 287)

4 Lower inner area of hind femur and the hind tibia bright red; integument with more rugulose and matt surface; (never from Australasian region) ***diminuta*** Walker (p. 336)

– Lower inner area of hind femur and hind tibia bluish green or ochraceous (in some Australasian populations these areas are orange); integument smooth, shiny 5

5 Posterior ventral basivalvular sclerite of ovipositor without any well defined spines on its lower inner margin (Text-fig. 26) 6

– Posterior ventral basivalvular sclerite of ovipositor with one or two tooth-like spines on its inner ventral margin (Text-fig. 25) 14

6 Brachypterous species 7

– Macropterous species 8

7 Larger species, over 30 mm; ventral surface of subgenital plate without lateral longitudinal carinulae (Text-fig. 256) ***paravicina*** Willemse (p. 333)

– Smaller species, under 26 mm; ventral surface of subgenital plate with lateral longitudinal ridges in posterior half (Text-fig. 80) ***minuta*** Carl (p. 293)

8 Posterior margin of subgenital plate, excluding spines, with triangular ventral profile (Text-fig. 227) 9

– Posterior margin of subgenital plate, excluding spines, transverse (Text-figs 70, 113) 11

9 Tegmen short, not or hardly surpassing apex of hind femur. Java ***javana*** Willemse (p. 333)

– Tegmen longer, clearly surpassing apex of hind femur. China and West Pakistan . 10

10 Hind femur reddish brown subapically. E. China . ***sinobidentata*** sp. n. (p. 330)

– Hind femur unicolourously ochraceous green; West Pakistan and surrounding area ***bidentata*** Willemse (p. 328)

11 Subgenital plate with ventral surface very flat and without lateral longitudinal ridges (Text-fig. 70); anterior margin of tegmen with a few small bristles ***fuscovittata*** (Marschall) (p. 289)

– Ventral surface of subgenital plate with lateral longitudinal ridges bordering a median concavity at least in posterior half (Text-fig. 90); anterior margin of tegmen without trace of bristles 12

12 Tegmen not reaching apex of hind femur; pronotum cylindrical. E. China ***ningpoensis*** Chang (p. 300)

– Tegmen always extending beyond apex of hind femur; pronotum relatively flat. N. India, Upper Burma, W. China 13

13 Median pair of spines on posterior margin of subgenital plate set close together (Text-fig. 90); costal bulge of tegmen well developed . ***grandis*** Willemse (p. 294)

– Median pair of spines on posterior margin of subgenital plate set wider apart (Text-fig. 101); costal bulge of tegmen poorly developed . . ***velox*** (Fabricius) (p. 297)

14 Ventral surface of subgenital plate with a broad median longitudinal groove running from posterior margin at least to visible middle of plate, with a lateral longitudinal ridge on each side (Text-figs 130, 134) 15

– Ventral surface of subgenital plate convex, flat or, at most, with a weak apical concavity (Text-figs 158, 170) 18

15 Subgenital plate with a sharply triangularly profiled posterior margin (Text-fig. 180); interocular distance wider than greatest width of frontal ridge . . . 16

– Posterior margin of subgenital plate (excluding spines) almost transverse (Text-fig. 130); interocular distance not wider than greatest width of frontal ridge . . 17

16 Brachypterous populations . . . . . ***agavisa tinkhami*** Uvarov (p. 319)

– Macropterous populations . . . . . . ***agavisa agavisa*** Tsai (p. 317)

17 Lateral longitudinal ridges on ventral surface of subgenital plate with spines (Text-fig. 134) . . . . ***japonica vitticollis*** (Blanchard) (p. 307)

– Lateral longitudinal ridges on ventral surface of subgenital plate without spines except at apices (Text-fig. 130) . . ***japonica japonica*** (Thunberg) (p. 302)

18 Ventral surface of subgenital plate with a subapical tooth on each side of a median apical spine (Text-fig. 170) . . . . . . ***nitidula*** (Walker) (p. 315)

– Ventral surface of subgenital plate without subapical teeth (Text-fig. 149) . . 19

19 Posterior margin of subgenital plate with a single spine medially (Text-fig. 158) . ***bolaangensis*** sp. n. (p. 312)

– Posterior margin of subgenital plate with a pair of spines medially or no spines at all (Text-figs 149, 198) 20

20 Ventral surface of subgenital plate concave in apical third medially (Text-fig. 149) ***stresemanni*** Ramme (p. 310)

– Ventral surface of subgenital plate completely convex. 21

21 Tegmen not extending beyond apex of hind femur. Japan and Taiwan only ***yezoensis*** Shiraki (p. 326)

– Tegmen extending beyond apex of hind femur but if shorter then not Japanese populations. S. E. Russia, Korea, China and Ryukyu Is. ***chinensis*** (Thunberg) (p. 322)

DESCRIPTIONS OF THE SPECIES AND SUBSPECIES

Oxya hyla Serville, 1831

This species is divided into two subspecies.

Oxya hyla hyla Serville, 1831

(Text-figs 1–11, 12–14, 18, 21, 27–32, 41–46, 54)

Oxya hyla Audinet-Serville, 1831: 287. Syntypes, Senegal and Java (lost). NEOTYPE ♂, Senegal, 'Senegal, Richard-Toll, xi-1967. Museum Paris. Mission IFAN Museum. A. Descarpentries, T. Leye et A. Villiers' (MNHN, Paris), here designated [examined].

Acridium (*Oxya*) *hyla* (Audinet-Serville) Audinet-Serville, 1839: 678, pl. 12, fig. 4.

Heteracris viridivitta Walker, 1870: 662. Holotype ♂, South Africa, 'Dr Smith, S. Afr.' (BMNH) [examined]. [Synonymized by Kirby, 1910: 393.]

Heteracris humeralis Walker, 1870: 662. Holotype ♀, 'Madagascar' (BMNH) [examined]. [Synonymised by Kirby, 1910: 393.]

Oxya serrulata Krauss, 1891: 662, pl. 45, figs 8, A, B. Syntypic series, São Tomé, 'São Thomé, Rolas'. [Synonymized by Kirby, 1910: 393.]

Oxya serrulata Krauss; Brunner von Wattenwyl, 1893: 152.

Oxya serrulata minor Sjöstedt, 1909: 196. LECTOTYPE ♂, Kenya: Kilimanjaro (NR, Stockholm), here designated [examined]. [Synonymised by I. Bolívar, 1918: 15.]

Oxya hyla Audinet-Serville; I. Bolívar, 1918: 15.

Oxya viridivitta (Walker) Willemse, 1925: 38, figs 39–41.

Oxya acuminata Willemse, 1925: 42, figs 42–44. Holotype ♀, India, 'Coll. Br. v. W. Mahé, (Malabar), Emile Deschamps', (NM, Vienna) [examined]. **Syn. n.**

Oxya multidentata Willemse, 1925: 44, figs 45–48. Holotype ♀, 'H. M. Lefroy' [probably India] (BMNH) [examined]. **Syn. n.**

Oxya ebneri Willemse, 1925: 46, figs 49–51. Holotype ♀, India, 'Calcutta, Dr Steiner' (NM Vienna) [examined]. **Syn. n.**

Oxya hyla Audinet-Serville; Johnston, 1956: 252.

Oxya hyla minor Sjöstedt; Johnston, 1956: 252.

Oxya viridivitta (Walker); Chopard, 1958: 128.

Oxya humeralis (Walker) Dirsh, 1962: 309, fig. 19.

Oxya hyla Audinet-Serville; Dirsh, 1963: 211.

This taxon was described originally from an unknown number of specimens from Senegal and Java and it is now known that the syntypic series is lost. In the past (see Synonymy below) there has been some confusion over the application of the name *O. hyla* Audinet-Serville, 1831 and in order to stabilise nomenclature a neotype is erected bearing the data given above.

Diagnosis. ♂. Integument finely pitted, shiny. Antenna slightly longer than head and pronotum together, with about 25 segments. Interocular distance slightly narrower than frontal ridge at median ocellus. Pronotum slightly flattened, hardly narrowing forwards, posterior margin of metazona rounded. Tegmen fully developed. Supra-anal plate (Text-fig. 4) trapezoid with triangular apical projection, at base of this projection, on dorsal surface, on either side there is a small tubercle; cercus conical or compressed laterally (Text-figs 1–3), with subacute or truncate apex. Epiphallus (Text-figs 11, 27–32) with narrow bridge, without ancorae, with curved hook-like outer lophi and usually well developed tooth-like inner lophi; rest of phallic complex as in Text-figs 6–11; apical valves of penis short and stubby, valvular plate of cingulum with a small emargination at apex (Text-figs 41–46).

♀. Larger and more robust than male. Antenna slightly shorter than combined lengths of head and pronotum. Interocular distance as wide as or slightly wider than frontal ridge at median ocellus. Anterior margin of tegmen with a dense row of short bristles. Spermatheca as in Text-fig. 18; valves of ovipositor with hook-like marginal spines (Text-fig. 21); inner ventral margin of posterior ventral basivalvular sclerite with very small spinelets; subgenital plate (Text-figs 12–14) with a pair of median spines on posterior margin, ventral surface with a median longitudinal concavity, which is bordered on each side by a longitudinal ridge bearing short spines.

MEASUREMENTS (mm) – Length of body, ♂ 17·5–27·0, ♀ 22·0–35·7; pronotum, ♂ 3·3–5·7; ♀ 4·3–7·5; tegmen, ♂ 12·5–25·8, ♀ 17·5–31·4; hind femur, ♂ 9·6–15·5, ♀ 11·9–20·6; maximum width of hind femur, ♂ 2·0–3·2, ♀ 2·4–4·3; mean ratio of length of tegmen to pronotum (E/P), ♂ 4·26, ♀ 4·09; mean ratio of length of tegmen to length of hind femur (E/F), ♂ 1·52, ♀ 1·49; mean ratio of hind femoral length to its maximum width (FL/FW), ♂ 4·90, ♀ 4·98.

DISCUSSION. This subspecies has a relatively large geographical range and, coupled with this feature, is tremendously variable in its general size and appearance. The length of the tegmen relative to the pronotum (E/P) is very variable for a fully winged taxon within this genus, the range in a measured random sample of 28 males being 3·56 to 4·82, and in a similar sample of 32 females being 3·40 to 4·84. There is a general tendency for the E/P value to be lower in African populations, with that of the Madagascan populations rather intermediate. The male cercus varies from conical with a subacute to weakly compressed with a truncate apex (Text-figs 1–3), and the posterior margin of the valvular plate of the cingulum varies in its degree of emargination (Text-figs 41–46). In the female subgenital plate the density of spines along the lateral longitudinal ridges is also variable (Text-figs 12–14), with the Madagascan specimens generally being most dense and African specimens least dense.

References to biological and economic literature on this subspecies may be found in Uvarov (1928), Johnston (1956 and 1968), Butani (1961), Descamps and Wintrebert (1966) and Bullen and MacCuaig (1969).

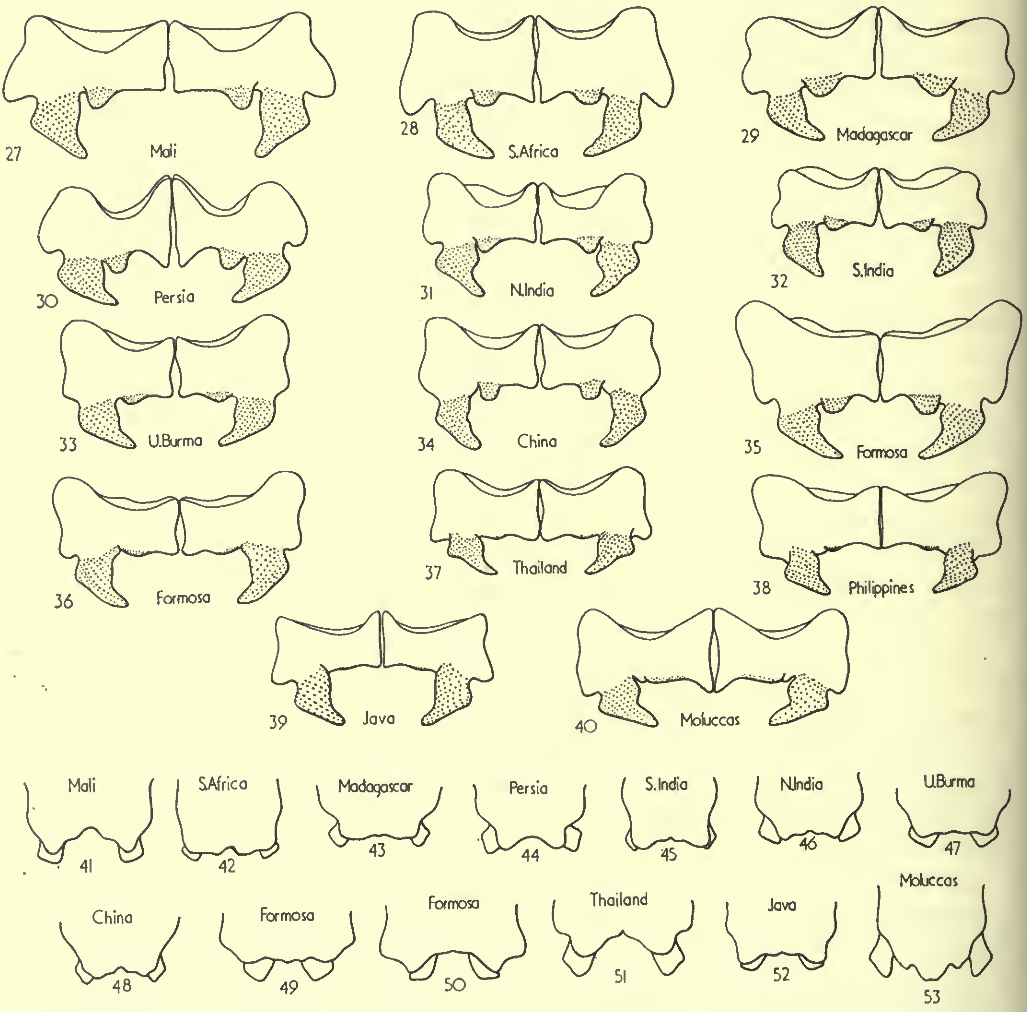
SYNONYMY. Walker's types of *H. viridivitta* and *H. humeralis* both fall well within the range of variation of *O. hyla hyla* as it is understood here and Kirby's synonymy is accepted.

O. serrulata Krauss was described from several specimens of both sexes from 'São Thomé, Rolas'. I have not seen this series but from the original description and drawings and other material from São Tomé it is clear that Kirby's synonymy should be accepted.

The type-series of *O. serrulata minor* Sjöstedt consists of 3 ♂ and 1 ♀ from Kilimanjaro. Sjöstedt did not designate a type from this series but I have examined 1 ♂ and 1 ♀ bearing the data 'Kilimandjaro, Sjöstedt. 1905–6. Kibonoto, 1,000–1,200 m. 1. nov.' The male bears a NR, Stockholm type-label and this specimen is selected as LECTOTYPE. The series is typical of upland populations of *O. hyla hyla* and does not warrant subspecific status.

Willemse (1925) used the Walkerian name *viridivitta* for this species as he was uncertain of the identity of *O. hyla* Serville. However, as Uvarov (1926) pointed out, although Serville obviously included more than one taxon under the name *hyla* this 'did not invalidate the name', and as Willemse included *hyla* in his synonymy of *O. viridivitta* it must become the senior synonym.

Willemse (1925) described *O. acuminata, O. multidentata* and *O. ebneri* from various localities, mostly in India, differentiating them from *hyla* and one another on such characters as the width of the hind femur, eye size, and the degree of reclin-



FIGS 27–53. Epiphalli and penis apices of *Oxya hyla* subspp. *O. h. hyla* Serville, epiphalli from various localities, figs 27–32; dorsal view of posterior apex of valvular plate of cingulum of specimens from various localities, figs 41–46; *O. h. intricata* (Stål), epiphalli of specimens from various localities, figs 33–40; dorsal view of posterior apex of valvular plate of cingulum of specimens from various localities, figs 47–53.

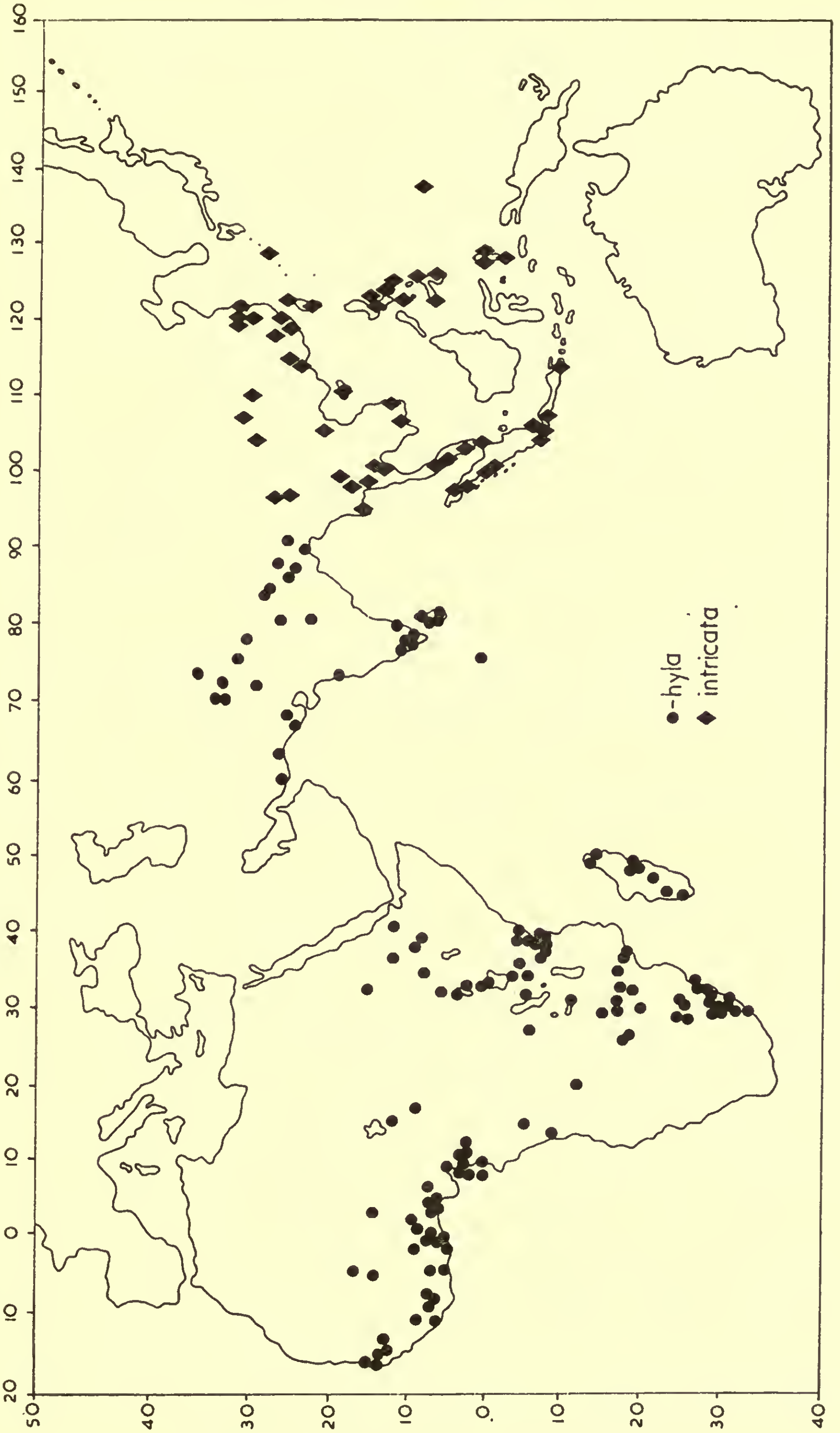


FIG. 54. *Oxya hyla* subspp., distribution map.

ation of the frons. After examination of long series from various localities in Africa, Madagascar, Iran and the Indo-Pakistan region, it seems that these differences merely represent individual morphological variations and the above synonymy is made. Uvarov (1925) has already hinted at the synonymy of *multidentata* with *hyla*. The ♀ paratype of *multidentata* from Stapak, Kuala Lumpur and the two ♀ paratypes of *ebneri* from Singapore are referrable to *O. hyla intricata* (Stål).

Dirsh (1962) used the name *humeralis* for Madagascan populations of this subspecies as he considered that *hyla* was not sufficiently defined and the African populations might represent more than one species. For reasons stated above, the variations found in African populations of *hyla* are not considered to be of morphologically subspecific importance and the Madagascan populations merge very well with the general variation plan of the subspecies.

Chopard (1958) erroneously regarded a specimen from Malabar, mentioned by Serville (1838) and bearing his handwritten label, as the type of *O. hyla* Serville, 1831. He considered this specimen to be a distinct species from African *hyla* (auctt.) and used *viridivitta* for the latter. Dirsh (1963) first pointed out this error of type-designation of *O. hyla*. Serville's specimen (a female), deposited in MNHN, Paris, has been examined and is regarded as conspecific with *O. hyla* Serville in the present context.

Willemse (1925: 41) regarded *Cantantops cyanipes* Karny, 1907 as a junior synonym of *O. viridivitta*, and Dirsh (1956: 107) regarded it as a synonym of *O. hyla*. The male holotype of *Catantops cyanipes* Karny is from 'Uganda, Gondokoro, Marz 1908' and is deposited in NM, Vienna. It is clearly not conspecific with *O. hyla* and is here transferred to the genus *Zulua* as *Zulua cyanipes* (Karny, 1907) **comb. n.**

DISTRIBUTION (Text-fig. 54). Countries and months of capture, from 807 specimens examined.

MALI: February, April, May, July, August, October, November; SENEGAL: January, June, August to November; GAMBIA: no dates; GUINEA: no dates; SIERRA LEONE: June; LIBERIA: March, April, July, September; IVORY COAST: January, March, April, July, October, December; GHANA: July through to May; DAHOMEY: June; NIGER: March, December; NIGERIA: October through to January, March, April, June; CHAD: October; CAMEROUN: January to August, November; FERNANDO PO: no dates; PRINCIPÉ: September, December; SÃO THOMÉ: June September; CENTRAL AFRICAN REPUBLIC: January, June; GABON: August; CONGO (Brazzaville): January, February, November; CONGO (Kinshasa): August to October; SUDAN: October, December; ETHIOPIA: December through to February, May, September; KENYA: March, August; UGANDA: July, September, October, December; TANZANIA: November through to September; MALAWI: April, December; ZAMBIA: March, April, June; ANGOLA: May, June, August; MOZAMBIQUE: July, October; RHODESIA: March to May; SOUTH AFRICA: August through to June; MADAGSACAR: January, February, April, May, July; PERSIA: June; AFGHANISTAN: July to September, November; W. PAKISTAN: July, September to November; NEPAL: January, May, October, December; INDIA: all year round; CEYLON: January to April, July, August, October; MALDIVE IS: May; E. PAKISTAN: October.

Oxya hyla intricata (Stål, 1861) **stat. n.**

(Text-figs 15–17, 19, 20, 33–40, 47–60)

Acridium (*Oxya*) *intricatum* Stål, 1861: 335. LECTOTYPE ♂, West Malaysia, 'Malacca. Kinb.' (NR, Stockholm), here designated [examined].
Oxya intricata (Stål) Stål, 1873: 82.
Oxya intricata (Stål); Brunner von Wattenwyl, 1893: 153, partim.
Oxya intricata (Stål); I. Bolívar, 1918: 16, partim.
Oxya universalis Willemse, 1925: 21, figs 12, 13. Holotype ♀, Taiwan, 'Takao, Formosa, H. Sauter', (NM, Vienna) [examined]. [Synonymized by Uvarov, 1926: 45.]
Oxya insularis Willemse, 1925: 34, figs 32, 33. Holotype ♀, Taiwan, 'Takao, Formosa, H. Sauter' (NM, Vienna) [examined]. [Synonymized by Uvarov, 1926: 45.]
Oxya siamensis Willemse, 1925: 37, figs 36–38. Holotype ♀, Thailand, 'Pachim District, Siam' (BMNH) [examined]. [Synonymized by Willemse, 1955: 149.]
Oxya intricata (Stål); Willemse, 1925: 57, fig. 64.
Oxya siamensis Willemse; Uvarov, 1926: 46.
Oxya intricata (Stål); Uvarov, 1928: 317, fig. 115, I, A.
Oxya intricata (Stål); Willemse, 1930: 122, figs 60, 61.
Oxya intricata (Stål); Willemse, 1931: 238.
Oxya intricata (Stål); Chang, 1934: 186.
Oxya intricata (Stål); Tinkham, 1940: 294.
Oxya moluccensis Ramme, 1941: 214. Holotype ♀, Maluku, 'Halmaheira, Gamkonora, 4 u. 5. 1931, G. Heinrich' (NMHU, Berlin) [examined]. **Syn. n.**
Oxya intricata (Stål); Mishchenko, 1951: 168, partim, figs 302, 304, 306.
[*Oxya rammei* Tsai; Mishchenko, 1951: 168, partim, figs 305, 308. Misidentification.]
Oxya intricata (Stål): Mishchenko, 1952: 158, partim, figs 226, 237, 239, 241.
[*Oxya rammei* Tsai; Mishchenko, 1952: 160, partim, figs 240, 243. Misidentification.]
Oxya intricata (Stål); Willemse, 1955: 149.
[*Oxya acuminata* Willemse; Willemse, 1955: 151, partim. Misidentification.]
[*Oxya multidentata* Willemse; Willemse, 1955: 152, partim. Misidentification.]
[*Oxya ebneri* Willemse; Willemse, 1955: 152. Misidentification.]
Oxya moluccensis Ramme; Willemse, 1955: 148.
Oxya intricata (Stål); Pemberton, 1963: 679.
Oxya intricata (Stål); Fukuhara, 1966: 202.
Oxya intricata (Stål): Yunus, 1967: 632.
Oxya intricata (Stål); Bullen and MacQuaig, 1969: 398.

This taxon was based on several specimens of both sexes from Java, Malacca, Singapore and Hong Kong. The 'Malacca' specimen bears a label in Stål's handwriting '*intricatum* Stål' and an NR, Stockholm type label, and is selected as the lectotype. Also in NR, Stockholm there is a male specimen labelled 'China. Kinb.' with both wings set and its measurements agree with those given by Stål; and yet another male labelled 'Java. Kinb.'; both these specimens are regarded here as paralectotypes of *Acridium* (*Oxya*) *intricatum* Stål, 1861.

Diagnosis. ♂. Differs from nominate subspecies in that inner lophi of epiphallus are normally poorly developed or almost absent. (Text-figs 33, 36–40).

♀. Differs from nominate subspecies in that ventral surface of subgenital plate is without longitudinal ridges or with only slight traces of them apically, and they are not at all spined except at most posterior apex (Text-figs 15–17).

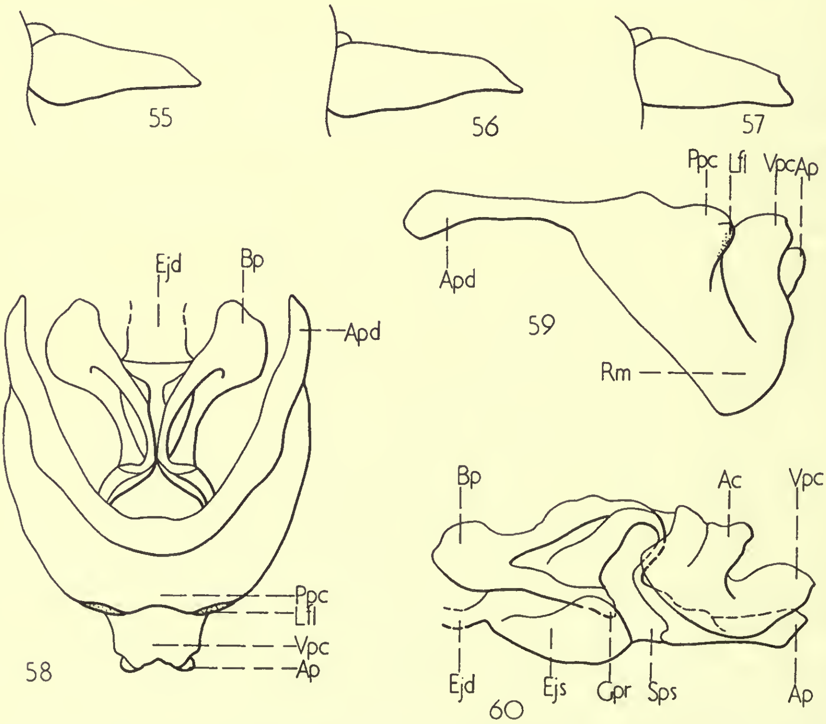
Measurements (mm) – Length of body, ♂ 17·9–24·2, ♀ 24·9–29·9; pronotum, ♂ 3·5–5·1, ♀ 4·9–6·2; tegmen, ♂ 14·0–21·1, ♀ 19·5–25·4; hind femur, ♂ 10·0–13·8, ♀ 13·5–17·1; maximum

width of hind femur, ♂ 2·0–2·7, ♀ 2·6–3·3; mean ratio of length of tegmen to pronotum (E/P), ♂ 4·15, ♀ 4·04; mean ratio of length of tegmen to hind femur (E/F), ♀ 1·46, ♀ 1·44; mean ratio of hind femoral length to maximum width (FL/FW), ♂ 4·91, ♀ 5·05.

DISCUSSION. As with the nominate subspecies, *O. hyla intricata* is very widely distributed and is very variable in size, relative length of tegmen, degree of emargination of the posterior margin of the valvular plate of the cingulum, and the degree of development of the lateral longitudinal ridges on the ventral surface of the subgenital plate.

It must be stressed that the division of *O. hyla* into two subspecies is arbitrary and the geographical line of demarcation, i.e., the Indo-Burmese border, rather more practical than real. As can be seen from Text-figs 27–40, the epiphallic character used to separate the two taxa in the male is not particularly good as the *hyla hyla* type appears in the *hyla intricata* range, but so far the converse has not been observed. The female subgenital plate character is rather more reliable.

It is possible that the *hyla – intricata* complex represents a superspecies or a sibling species-group or reticulum and some statistical work, coupled with obser-



FIGS 55–60. *Oxya hyla intricata* (Stål), male terminalia and genitalia; 55, cercus, lateral view, of specimen from Philippines; 56, same, from Moluccas; 57, same, from China; 58, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 59, cingulum, lateral view; 60, endophallus, lateral view.

vations on behaviour, cytological studies and breeding experiments, will have to be carried out before the problem is clarified.

Synonymy. Uvarov (1926) synonymized *O. universalis* Willemse and *O. insularis* Willemse with *O. intricata* (Stål). After examining Willemse's and Stål's type-material and a mass of material from S. E. Asia this synonymy is accepted. The female paratype of *insularis* labelled 'Ceylon; Vega exp.' and deposited in NR, Stockholm, is referred to *O. hyla hyla*. Uvarov (1926) also expressed doubts about the validity of *O. siamensis* Willemse and later Willemse (1955) formally synonymized this species with *intricata*.

The female paratype of *O. rammei* Tsai labelled 'China, Canton, Lien-cao, 29. 7·12, Mell S.V.' (MNHU, Berlin) is referred to *O. hyla intricata*. This specimen was badly damaged in postal transit from Berlin.

The type-series of *O. moluccensis* Ramme consists of the male holotype and four male and four female paratypes from Halmahera. (The holotype and one female paratype were also badly damaged in postal transit from Berlin.) After examination of the holotype and a male and two female paratypes, together with material from neighbouring islands it is clear that, morphologically, *moluccensis* represents the extreme south-eastern populations of *hyla intricata* and the above synonymy is made. The complete reduction of the inner lophi of the epiphallus and ventral longitudinal ridges of the female subgenital plate are culminations of observable trends as the subspecies extends eastwards.

Distribution (Text-fig. 54). Countries and months of capture from 337 specimens examined.

Burma: November through to January, May, June; China: March, May to December; Taiwan: March; Ryuku Is: November; Thailand: March to August, October, November; Vietnam: September; West Malaysia: April through to February; Singapore: May, July, August, October, December; Sumatra: November through to April, July to September; Java: June; Krakatau: November; Philippines all year round; Palaus Is: March. (Significantly absent from Borneo and Celebes.)

Oxya fuscovittata (Marschall, 1836)

(Text-figs 22–24, 61–72)

Gryllus fuscovittatus Marschall, 1836: 211, pl. 18, fig. 3. Holotype ♀, no data [probably N.W. India] (NM, Vienna) [examined].

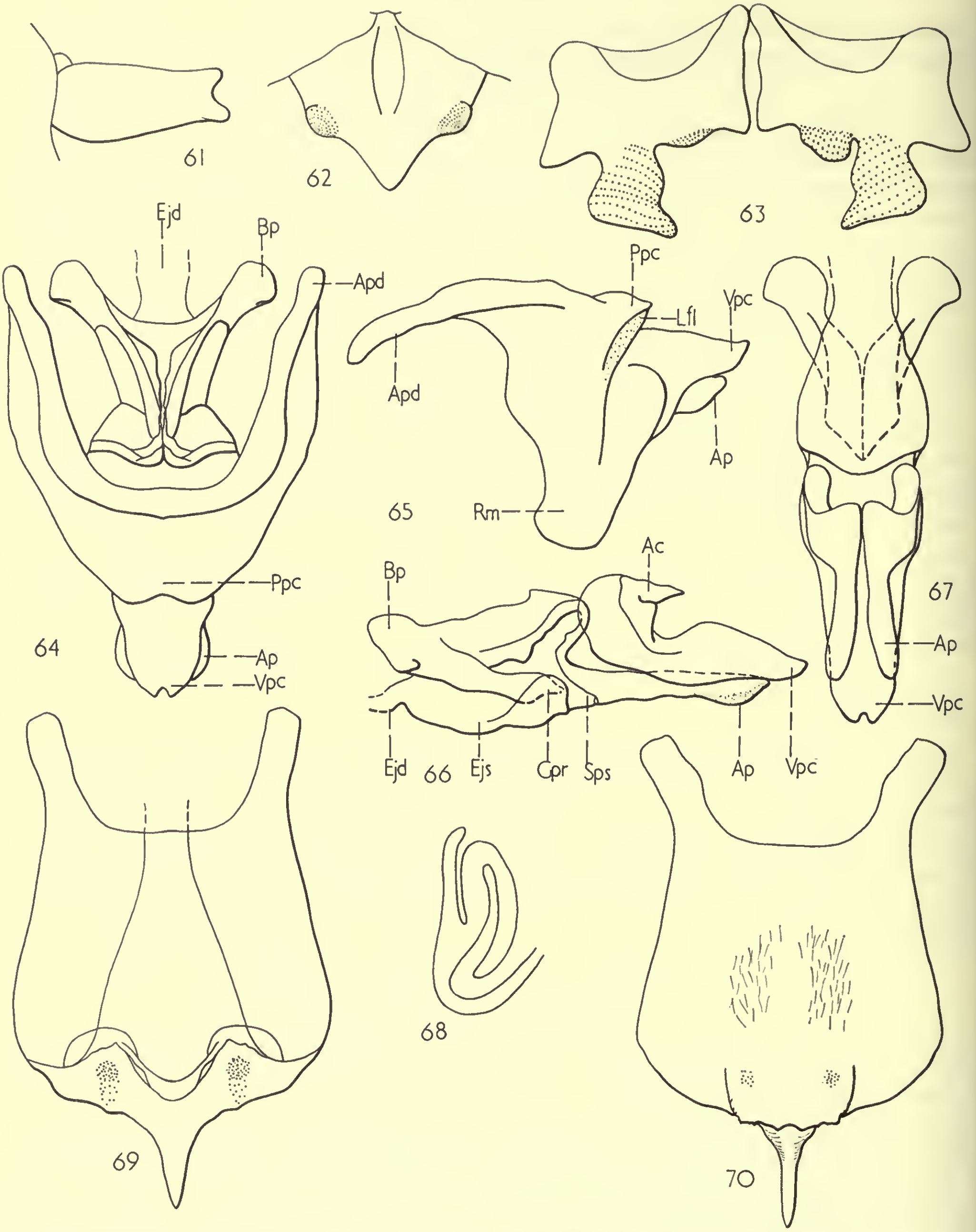
Gryllus fuscovittatus Marschall; Kirby, 1910: 586

Oxya turanica Uvarov, 1912: 28. 3 ♂ and 3 ♀ syntypes, U.S.S.R., 'Transcaspia: Farab ad fl. Amu-Darja, 20–26. viii. 1911 (A. Holbeck leg).' (ZI, Leningrad or Zoological Museum of the Moscow University.) [Synonymized by Willemse, 1925: 23].

Oxya turanica Uvarov; I. Bolívar, 1918: 17.

Oxya oryzivora Willemse, 1925: 25, figs 18, 19. Holotype ♀, India, 'Godwari Dist. Samalcot, on paddy, 10/29. xi. 1921, Y. R. Rao coll.' (BMNH), [examined]. **Syn. n.**

Oxya uvarovi Willemse, 1925: 27, figs 23–25. Holotype ♂, Pakistan (West), 'N.W. India: Peshawar Distr., Taru, 17–21.x.1914, on sugar cane, Fletcher coll.' (BMNH), [examined]. **Syn. n.**



FIGS 61–70. *Oxya fuscovittata* (Marschall), terminalia and genitalia; male, 61, cercus, lateral view; 62, supra-anal plate, dorsal view; 63, epiphallus; 64, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 65, cingulum, lateral view; 66, endophallus, lateral view; 67, same, ventral view; female, 68, spermatheca; 69, subgenital plate, dorsal view; 70, same, ventral view.

Oxya uvarovi f. *brachyptera* Willemse, 1925: 29.
Oxya fuscovittata (Marschall) Uvarov, 1926: 46.
Oxya uvarovi Willemse; Uvarov, 1926: 47.
Oxya fuscovittata (Marschall); Mishchenko, 1951: 164, figs 274, 277.
Oxya fuscovittata (Marschall); Mishchenko, 1952: 148, figs 209, 212.
Oxya uvarovi Willemse; Bullen and MacQuaig, 1969: 398.
Oxya fuscovittata (Marschall); Tandon and Shishodia, 1969: 266.

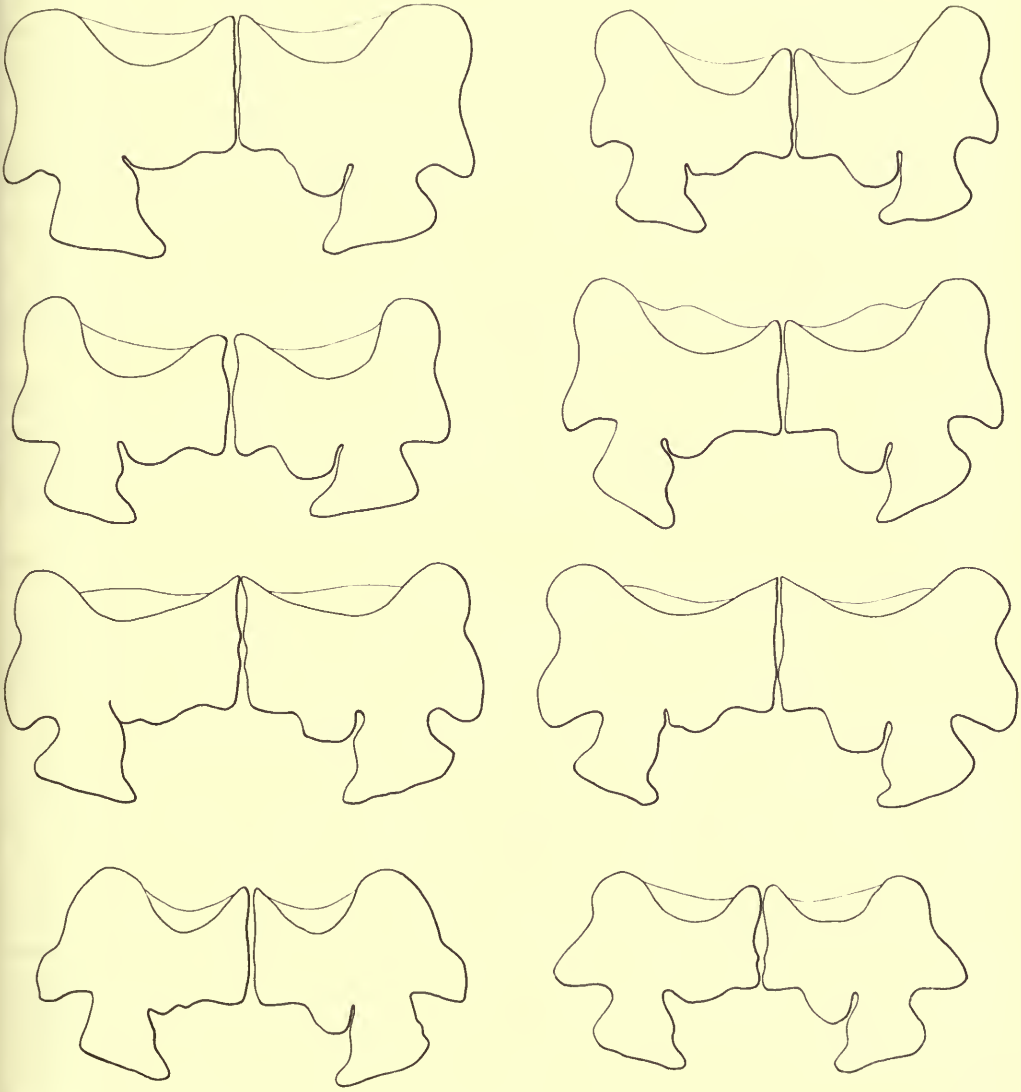


FIG. 71. *Oxya fuscovittata* (Marschall), silhouettes of epiphalli from random sample showing variations in shape of inner lophi.

Diagnosis. ♂. Integument finely pitted and shiny. Antenna with 26–28 segments, as long as or slightly longer than the combined lengths of head and pronotum, interocular distance slightly narrower than frontal ridge at median ocellus. Pronotum with dorsum flattened, parallel-sided. Tegmen fully developed. Supra-anal plate (Text-fig 62) similar to that of *O. hyla* but the lateral tubercles are more pronounced and the posterior lobe slightly less developed; cercus (Text-fig. 61) strongly compressed, hardly or not at all narrowing apically, apex strongly truncate or almost bifid. Epiphallus (Text-figs 63, 71) with narrow bridge, without ancorae, and with boot-shaped outer lophi and tooth-like lophi; of the latter the left lophus is always less developed than the right (Text-fig. 71). Rest of phallic complex as in Text-figs 64–67; lateral fleshy lobes not visible from above, valvular plate of cingulum with shallow but well defined emargination, apical valves of penis of moderate length and thickness.

♀. Larger and more robust than male. Antenna slightly shorter than combined lengths of head and pronotum. Interocular distance slightly wider than frontal ridge at median ocellus. Anterior margin of tegmen weakly spined. Spermatheca as in Text-fig. 68. Valves of ovipositor (Text-figs 22–24) with tooth-like marginal spines; posterior ventral basivascular sclerite with small spines on inner ventral margin (Text-fig. 24); subgenital plate (Text-figs 69, 70) with very broadly flattened ventral surface; posterior margin emarginates medially, straight, or with two very small medial spines.

Measurements (mm) – Length of body, ♂ 17·0–26·9, ♀ 22·1–35·1; pronotum, ♂ 3·7–5·8, ♀ 4·5–7·4; tegmen, ♂ 15·2–21·4, ♀ 12·6–28·0; hind femur, ♀ 10·3–15·3, ♀ 13·5–20·2; maximum width of hind femur, ♀ 2·2–3·3, ♂ 2·6–4·0; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·18, ♀ 3·43; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·44, ♀ 1·31; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·63, ♀ 4·73.

Discussion. The form of the ♂ supra-anal plate, cercus and phallic complex, and the ♀ tegmen, subgenital plate and ovipositor suggest this species is very close to the *hyla-intricata* complex. It may be distinguished from *O. hyla* by the extremely broad male cercus and the short, tooth-like spine on the valves of the female ovipositor.

Biological and economic references to this species may be found in Mishchenko (1951 and 1952) and Bullen and MacQuaig (1969).

Synonymy. Willemse (1925) synonymized *O. turanica* Uvarov with *O. fuscovittata* and Uvarov (1926) agreed with this synonymy. I have not seen Uvarov's type-series but, from the literature and the specimens identified as *O. turanica* by Uvarov in the BMNH, it is clear that Willemse's synonymy should be accepted.

After examination of further material from South and North India and Afghanistan, it seems that the characters used by both Willemse (1925) and Uvarov (1926) to separate *O. oryzivora* and *O. fuscovittata*, i.e. respectively, the degree of serration of the anterior margin of the female tegmen, and the form of the female subgenital plate, are not valid, and the above synonymy is made.

O. uvarovi Willemse was described from a male holotype from W. Pakistan and further paratypes from various localities in N. E. and N. W. India, and Mauritius. I have not examined this last specimen but in all probability it is not conspecific with the type and should be identified as *O. hyla*. Uvarov (1926) expressed doubts about the validity of *O. uvarovi* and it is now confirmed as a synonym of O. *fuscovittata*.

Distribution (Text-fig. 72). Countries and months of capture from 52 specimens examined.

USSR (South-West): July, September; AFGHANISTAN: September, October; KASHMIR: July, September; W. PAKISTAN: September, October; INDIA: July through to January, April.

Oxya minuta Carl, 1916
(Text-figs 72–82)

Oxya minuta Carl, 1916: 472. LECTOTYPE ♂, JAVA, 'Zehntner, Java' (MNH, Geneva), here designated [examined].
Oxya minuta Carl; Willemse, 1925: 16, figs 4, 5.
Oxya minuta Carl; Kalshoven and Van der Vecht, 1950: 108.
Oxya minuta Carl; Willemse, 1955: 147.

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna with 24 segments, shorter than combined lengths of head and pronotum. Interocular distance of the same width as the frontal ridge at median ocellus. Dorsum of pronotum slightly flattened, with almost parallel sides, posterior margin of metazona rounded. Tegmina shortened, hardly reaching middle of abdomen but touching each other along dorsal mid line. Supra-anal plate (Text-fig. 74) with a

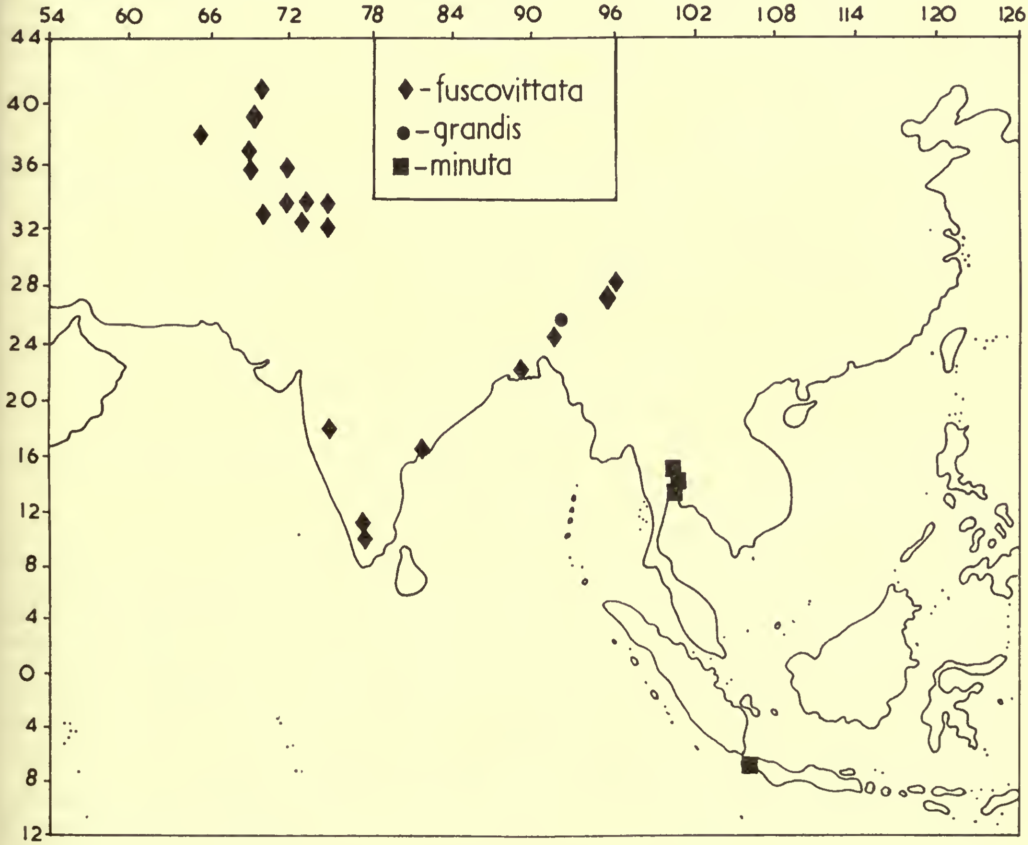


FIG. 72. *Oxya* spp., distribution map.

triangular apical lobe; cercus (Text-fig. 73) subconical, with rounded apex, Epiphallus (Text-fig. 75) with narrow bridge, without ancorae, with boot-shaped outer lophi and large, tooth-like inner lophi, rest of phallic complex as in Text-figs 76–78; lateral fleshy lobes large and visible from above, valvular plate of cingulum without posterior emargination, apical valves of penis of moderate length.

♀. Larger and more robust than ♂. Antenna slightly shorter. Interocular distance wider than frontal ridge at median ocellus. Anterior margin of tegmen without spines. Spermatheca as in Text-fig. 79; valves of ovipositor (Text-fig. 82) with tooth-like spines, posterior ventral basivascular sclerite without spines on inner ventral margin, ventral surface of subgenital plate (Text-fig. 80) with very weak, short, lateral longitudinal ridges in apical third, median pair of spines on posterior margin fairly widely spaced apart.

MEASUREMENTS (mm) – Length of body, ♂ 15·6–19·2, ♀ 19·4–25·40; pronotum, ♂ 3·3–4·4, ♀ 4·2–5·8; tegmen, ♂ 4·7–6·9, ♀ 5·8–7·6; hind femur, ♂ 9·4–12·0, ♀ 11·8–14·5; maximum width of hind femur, ♂ 2·2–2·5, ♀ 2·5–3·1; mean ratio of length of tegmen to pronotum (E/P), ♂ 1·42, ♀ 1·37; mean ratio of length of tegmen to hind femur (E/F), ♂ 0·52, ♀ 0·49; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·49, ♀ 4·64.

DISCUSSION. The form of the male phallic complex and trilobate supra-anal plate and the female ovipositor suggest this species is related to *O. fuscovittata* (Marschall) but it is easily distinguished by its small size, short tegmina and bluish green hind tibia. It could be confused with *O. diminuta* Walker but the latter species has bright red hind tibia.

Biological and economic references to this species may be found in Kalshoven and Van der Vecht (1950).

DISTRIBUTION (Text-fig. 72). Countries and months of capture, from 24 specimens examined.

THAILAND; June, July, September; JAVA: January.

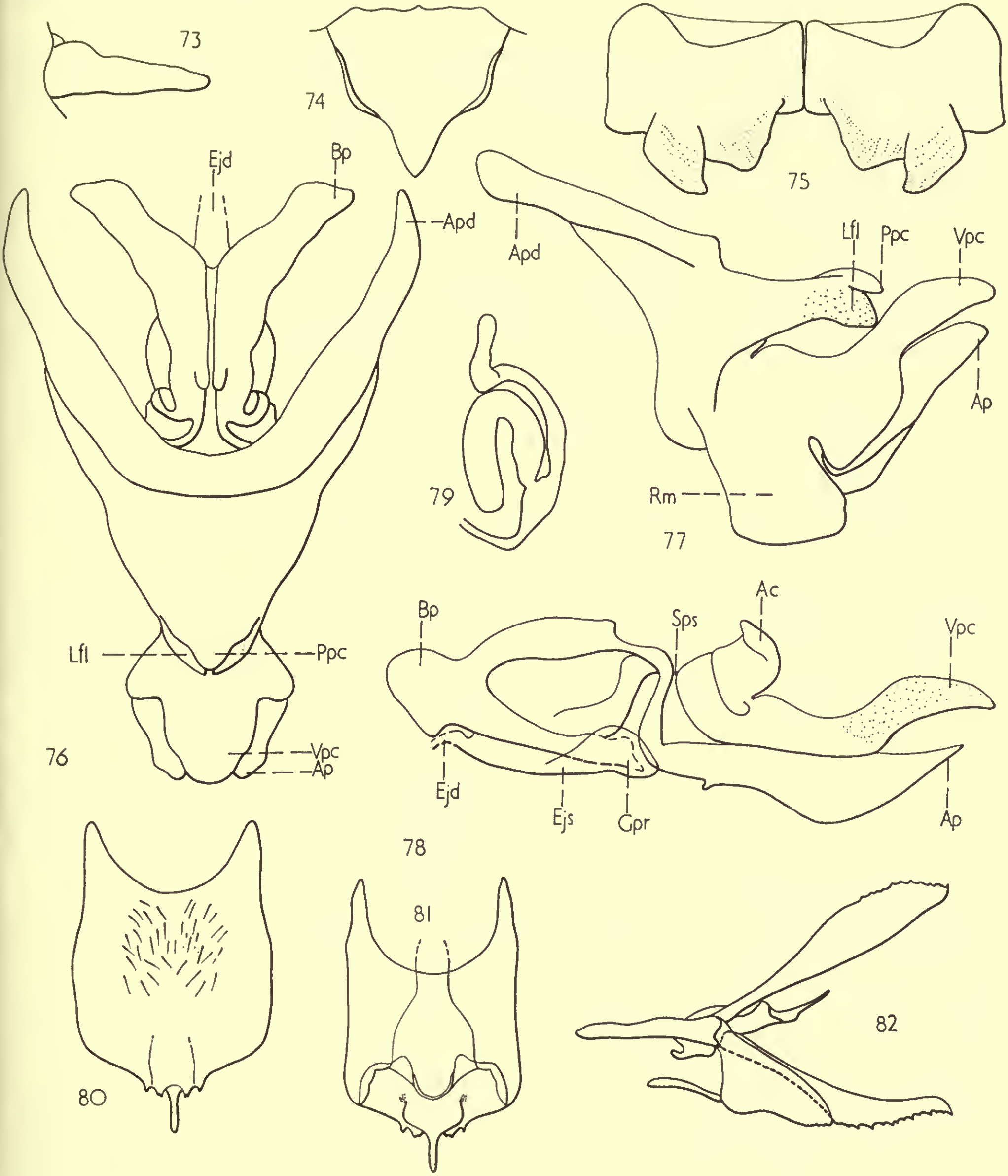
Oxya grandis Willemse, 1925

(Text figs 26, 72, 83–93)

Oxya grandis Willemse, 1925: 36, figs 34, 35. Holotype ♂, INDIA, 'Brahmaputra River, Goal undo-Gauhati, July, 1919, Fletcher'. (BMNH) [examined].
Oxya grandis grandis Willemse; Chang, 1934: 192.

DIAGNOSIS. ♂. Large species. Integument finely pitted and shiny. Antenna with 26 segments, longer than combined lengths of head and pronotum. Interocular distance narrower than frontal ridge at median ocellus. Dorsum of pronotum flattened, with parallel sides; posterior margin of metazona obtuse-angular. Tegmen fully developed. Supra-anal plate (Text-fig. 84) with broadly triangular posterior lobe; cercus (Text-fig. 83) with bifurcate apex, the upper lobe rounded. Epiphallus (Text-fig. 85) with narrow bridge, without ancorae, with hook-like outer lophi and broad, tooth-like inner lophi; rest of phallic complex as in Text-figs 86–89; lateral fleshy lobes small, not visible from above, valvular plate of cingulum with narrow but deep posterior emargination; apical valves of penis fairly long, narrow.

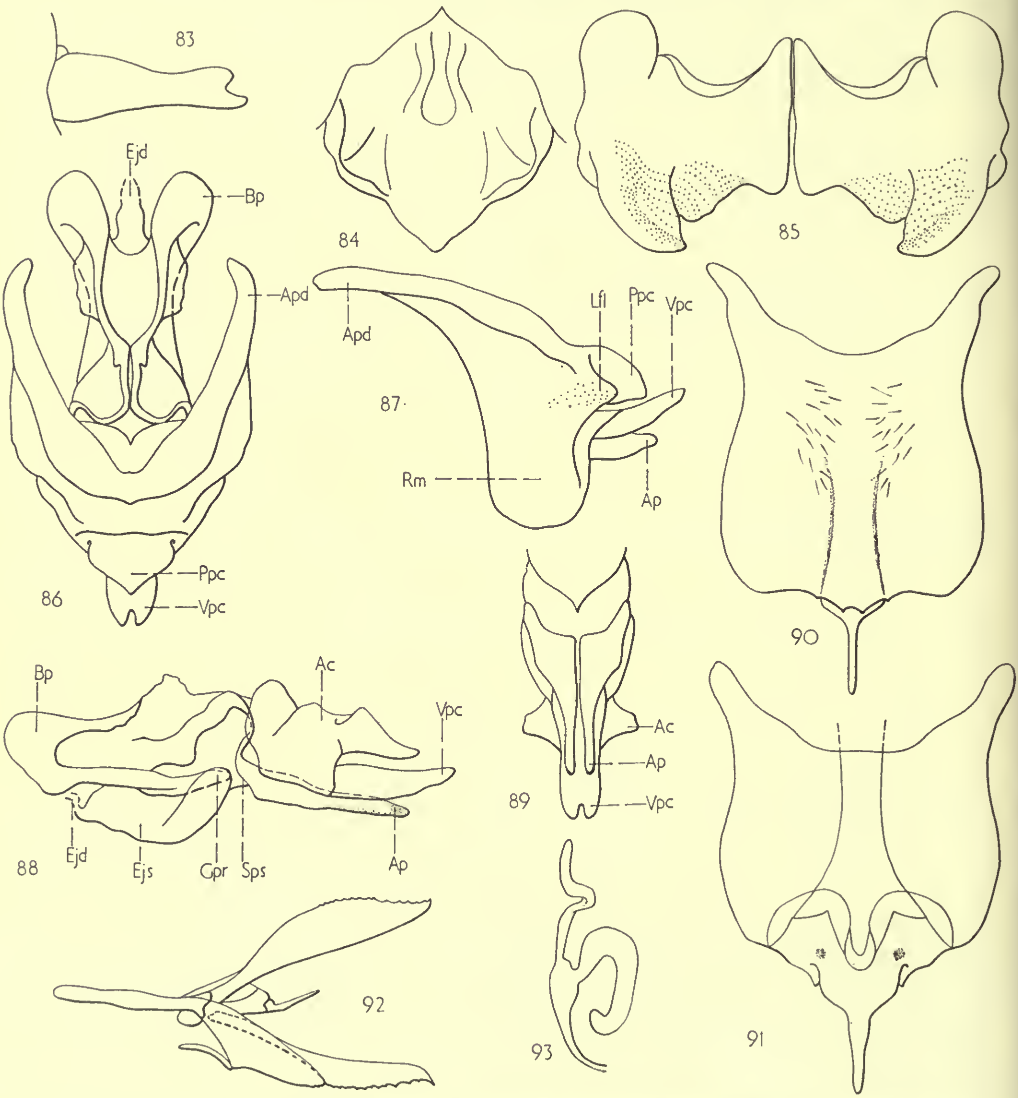
♀. Larger and more robust than ♂. Antenna only as long as combined lengths of head and pronotum. Interocular distance as wide as frontal ridge at median ocellus. Anterior margin of tegmen without spines. Spermatheca as in Text-fig. 93; valves of ovipositor (Text-fig. 92) with tooth-like spines; posterior ventral basivascular sclerite without spines on inner ventral



Figs 73–82. *Oxya minuta* Carl, terminalia and genitalia; male, 73, cercus, lateral view; 74, supra-anal plate, dorsal view; 75, epiphallus; 76, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 77, cingulum, lateral view; 78, endophallus, lateral view; female, 79, spermatheca; 80, subgenital plate, ventral view; 81, same, dorsal view; 82, ovipositor, lateral view.

margin; ventral surface of subgenital plate (Text-fig. 90) with a long median concavity bordered on each side by a well developed lateral longitudinal ridge, posterior margin with a pair of small, closely spaced median spines.

MEASUREMENTS (mm) – Length of body, ♂ 37·3, ♀ 37·5; pronotum, ♂ 6·6, ♀ 8·1; tegmen, ♂ 29·5, ♀ 33·9; hind femur, ♂ 19·7, ♀ 22·3; ratio of length of tegmen to pronotum (E/P), ♂ 4·47,



FIGS 83–93. *Oxya grandis* Willemse, terminalia and genitalia; male, 83, cercus, lateral view; 84, supra-anal plate, dorsal view; 85, epiphallus; 86, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 87, cingulum, lateral view; 88, endophallus, lateral view; 89, apex of penis, ventral view; female, 90, subgenital plate, ventral view; 91, same, dorsal view; 92, ovipositor, lateral view; 93, spermatheca.

♀ 4·19; ratio of length of tegmen to hind femur (E/F), ♂ 1·49, ♀ 1·52; ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·69, ♀ 4·96.

DISCUSSION. *O. grandis* Willemse has not been recorded since its original description and seems to be rare. It is recognizeable by its large size, the structure of the male supra-anal plate, cercus and phallic complex, and the female subgenital plate. The lobate male supra-anal plate and the form of the phallic complex would suggest a close relationship between this species and *O. fuscovittata* and the *hyla-intricata* complex, while the female ovipositor and subgenital plate are similar in structure to those of *O. velox*.

SYNONYMY. Chang (1934) divided this taxon into two subspecies when he described *O. grandis ningpoensis* from Ningpo, China. As mentioned below, *O. ningpoensis* Chang is regarded here as a distinct species and *O. grandis* may now revert to being a monotypic species.

DISTRIBUTION (Text-fig. 72). Known only from the type-series.

Oxya velox (Fabricius, 1787)

(Text-figs 94–105)

Gryllus velox Fabricius, 1787: 239. LECTOTYPE ♀, 'China' (UZM, Copenhagen), here designated [examined].

Gryllus squalidus Marschall, 1836: 213, pl. 18, fig. 5. Holotype ♂, probably N. INDIA [not Brazil as stated by Marschall] (NM, Vienna) [examined]. **Syn. n.**

Heteracris apta Walker, 1870: 666. Holotype ♀, INDIA, 'a. Silhet' (BMNH) [examined]. **Syn. n.**

Oxya velox (Fabricus) Kirby, 1910: 393, partim.

Gryllus squalidus Marschall; Kirby, 1910: 586.

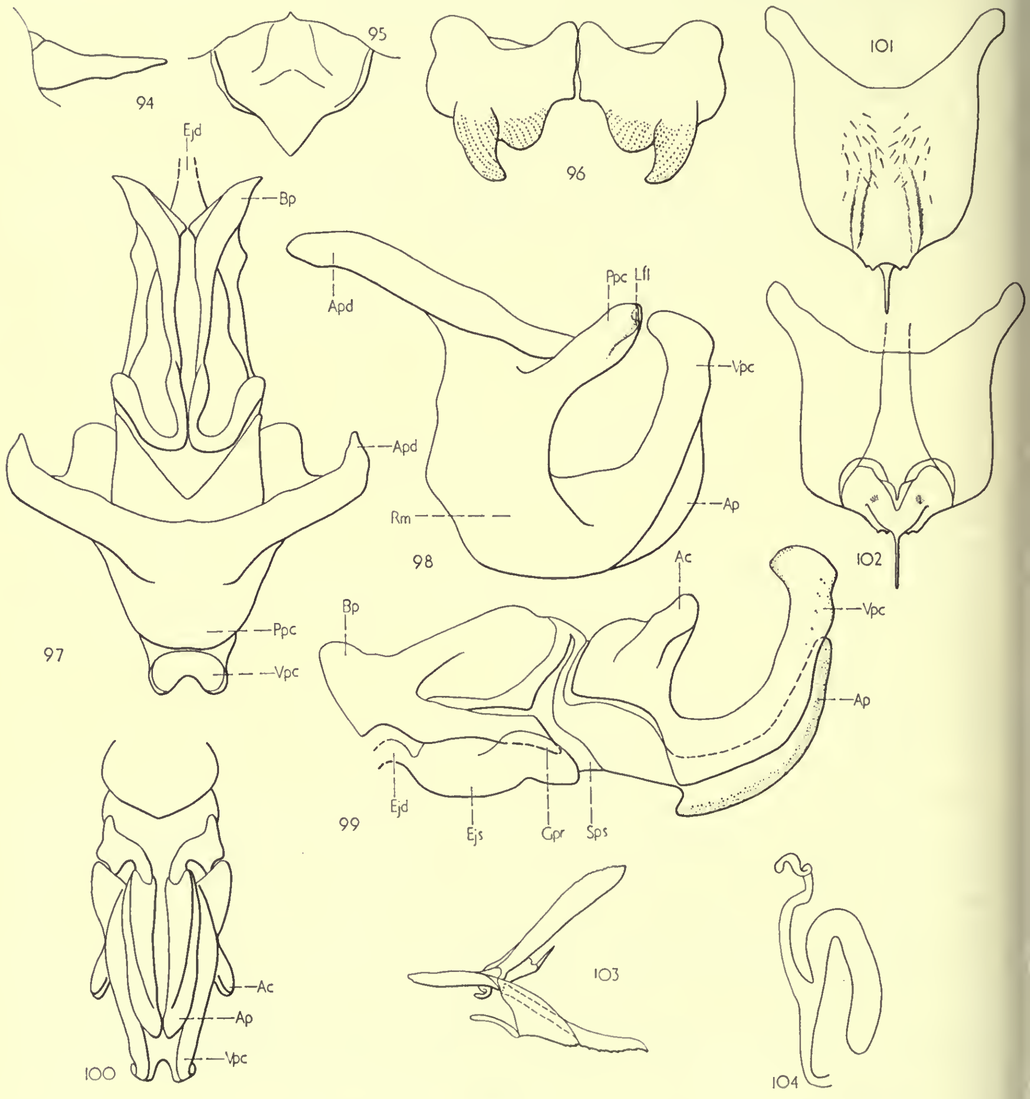
Oxya velox (Fabricius); Kirby, 1914: 199, fig. 116, partim.

Oxya squalida (Marschall) Willemse, 1925: 58, fig. 65.

TYPE-DATA. Zimsen (1964) in her discussion of Fabricius's type-material states, for *Gryllus velox* 'Copenhagen, 3 specimens'. I have received two specimens a male and female, from UZM, Copenhagen. The female bears the following labels: a small green square; a red label with the word 'Type' handwritten on it; a buff label bearing the handwritten data 'China Pflug Mus. Sch. e T.L.'; and lastly a label in C. Willemse's handwriting '*Oxya velox* Fabr. (= *vicina* Br. v. W.)' and in another hand 'C. Willemse det'. The male bears a small green label; a red label with the handwritten word 'Type'; and a buff label with the handwritten legend 'China Pflug Mus. S. and T.L. *Gryllus velox* F.' It seems that both these specimens are part of Fabricius's type-series as they agree with his data 'Habitat in China D. Pflug', and as Willemse obviously regarded the female as the type I am formally designating this specimen as the LECTOTYPE of *Gryllus velox* Fabricius. The male specimen I have examined is not the same species and is identified as *Oxya hyla intricata* (Stål).

It is interesting to note that Willemse (1955) in his discussion of *O. velox* (here =

O. chinensis) mentions under type-data 'China, probably lost'. The reason for this statement is obscure as he clearly saw the type-material before publication of his revision of the genus (1925).



FIGS 94–104. *Oxya velox* (Fabricius), terminalia and genitalia; male, 94, cercus, lateral view; 95, supra-anal plate, dorsal view; 96, epiphallus; 97, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 98, cingulum, lateral view; 99, endophallus, lateral view; 100, apex of penis, ventral view; female, 101, subgenital plate, ventral view; 102, same, dorsal view; 103, ovipositor, lateral view; 104, spermatheca.

Diagnosis. ♂. Integument finely pitted and shiny. Antenna with 22–26 segments, as long as combined lengths of head and pronotum. Interocular distance as wide as frontal ridge at median ocellus. Dorsum of pronotum slightly flattened and slightly narrowing forwards, posterior margin of metazona widely obtuse-angular. Tegmen fully developed. Supra-anal plate (Text-fig. 95) with rounded triangular posterior projection; cercus (Text-fig. 94) conical, with subacute apex. Epiphallus (Text-fig. 96) with narrow bridge, without ancorae, with hook-like outer lophi and large, tooth-like inner lophi; rest of phallic complex as in Text-figs 97–100; lateral fleshy lobes small, not visible from above; valvular plate of cingulum very large, upcurved and rolled almost into a cylinder, apex enlarged; apical valves of penis long, slender, upcurved, almost completely enclosed within the valvular plate of cingulum.

♀. Larger and more robust than ♂. Antenna shorter than combined lengths of head and pronotum. Interocular distance wider than frontal ridge at median ocellus. Tegmen weakly spined. Spermatheca as in Text-fig. 104; valves of ovipositor (Text-fig. 103) with tooth-like spines; posterior ventral basivalvular sclerite without spines on inner ventral margin; ventral surface of subgenital plate (Text-fig. 101) in posterior half with a median longitudinal concavity bordered on each side by a lateral longitudinal ridge; median pair of spines on posterior margin widely spaced.

Measurements (mm) – Length of body, ♂ 17·8–26·3, ♀ 22·9–29·6; pronotum, ♂ 3·7–5·7, ♀ 5·2–6·7; tegmen, ♂ 14·3–22·6, ♀ 16·6–27·2; hind femur, ♂ 10·3–15·5, ♀ 14·8–18·8; maximum width of hind femur, ♂ 2·3–3·3, ♀ 3·0–3·8; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·90, ♀ 3·65; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·37, ♀ 1·33; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·74, ♀ 4·85.

Discussion. When Willemse (1925) examined the type of *Gryllus velox* Fabricius he clearly misinterpreted the characters on the female subgenital plate and ovipositor and referred it to the species regarded here as *O. chinensis* (Thunberg), recording it from various localities in S. E. China, Formosa and Japan.

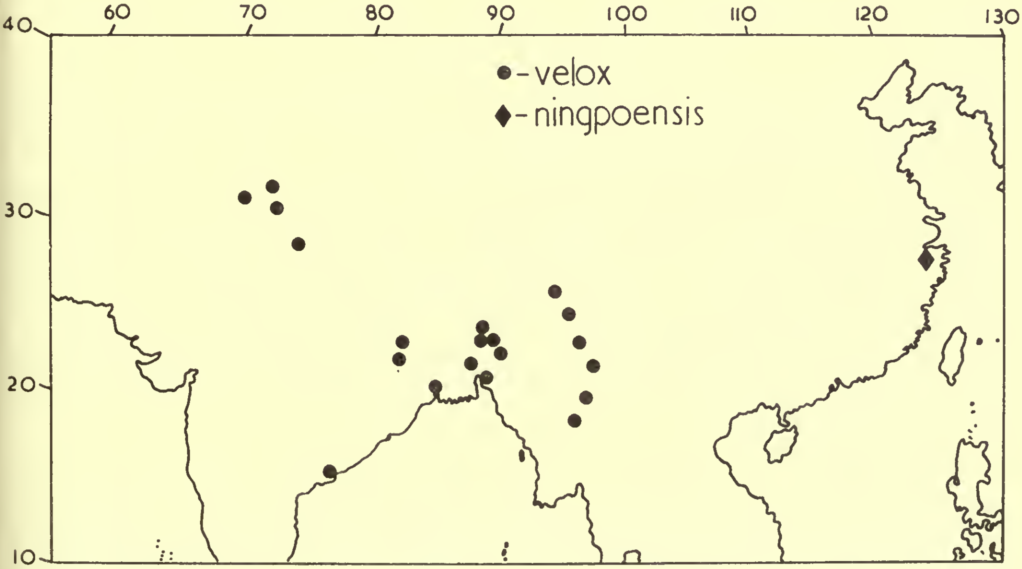


Fig. 105. *Oxya* spp., distribution map.

O. velox is a relatively poorly known species, restricted in its distribution to India, W. and E. Pakistan, Upper Burma and the Tibetan Himalayas.

The form of the male supra-anal plate and phallic complex and the female ovipositor and subgenital plate suggest *velox* is closely related to *O. ningpoensis* Chang and less closely to *O. grandis* and the *hyla-intricata* complex. It may be readily identified by the extraordinary development of the valvular plate of the cingulum in the male and the form of the subgenital plate and posterior ventral basivalvular sclerite of the ovipositor in the female.

SYNONYMY. *Gryllus squalidus* Marschall was described from a single male, deposited in NM, Vienna, and bears the following labels: a handwritten label 'Marschall Type XVIII/5', and a 'Mus. Caes. Vind.' label with the handwritten legend '*Oxya squalida* Marsch. Type!' Structurally this specimen agrees very well with other material of the same sex from India which is regarded here as *O. velox*.

Apart from its somewhat smaller size, Walker's type of *H. apta* agrees very well with the type of *O. velox* . Kirby(1914) synonymized *O. apta* with *O. velox* but it is clear from the BMNH collections that Kirby's interpretation of *O. velox* included, besides this species, *O. japonica* (Thunberg) and possibly other species.

DISTRIBUTION (Text-fig. 105). Countries and months of capture, from 42 specimens examined.

W. PAKISTAN: May, October; KASHMIR: August; INDIA: March, April, June to August, October, November; E. PAKISTAN: May, August to October; BURMA: September to December; CHINA: no dates; THAILAND: March.

Oxya ningpoensis Chang, 1934 **stat. n.**

(Text-figs 105–116)

Oxya grandis ningpoensis Chang, 1934: 190, figs 1–3. 10 ♂ and 7 ♀ syntypes, CHINA, 'Ningpo, Chekiang, China, vii. 1934 (Chang)' [most of series not traced but 1 ♂ and 1 ♀ bearing Chang's original 'paratype' labels examined in BMNH.

DIAGNOSIS. ♂. Large, robust species. Integument finely pitted and shiny. Antenna longer than combined lengths of head and pronotum. Interocular distance wider than frontal ridge at median ocellus. Dorsum of pronotum hardly flattened, parallel-sided, posterior margin of metazona rounded. Tegmen fully developed but not reaching to apex of hind femur. Supra-anal plate (Text-fig. 107) with a rounded triangular posterior lobe; cercus (Text-fig. 106) with bilobate apex, the upper lobe rounded. Epiphallus (Text-fig. 108) with narrow bridge, without ancorae, with hook-like outer lophi and large tooth-like inner lophi; rest of phallic complex as in Text figs. 109–112 lateral fleshy lobes small, not visible from above; valvular plate of cingulum short, fleshy, with complicated folds; apical valves of penis similar, fleshy and folded.

♀. Larger and more robust than ♂. Anterior margin of tegmen without spines. Spermatheca as in Text-fig. 115; valves of ovipositor (Text-fig. 116) with toothlike spines, posterior ventral basivalvular sclerite of ovipositor without spines on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 113) with a median concavity in posterior half which is bordered laterally by weak longitudinal ridges, median pair of spines on posterior margin widely spaced.

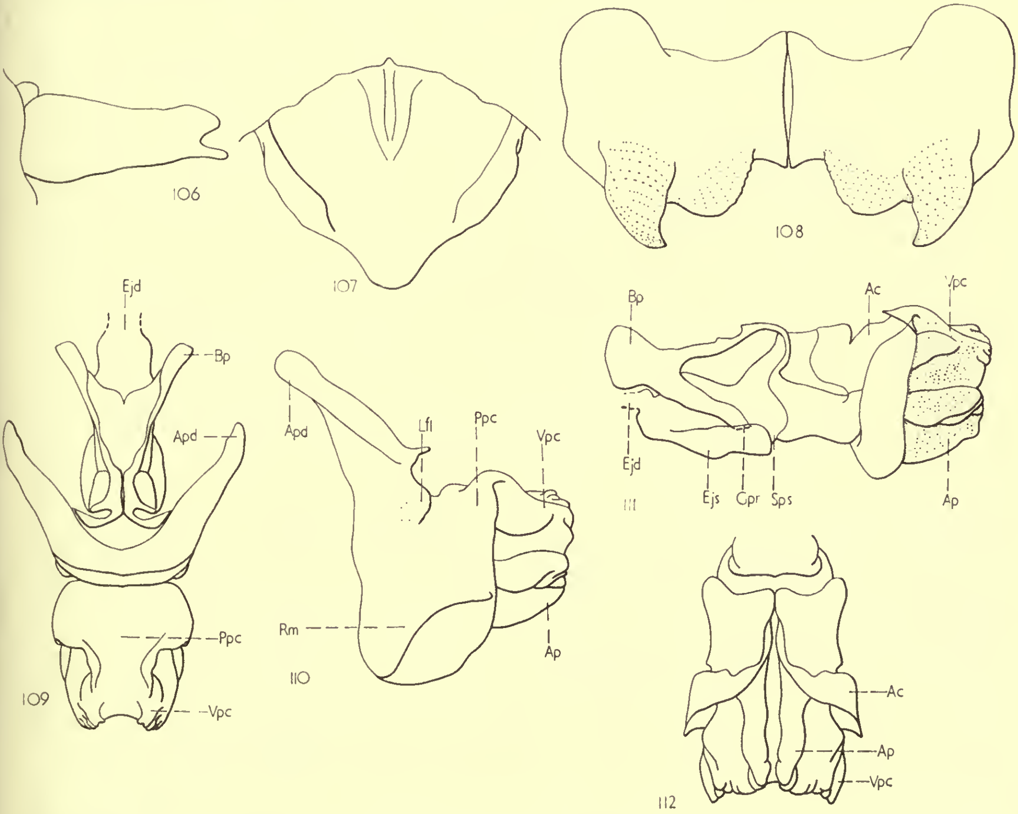
Measurements (mm) – Length of body, ♂ 35·8, ♀ 41·5; pronotum, ♂ 7·9, ♀ 9·8; tegmen, ♂ 23·6, ♀ 25·8; hind femur, ♂ 20·1, ♀ 23·6; maximum width of hind femur, ♂ 4·3, ♀ 5·2; ratio of length of tegmen to pronotum (E/P), ♂ 2·99, ♀ 2·63; ratio of length of tegmen to hind femur (E/F), ♂ 1·12, ♀ 1·09; ratio of length of hind femur to its maximum width (FL/FW), ♂, 4·91, ♀ 4·54.

Discussion. The form of the male phallic complex and female subgenital plate and ovipositor would suggest this species is closely related to *O. velox*, but the convoluted and fleshy valvular plate of the cingulum and apical penis valves are unique in this genus.

Distribution (Text-fig. 105). Known only from type-series.

Oxya japonica (Thunberg, 1824)

This species is divided into two subspecies.

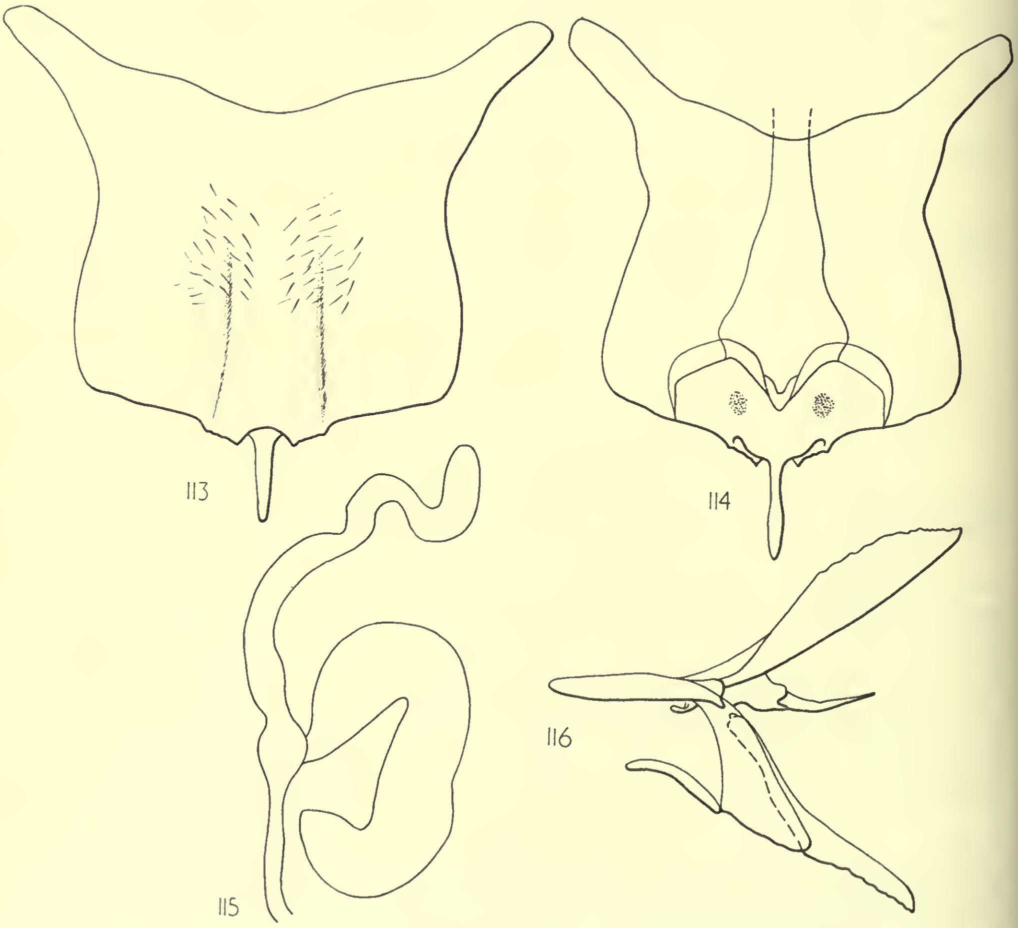


Figs 106–112. *Oxya ningpoensis* Chang, male terminalia and genitalia; 106, cercus, lateral view, 107, supra-anal plate, dorsal view; 108, epiphallus; 109, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 110, cingulum, lateral view; 111, endophallus, lateral view; 112, apex of penis, ventral view.

Oxya japonica japonica (Thunberg, 1824)

(Text-figs 117–121, 123–133, 138)

Gryllus japonicus Thunberg, 1824: 429. Holotype ♀, JAPAN, '*japonicus* Japonica' (ZIUU, Uppsala) [examined].
Acridium sinense Walker, 1870: 628. Holotype ♀, 'CHINA' (BMNH) [examined]. **Syn. n.**
Heteracris straminea Walker, 1870: 666. Holotype ♀, 'CHINA' (BNMH) [examined]. **Syn. n.**
Heteracris simplex Walker, 1870: 669. Holotype ♀, 'PHILIPPINE IS.' (BMNH) [examined]. **Syn. n.**
[*Oxya chinensis* (Thunberg); Stål, 1873: 82. var *a* and *c*. Misidentification.]
Oxya lobata Stål, 1877: 53. Holotype ♀, PHILIPPINE IS., 'Ins. Philipp.' (NR, Stockholm) [examined]. **Syn. n.**
[*Oxya velox* (Fabricius); Brunner von Wattenwyl, 1893: 152, partim. Misidentification.]

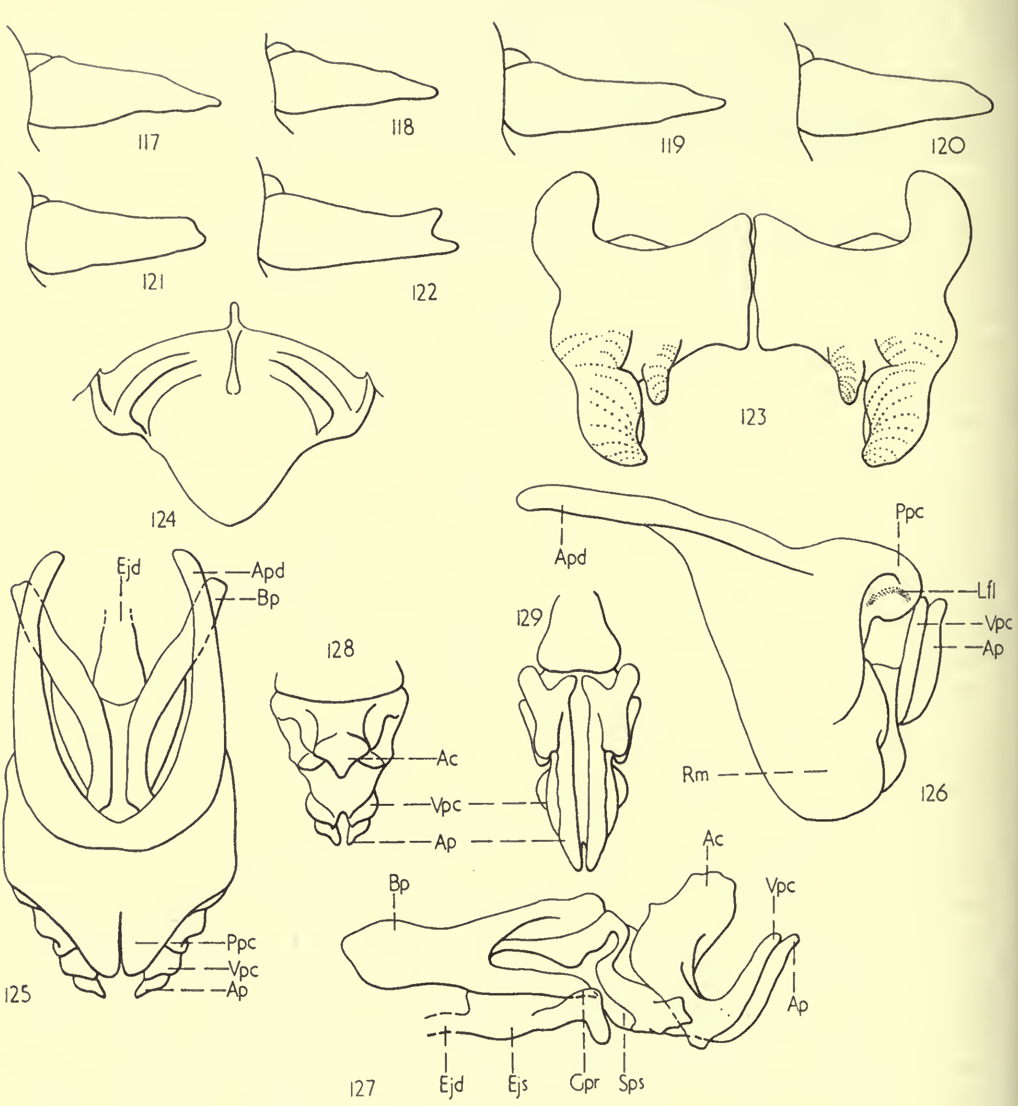


FIGS 113–116. *Oxya ningpoensis* Chang, female; 113, subgenital plate, ventral view; 114, same, dorsal view; 115, spermatheca; 116, ovipositor, lateral view.

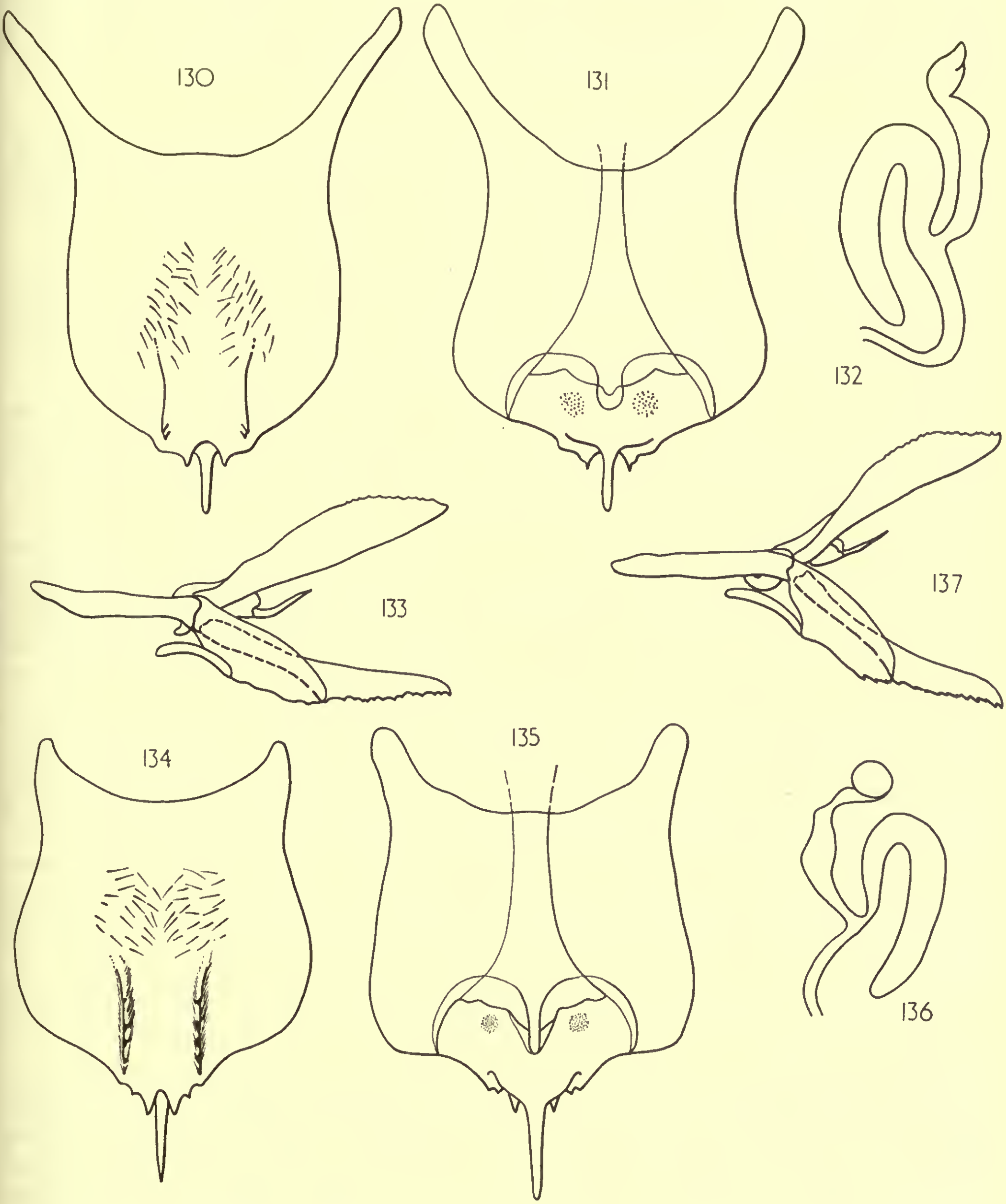
[*Oxya velox* (Fabricius); Kirby, 1910: 393, partim. Misidentification.]
[*Oxya velox* (Fabricius); Kirby, 1914: 199, partim. Misidentification.]
[*Oxya velox* (Fabricius); I. Bolívar, 1918: 15, partim. Misidentification.]
Oxya asinensis Willemse, 1925: 32, figs 29, 30. Holotype ♀, INDIA, 'Malabar Dt., Periya Ghat, 2,500', 6.x.17, T.V.R. Coll.' (BMNH) [examined]. **Syn. n.**
Oxya rufostriata Willemse, 1925: 33, fig. 31. Holotype ♀, INDIA, 'Adderley, 28.ix.1921, Susainathan coll.' (BMNH) [examined]. **Syn. n.**
[*Oxya sinensis* (Walker), Willemse, 1925: 49, figs 54–57. Misidentification.]
Oxya sinensis f. *robusta* Willemse, 1925: 52.
[*Oxya sinensis* f. *lobata* Stål; Willemse, 1925: 52, fig. 55. Misidentification.]
[*Oxya chinensis* (Thunberg); Uvarov, 1926: 48. Misidentification.]
[*Oxya velox* (Fabricius); Swezey, 1926: 378, figs 1–4. Misidentification.]
[*Oxya chinensis* (Thunberg); Uvarov, 1928: 318, fig. 115 c. Misidentification.]
[*Oxya chinensis* (Thunberg); Willense, 1930: 123, figs 62, 63. Misidentification.]
[*Oxya gavisa* (Walker); Willemse, 1931: 239. Misidentification.]
[*Oxya chinensis* (Thunberg); Willemse, 1931: 240. Misidentification.]
[*Oxya chinensis* (Thunberg); Pemberton, 1933: 251. Misidentification.]
[*Oxya chinensis* (Thunberg); Pemberton, 1933a: 1253. Misidentification.]
[*Oxya chinensis* (Thunberg); Chang, 1934: 187. Misidentification.]
[*Oxya velox* (Fabricius); Shiraki, 1937: 20. Misidentification.]
[*Oxya formosana* Shiraki; Takano and Yanagihara, 1939: 76. Misidentification.]
[*Oxya chinensis* (Thunberg); Tinkham, 1940: 295. Misidentification.]
[*Oxya chinensis* (Thunberg); Fullaway and Krauss, 1945: 36. Misidentification.]
[*Oxya velox* (Fabricius); Mischenko, 1951: 167, partim, figs 288, 297. Misidentification.]
[*Oxya chinensis* (Thunberg); Mischenko, 1951: 167, partim. Misidentification.]
[*Oxya velox* (Fabricius); Mischenko, 1952: 154, partim, figs 223, 232. Misidentification.]
[*Oxya velox* (Fabricius); Murai, 1954: 1. Misidentification.]
[*Oxya chinensis* (Thunberg); Willemse, 1955: 156, figs 102, A, B. Misidentification.]
[*Oxya velox* (Fabricius); Murai, 1957: 22. Misidentification.]
[*Oxya chinensis* (Thunberg); Pemberton, 1963: 679. Misidentification.]
[*Oxya chinensis* (Thunberg); Meer Mohr, 1965: 103. Misidentification.]
[*Oxya velox* (Fabricius); Fukuhara, 1966: 202. Misidentification.]
[*Oxya chinensis* (Thunberg); Yunus, 1967: 632, Misidentification.]
[*Oxya chinensis* (Thunberg); Bullen and MacQuaig, 1969: 398. Misidentification.]
[*Oxya chinensis* (Thunberg); Grist and Lever, 1969: 285. Misidentification.]

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna with 24–26 segments, slightly longer or only as long as combined lengths of head and pronotum. Interocular distance as wide as or slightly narrower than frontal ridge at median ocellus. Dorsum of pronotum slightly flattened, parallel sided. Tegmen fully developed. Supra-anal plate (Text-fig. 124) rounded triangular, with very well developed basal folds; cercus (Text-figs 117–121) conical, with subacute or truncate apex. Epiphallus (Text-fig. 123) with narrow bridge, without ancorae, with hook-like outer lophi and short, slender inner lophi; rest of phallic complex as in Text-figs 125–129; posterior process of cingulum, from above, rounded triangular with deep division posteriorly; valvular plate of cingulum with deep posterior emargination; apical valves of penis long, slender and upcurved.

♀. Larger and more robust than ♂. Interocular distance as wide as or slightly wider than frontal ridge at median ocellus. Anterior margin of tegmen very weakly spined. Spermatheca as in Text-fig. 132; valves of ovipostor (Text-fig. 133) with tooth-like spines; posterior ventral basivalvular sclerite of ovipositor with a large spine on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 130) with a deep median longitudinal concavity posteriorly which is bordered on each side by a well developed lateral longitudinal ridge, latter unspined except at most posterior apex; median pair of spines on posterior margin well developed, fairly closely spaced.



Figs 117–129. *Oxya japonica* subspp., male terminalia and genitalia; *O. japonica japonica* (Thunberg) 117, cercus, lateral view, of specimen from Ceylon; 118, same, from S. India; 119, same, from Assam; 120, same, from Penang; 121, same, from Hawaii; 123, epiphallus; 124, supra-anal plate, dorsal view; 125, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 126, cingulum, lateral view; 127, endophallus, lateral view; 128, apex of penis, dorsal view; 129, same, ventral view; *O. japonica vitticollis* (Blanchard) 122, cercus, lateral view.



FIGS 130–137. *Oxya japonica* subspp., female; *O. japonica japonica* (Thunberg) 130, subgenital plate, ventral view; 131, same, dorsal view; 132, spermatheca; 133, ovipositor, lateral view; *O. japonica vitticollis* (Blanchard) 134, subgenital plate, ventral view; 135, same, dorsal view; 136, spermatheca; 137, ovipositor, lateral view.

MEASUREMENTS (mm) – Length of body, ♂ 17·4–33·8, ♀ 20·8–37·4; pronotum, ♂ 3·5–6·7, ♀ 4·7–8·9; tegmen, ♂ 14·1–26·5, ♀ 14·4–33·4; hind femur, ♂ 10·4–18·2, ♀ 12·8–23·2; maximum width of hind femur, ♂ 2·2–3·7, ♀ 2·9–4·7; mean ratio of length of tegmen to pronotum (E/P) ♂ 3·94, ♀ 3·64; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·40, ♀ 1·34 mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·79, ♀ 4·70.

DISCUSSION. *O. japonica japonica* is extremely variable in size, relative length of tegmen and the form of the male cercus. The latter varies almost clinally along the geographical range of the subspecies, being less truncate apically in western populations and more truncate in eastern populations, reaching a climax east of the island of Halmahera in the subspecies *j. vitticollis*.

O. j. japonica may be recognized in the female by the form of the subgenital plate and the spined posterior ventral basivalvular sclerite of the ovipositor, and in the male by the basal folds on the supra-anal plate, the slender inner lophi of the epiphallus and the shape of the posterior process of the cingulum.

Biological and economic references to this subspecies may be found in Swezey (1926), Uvarov (1928), Pemberton (1933, 1933*a*, 1963), Tinkham (1940), Fullaway and Krauss (1945), Murai (1954, 1957), Meer Mohr (1965), Yunus (1967), Bullen and MacQuaig (1969) and Grist and Lever (1969).

SYNONYMY. Willemse (1925) made no mention of the name *Gryllus japonicus* Thunberg, 1824 and recognized this species as *O. sinensis* (Walker), regarding it as synonymous with *O. chinensis* (Thunberg) var. *a*, as identified by Stål (1873: 82). Stål also considered *G. japonicus* to be a synonym of *O. chinensis* var. *b*. Uvarov (1926) pointed out that if Stål's interpretation was correct then the older name, *viz. O. chinensis* (Thunberg), should be applied to this species.

An examination of Thunberg's type-material has shown that *japonicus* and *chinensis* are distinct species and *sinense* Walker is a synonym of *chinensis*. Under *Gryllus lutescens* in Thunberg's collection are three specimens labelled α, β, and γ which probably correspond to Stål's *O. chinensis* (Thunberg) var. *a*, *b*, and *c*. Mention of these varieties was made in Thunberg's original description but not by specific letter. Var. α and var. γ are synonymous with *japonicus* Thunberg, but for reasons given below neither of these specimens is considered as the lectotype of *G. lutescens* Thunberg.

DISTRIBUTION. (Text-fig. 138). Countries and months of capture, from 678 specimens examined.

CEYLON: January to March, May; INDIA: April to December; E. PAKISTAN: October; BURMA: July; ANDAMAN IS: February, March, August; CHINA: April, May, July, August, October, December; TAIWAN: August; JAPAN (including Ryuku Is): June, July, October; THAILAND: January to March, May to August, November; VIETNAM: January, March, September, December; WEST MALAYSIA: February, April, July to November; SINGAPORE: March, May, June, SUMATRA: February to December; JAVA: October through to January, March, May, July, August; BALI: no dates; LOMBOK: March; SUMBA: June to September; TIMOR: March; PHILIPPINE IS: January, February, May, July; PALAUS IS: March; BORNEO:

August through to January, March, April; CELEBES: May, July; SULA IS: March, May; HALMAHERA IS: October; HAWAII IS: January, May, September to November.

Oxya japonica vitticollis (Blanchard, 1853) **stat. n.**

(Text-figs 122, 134–137)

Acridium vitticolle Blanchard, 1853: 373, pl. 1, fig. 10. Holotype ♂, NEW GUINEA, 'Museum Paris. Nouv.-Guinée, Baie Triton, Jacquinot 1841' (MNHN, Paris) [examined].

Acridium vittigerum Blanchard, 1853: 371, pl. 3, fig. 9. Holotype ♀ NEW GUINEA 'Museum Paris. Nouv.-Guinée, Baie Triton, Jacquinot 1841' (MNHN, Paris) [examined]. [Homonym of *Acridium vittigerum* Blanchard, 1851: 73.]

Heteracris gavisa Walker, 1870: 699. Holotype ♂, MALUKU, 'Ceram' (BMNH) [examined]. **Syn. n.**

[*Oxya velox* (Fabricius); Brunner von Wattenwyl, 1893: 152, partim. Misidentification.]

[*Oxya velox* (Fabricius); I. Bolívar, 1918: 15, partim. Misidentification.]

[*Oxya velox* (Fabricius); Sjöstedt, 1921: 92. Misidentification.]

Oxya gavisa (Walker) Willemse, 1925: 47, figs 52, 53.

[*Oxya sinensis* (Walker); Sjöstedt, 1935: 71. Misidentification.]

Oxya gavisa aurantiaca Willemse, 1935: 179. Holotype ♂, NEW GUINEA (RNH, Leiden) [examined]. **Syn. n.**

Oxya gavisa (Walker); Willemse, 1955: 155, figs 99, 101.

Oxya gavisa var. *brachyptera* Willemse, 1955: 156. Holotype ♀, NEW GUINEA (RNH, Leiden) [examined]. **Syn. n.**

Oxya gavisa (Walker); Rehn, 1957: 20, pl. 1, figs 3–6, pl. 7, figs 60–63.

[*Oxya velox* (Fabricius); Pemberton, 1963: 679, partim. Misidentification.]

Oxya vittigera (Blanchard) Dirsh, 1965: 40.

Oxya gavisa (Walker); Kevan, 1968: 76.

Oxya gavisa (Walker); Bullen and MacQuaig, 1969: 398, partim.

DIAGNOSIS. Differs from nominate subspecies as follows: ♂. Antenna always much longer than combined lengths of head and pronotum. Cercus (Text-fig. 122) with more truncate apex, almost to bifid condition.

♀. Lateral longitudinal ridges on ventral surface of subgenital plate (Text-fig. 134) bear spines along their length; medial pair of spines on posterior margin of subgenital plate strongly developed and closer together.

MEASUREMENTS (mm) – Length of body, ♂ 17·0–24·8, ♀ 20·6–34·1; pronotum, ♂ 3·4–5·5, ♀ 4·8–7·5; tegmen, ♂ 7·4–20·3, ♀ 10·4–27·3; hind femur, ♂ 10·4–15·8, ♀ 13·1–20·5; maximum width of hind femur, ♂ 2·1–3·2, ♀ 2·9–4·3; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·33, ♀ 3·14; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·12, ♀ 1·13; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 5·03, ♀ 4·74.

DISCUSSION. As may be expected the geographical line of demarcation between these two subspecies is not absolute. If a line is drawn east of Timor, Sula and Halmahera and west of Buru, then populations to the west of this line are *j. japonica*, and to the east of it are *j. vitticollis*; specimens of the *j. vitticollis* type have been found from Sula Is and those of the *j. japonica* type from New Guinea. Specimens examined from Obi Is appear to be a mixture of the two forms, and the populations on the Hawaiian Islands are a special case as they were introduced artificially.

SYNONYMY. Prior to the present revision the binomen applied to this taxon was *Oxya vittigera* (Blanchard, 1851), see Dirsh (1965: 40), but for reasons given below this name is not accepted here.

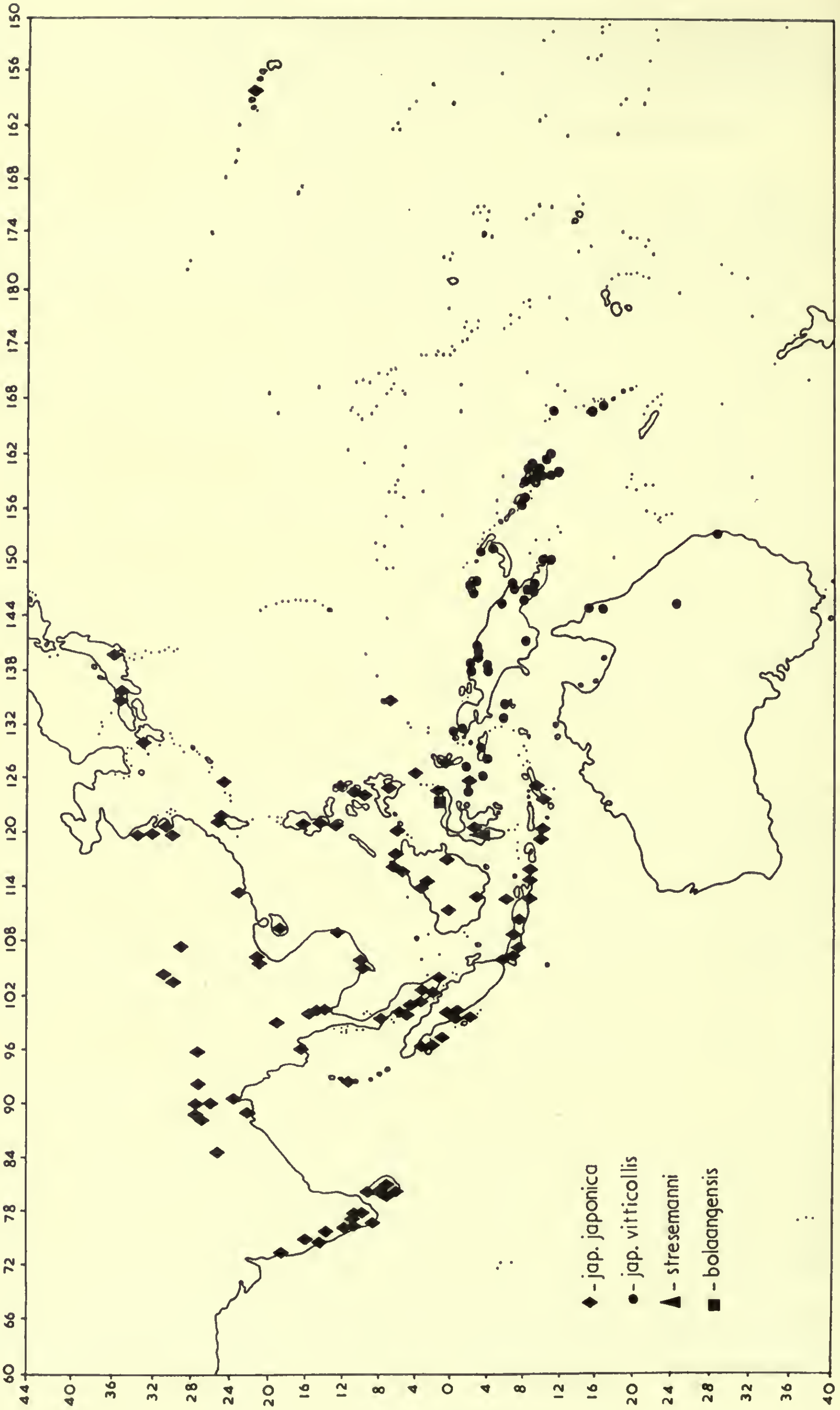


FIG. 138. *Oxya* spp., distribution map.

Blanchard (*in* Gay, 1851) described *Acridium vittigerum* from an unspecified number of individuals from Coquimbo, Santa Rosa, Chile; and later (Blanchard, 1853) described another species, this time from a single female, from Triton Bay, New Guinea, under the same name, viz. *Acridium vittigerum.* Both descriptions are not particularly diagnostic but in each case measurements are given and these differ from one another quite appreciably.

A. vittigerum Blanchard, 1851 has since been placed in the genus *Dicroplus* (Phillipi, 1863; Berg, 1881; Liebermann, 1942, 1958) but Kirby (1910) quoted this species under *Schistocera* (Kirby, 1910: 461) and *Osmilia* (Kirby, 1910: 540, as *O. vittiger*).

A. vittigerum Blanchard, 1853 has been placed in the genus *Oxya* (Kirby, 1910, Willemse, 1955).

Dirsh (1965: 40), during his preliminary study of the genus *Schistocerca,* asked to borrow from MNHN, Paris the type of *Acridium vittigerum* Blanchard, 1851, as this species was listed by Kirby (1910: 461) under the genus *Schistocera.* He received from MNHN, Paris the type-female of *Acridium vittigerum* Blanchard, 1853 and not, as he thought, that of *A. vittigerum* Blanchard, 1851. Further he found, quite correctly, this specimen to be conspecific with the type of *Oxya gavisa* (Walker, 1870), but he published Walker's name in synonymy with *Acridium vittigerum* Blanchard, 1851 (nec 1853), hence causing some confusion in the literature.

I have now explained the relevant material from MNHN, Paris and offer the following interpretation of the situation.

There are, in MNHN, Paris, at least two female specimens bearing relevant data to both Blanchard's 1851 and 1853 descriptions. One bears the following data: 'Museum Paris. Chili. Gay, 15–43'; a green disc with the handwritten figures on the back '15' (or 19) '43' (or 48); and a red label with the handwritten data '*Acridium vittigerum* Blanch. Paratypus – CSC. 1966'. The locality 'Chili' and collector 'Gay' is consistent with Blanchard's 1851 publication. Two of its measurements are – body length, 22·3 mm, fore wings extended, 40· 3mm, or on the French line scale 11 lines and 18 lines respectively. These measurements fall well within the range given in the 1851 description, i.e., 'Long., 10–12 lin.; enverg. alar., 18–19 lin.' I therefore take this specimen to be a syntype of *Acridium vittigerum* Blanchard, 1851, and further agree with other authors (Phillipi, 1863; Berg, 1881; Liebermann, 1942, 1958) that it should be placed in the genus *Dichroplus.*

Another specimen bears the following data: a red type label; a buff label with the legend 'Museum Paris. Nouv.-Guinée, Baie Triton. Jaquinot 1841'; a pinkish disc with the handwritten figures on the back '733. 41'; a label with Blanchard's handwriting '*Acridium vittigerum* Bl.'; and a label in Dirsh's handwriting '*Oxya vittigerum* Blanch. V. M. Dirsh det. 1964'. This information is consistent with Blanchard's 1853 publication, as he states (pages 1 and 2) the entomological material was collected by Jacquinot and Hombron, and after the description (p. 372) he gives the type-locality as Triton Bay, New Guinea. Two of its measurements are: body length, 32·4 mm, fore wings extended, 51·1 mm, which agree with figures quoted in the 1853 description, 'Long. corp. 32 millim., extens. alar., 52 millim.' Therefore

I take this specimen to be the female holotype of *Acridium vittigerum* Blanchard, 1853. It is conspecific with the holotype of *Oxya gavisa* (Walker, 1870) but is invalid due to its primary homonymy with *Acridium vittigerum* Blanchard, 1851.

At the time of describing *A. vittigerum* Blanchard, 1853 (nec 1851), Blanchard also described *Acridium vitticolle* from a single male from the same locality. This specimen is conspecific with the holotypes of both *A. vittigerum* Blanchard, 1853 and *Heteracris gavisa* Walker, 1870, and becomes the valid name for this taxon.

The male holotype of *Oxya gavisa aurantiaca* Willemse is labelled 'N. N. Guinea Exp. 1926, W. Docters v. Leeuwen, Mamberamo, Datum vi.' It represents a colour variety very common in New Guinea populations of *j. vitticollis*.

Oxya gavisa var. *brachyptera* Willemse was erected in title as a variety but regarded in Willemse's discussion as a subspecies. The female holotype is labelled 'Neth. Ind. Amer. New Guinea Exp. Baliem Camp 1938, 1,600 M., 16–22.xi. L.J. Toxopeus leg.' This form has not been recorded since its original description and is known only from a male and two female specimens, all from the type-locality. Willemse distinguished it from '*gavisa*' by the smaller size, shortened tegmina, and truncate rather than bilobed apex of the male cercus. In fact the male cercus is very similar to that of *j. japonica*, a feature which is rare but not unique in New Guinea populations of *j. vitticollis*. The smaller size and abbreviated tegmina of these specimens is possibly due to some temperature effect as they were collected at a height of 1,600 metres.

DISTRIBUTION (Text-fig. 138). Countries and months of capture, from 426 specimens examined.

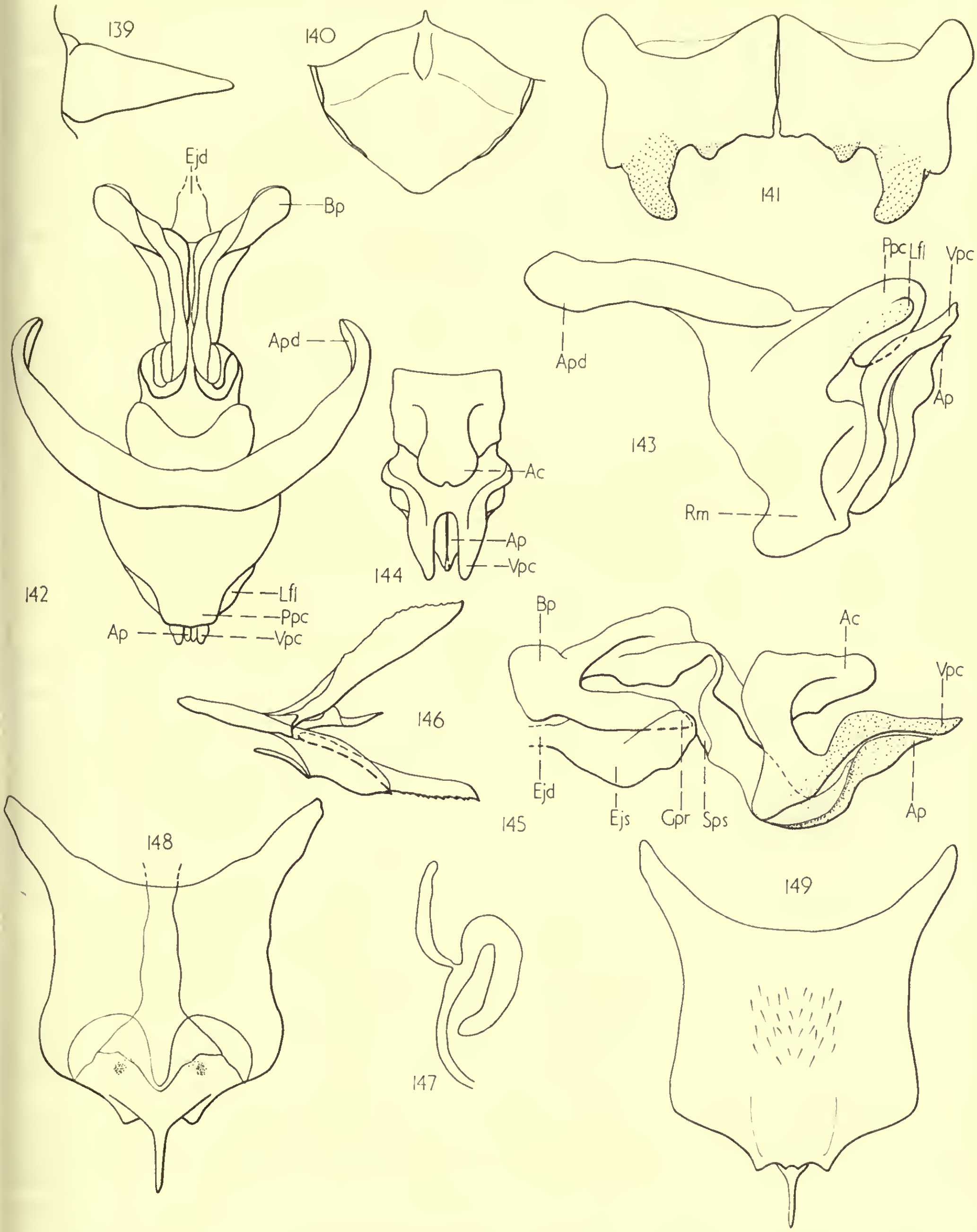
SULA IS: May; OBI IS: March to May, July, August, October; BURU: August; AMBOINA: September, October; CERAM: April, November; KEY IS: September; ARU IS: September, October; NEW GUINEA: all year round; BISMARCK ARCHIPELAGO: March, April, June, December; SOLOMON IS: including Bougainville; all year round; NEW HEBRIDES: April, August, December; AUSTRALIA: February to April, June, July.

Oxya stresemanni Ramme, 1941

(Text-figs 138–149)

Oxya stresemanni Ramme, 1941: 213. Holotype ♂, SULAWESI, 'Celebes, Latimodjong – Geb. Oeroe, 800 m., 8.1930, Heinrich G.' (MNHU, Berlin) [examined].
Oxya stresemanni Ramme; Willemse, 1955: 156.

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna as long as combined lengths of head and pronotum, with 25–26 segments. Interocular distance slightly narrower than frontal ridge at median ocellus. Dorsum of pronotum slightly flattened and hardly narrowing forwards, posterior margin of metazona broadly obtuse-angular. Tegmen fully developed. Supra-anal plate (Text-fig. 140) rounded triangular, without basal folds; cercus (Text-fig. 139) conical with subacute apex. Epiphallus (Text-fig. 141) with narrow bridge, without ancorae, with hook-like outer lophi and very small tooth-like inner lophi; rest of phallic complex as in Text-figs 142–145; posterior process of cingulum trapezoid from above, lateral fleshy lobes large and visible from above; valvular plate of cingulum with very deep posterior emargination; apical valves of penis long, slender, upcurved and twisted.



Figs 139–149. *Oxya stresemanni* Ramme, terminalia and genitalia; male, 139, cercus, lateral view; 140, supra-anal plate, dorsal view; 141, epiphallus; 142, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 143, cingulum, lateral view; 144, apex of penis, dorsal view; 145, endophallus, lateral view; female, 146, ovipositor, lateral view; 147, spermatheca; 148, subgenital plate, dorsal view; 149, same, ventral view.

♀. Larger and more robust than ♂. Antenna slightly shorter than combined lengths of head and pronotum. Interocular distance as wide as frontal ridge at median ocellus. Anterior margin of tegmen weakly spined. Spermatheca as in Text-fig. 147. Valves of ovipositor (Text-fig. 146) with tooth-like spines; posterior ventral basivalvular sclerite with a strong spine on its inner ventral margin. Ventral surface of subgenital plate (Text-fig. 149) with a weak posterior flattening and two weak lateral longitudinal ridges; medial pair of spines on posterior margin closely spaced and smaller than lateral pair.

MEASUREMENTS (mm) – Length of body, ♂ 25·3, ♀ 27·9; pronotum, ♂ 4·8, ♀ 6·0; tegmen, ♂ 17·4, hind femur, ♂ 13·7, ♀ 16·9; maximum width of hind femur, ♂ 2·8, ♀ 3·4; ratio of length of tegmen to pronotum (E/P), ♂ 3·62; ratio of length of tegmen to hind femur (E/F), ♂ 1·27; ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·89, ♀ 4·97.

DISCUSSION. By the form of the phallic complex it seems that this species is close to *O. japonica* (Thunberg), from which it may be distinguished in the male by the sinuous apical penis valves and the absence of basal folds on the supra-anal plate, and in the female by the structure of the subgenital plate.

DISTRIBUTION (Text-fig. 138). Known only from the type-series.

Oxya bolaangensis **sp. n.**

(Text-figs 25, 138, 150–159)

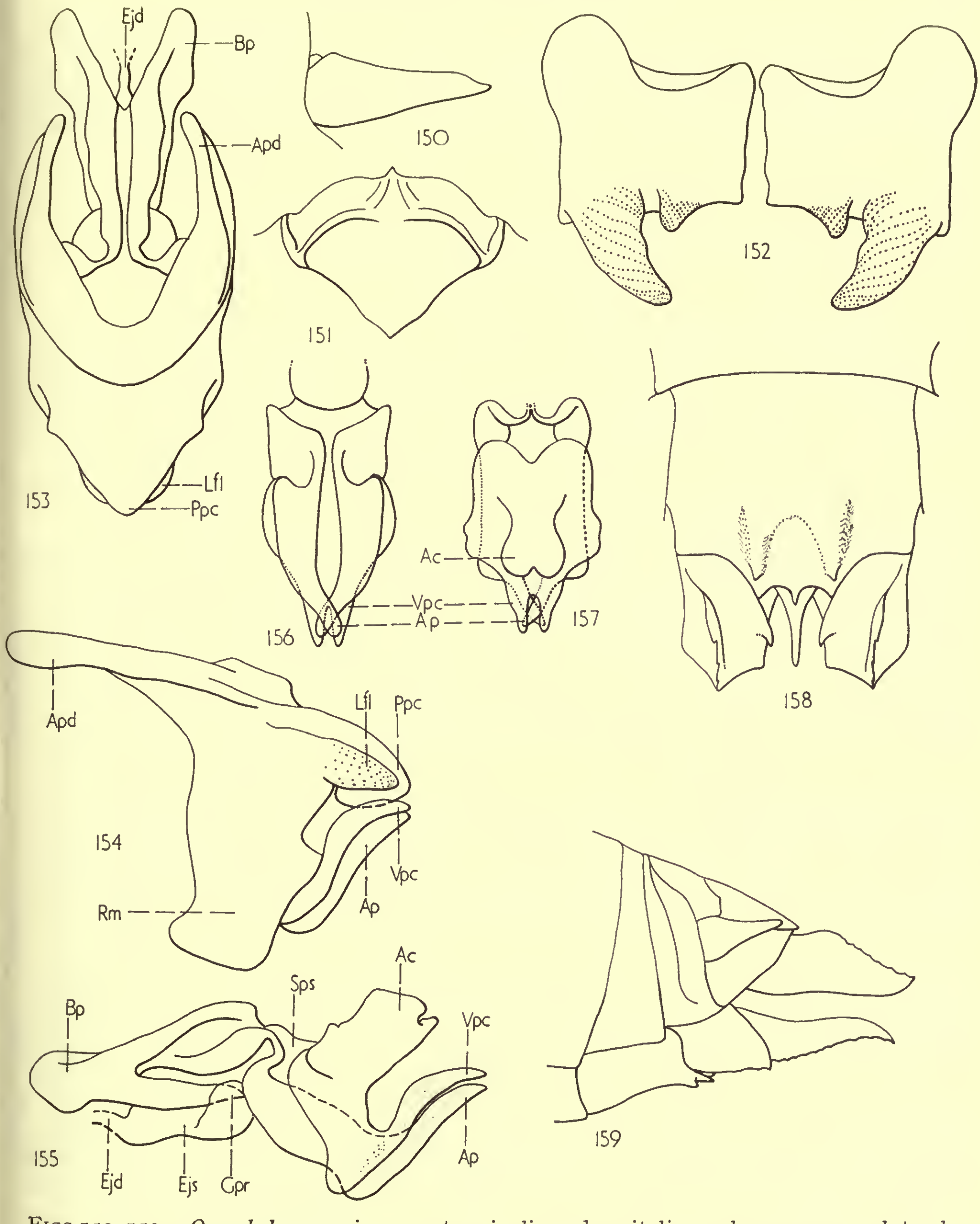
DESCRIPTION. ♂. Integument finely pitted and shiny. Antenna incomplete but from size of medial segments of flagellum obviously longer than combined lengths of head and pronotum. Interocular distance slightly narrower than frontal ridge at median ocellus. Dorsum of pronotum flattened and narrowing forwards, posterior margin of metazona widely obtuse-angular. Tegmen fully developed and extending beyond apex of hind femur. Supra-anal plate (Text-fig. 151) rounded triangular with well developed basal folds; cercus (Text-fig. 150) conical, with weakly truncate apex. Epiphallus (Text-fig. 152) with narrow bridge, without ancorae, with hook-like outer lophi and small tooth-like inner lophi; rest of phallic complex as in Text-figs 153–157; posterior process of cingulum rounded triangular from above, lateral fleshy lobes large and visible from above; valvular plate of cingulum with a deep posterior emargination; apical valves of penis long, slender, upcurved.

♀. Larger and more robust than ♂. Antenna slightly shorter than combined lengths of head and pronotum, with 28 segments. Interocular distance slightly wider than frontal ridge at median ocellus. Anterior margin of tegmen very weakly spined. Valves of ovipositor (Text-fig. 159) with tooth-like spines; posterior ventral basivalvular sclerite with a large spine on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 158) with a small median posterior concavity bordered on each side by a weak lateral longitudinal ridge; posterior margin with a single medial spine and a pair of lateral spines.

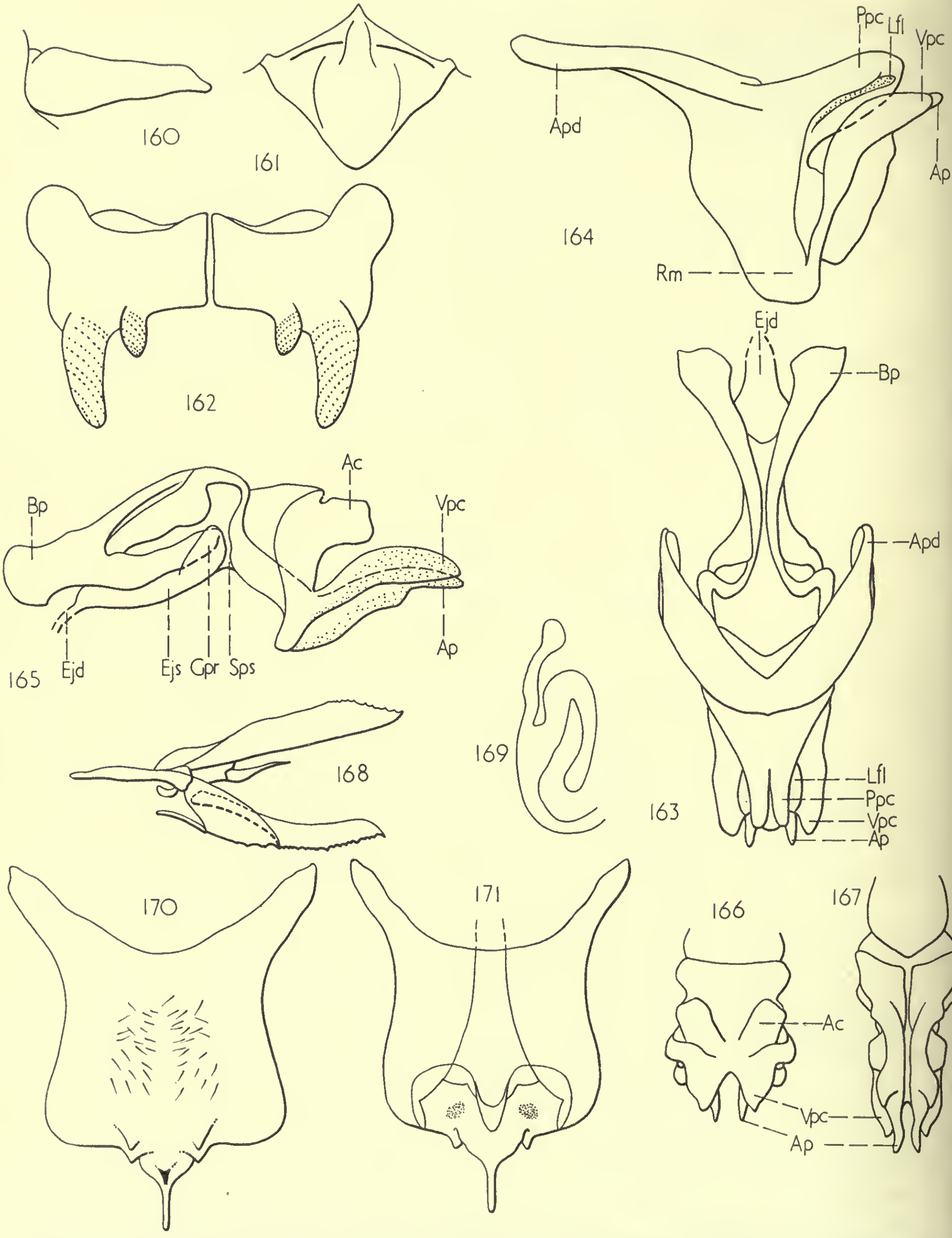
MEASUREMENTS (mm) – Length of body, ♂ 25·1, ♀ 28·7; pronotum, ♂ 5·1, ♀ 6·2; tegmen, ♂ 19·1, ♀ 22·3; hind femur, ♂ 14·4, ♀ 17·1; maximum width of hind femur, ♂ 2·8, ♀ 3·6; ratio of length of tegmen to pronotum (E/P), ♂ 3·74, ♀ 3·60; ratio of length of tegmen to hind femur (E/F), ♂ 1·33, ♀ 1·30; ratio of length of hind femur to its maximum width (FL/FW), ♂ 5·14, ♀ 4·75.

Holotype ♂, SULAWESI: 'Bolaang, N. Celebes, Aug. 1917, W. Kaudern', deposited in coll. Willemse.

Paratype. 1 ♀, same data and depository as holotype.



FIGS 150–159. *Oxya bolaangensis* sp. n., terminalia and genitalia; male, 150, cercus, lateral view (from dry specimen); 151, supra-anal plate, dorsal view (from dry specimen); 152, epiphallus; 153, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 154, cingulum, lateral view; 155, endophallus, lateral view; 156, apex of penis, ventral view; 157, same, dorsal view; female, 158, subgenital plate and posterior ventral basivalvular sclerite, ventral view (from dry specimen); 159, apex of abdomen, lateral view (from dry specimen.)



Figs 160–171. *Oxya nitidula* (Walker), terminalia and genitalia; male, 160, cercus, lateral view; 161, supra-anal plate, dorsal view; 162, epiphallus; 163, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 164, cingulum, lateral view; 165, endophallus, lateral view; 166, apex of penis, dorsal view; 167, same, ventral view; female, 168, ovipositor, lateral view; 169, spermatheca; 170, subgenital plate, ventral view; 171, same, dorsal view.

Discussion. The form of the male supra-anal plate and phallic complex suggests that this species is closely related to *O. japonica* (Thunberg), from which it may be distinguished, in the male, by the absence of any dorsal division on the posterior process of the cingulum, and by the unique structure of the female subgenital plate.

Oxya nitidula (Walker, 1870)

(Text-figs 160–172)

Acridium nitidulum Walker, 1870: 631. Holotype ♀, 'S. India' (BMNH) [examined].
Oxya nitidula (Walker) Walker, 1871: 64.
[*Oxya intricata* (Stål); Brunner von Wattenwyl, 1893: 153, partim. Misidentification.]
[*Oxya velox* (Fabricius); Kirkby, 1910: 393, partim. Misidentification.]
Oxya tridentata Willemse, 1925: 30, fig. 27. Holotype ♀, Ceylon, 'Nord Ceylon, Jun. 1889, H. Fruhstorfer' (NM, Vienna) [examined]. [Synonymized by Uvarov, 1926: 47.]
Oxya tridentata Willemse; Tandon and Shishodia, 1969: 266.

Diagnosis. ♂. Integument finely pitted and shiny. Antenna about as long as combined lengths of head and pronotum, with 24–26 segments. Interocular distance as wide as frontal ridge at median ocellus. Pronotum almost cylindrical, narrowing forwards, posterior margin of metazona rounded. Tegmen fully developed, clearly surpassing apex of hind femur. Supra-anal plate (Text-fig. 161) rounded triangular, with well developed basal folds; cercus (Text-fig. 160) conical, with strongly truncate apex. Epiphallus (Text-fig. 162) with narrow bridge, without ancorae, with relatively straight outer lophi and small, slender inner lophi; rest of phallic complex as in Text-figs 163–167; posterior process of cingulum narrowly rounded triangular in dorsal view, with strong median division posteriorly; lateral fleshy lobes visible from above; valvular plate of cingulum deeply and broadly emarginate posteriorly; apical valves of penis long, slender, upcurved.

♀. Larger and more robust than ♂. Antenna slightly shorter than combined lengths of head and pronotum. Interocular distance slightly wider than frontal ridge at median ocellus. Anterior margin of tegmen weakly spined. Spermatheca as in Text-fig. 169); valves of ovipositor (Text-fig. 168) with tooth-like spines; posterior ventral basivalvular sclerite with a spine on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 170) with a pair of well developed submargino-lateral spines, posterior margin with a single medial spine and a pair of lateral spines.

Measurements (mm) – Length of body, ♂ 18·3–23·3, ♀ 22·6–29·1; pronotum, ♂ 3·6–4·9, ♀ 4·9–5·9; tegmen, ♂ 12·2–19·8, ♀ 15·7–24·2; hind femur, ♂ 9·7–11·9, ♀ 12·7–15·6; maximum width of hind femur, ♂ 2·2–2·6, ♀ 2·7–3·2; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·89, ♀ 3·78; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·49, ♀ 1·47; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·62, ♀ 4·75.

Discussion. *O. nitidula* is very close to *O. japonica* (Thunberg) but may be distinguished from the latter by the truncate apex of the male cercus (*O. japonica* from S. India and Ceylon has a cercus with an almost pointed apex) and the form of the subgenital plate.

Synonymy. *O. tridentata* Willemse was described from a female holotype and other material from Ceylon, Mahe and India. Uvarov (1926) made the above synonymy, mentioning that the species identified by Willemse (1925) as *O. nitidula* unique (Walker) was another species altogether.

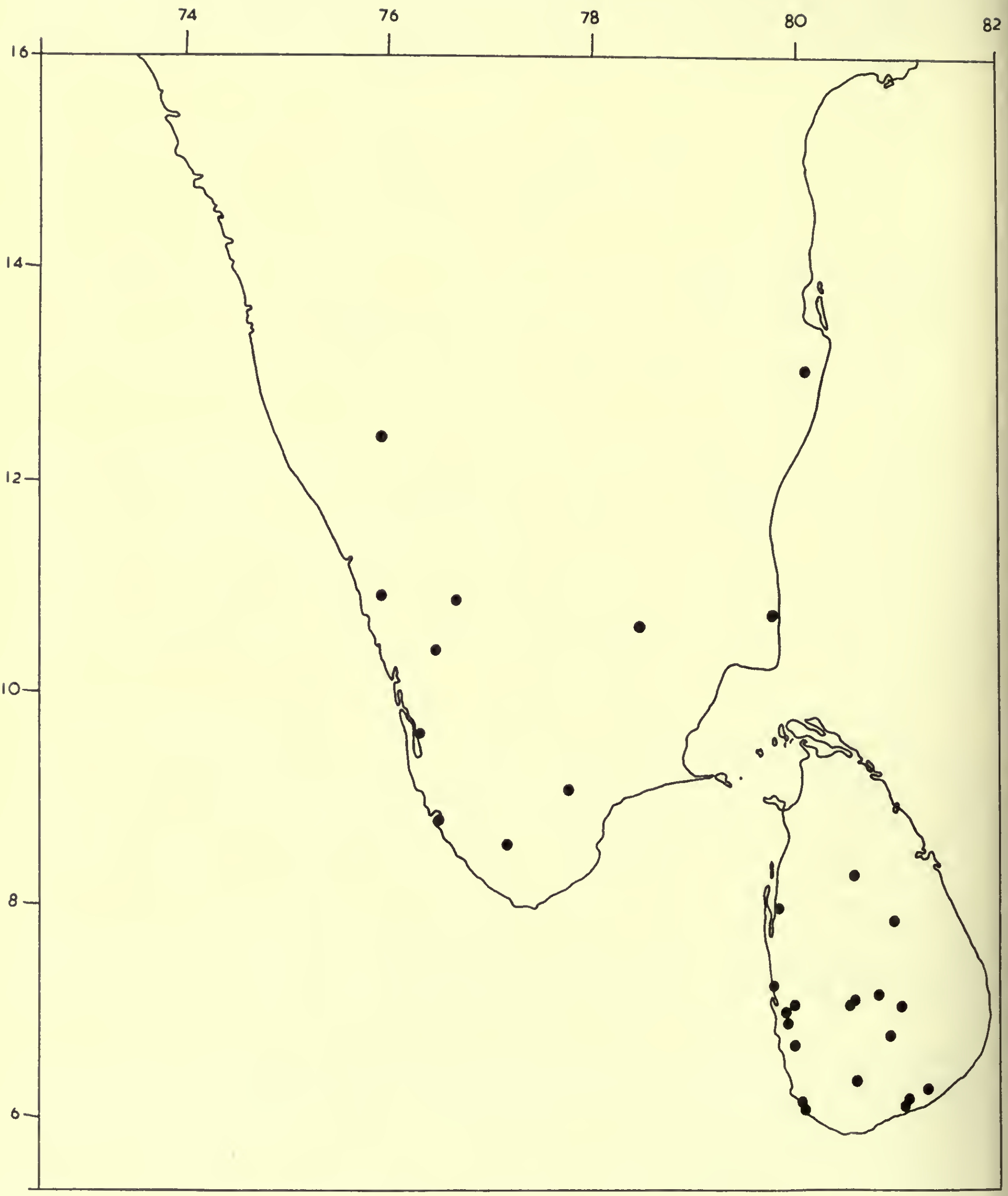


FIG. 172. *Oxya nitidula* (Walker), distribution map.

Brunner von Wattenwyl (1893), in his discussion of *O. intricata* (Stål), mentions that he had material from Ceylon. Willemse's type of *O. tridentata* bears a Brunner von Wattenwyl identification '*Oxya intricata*' and it therefore seems that the latter's record of *O. intricata* from Ceylon should be referred to *O. nitidula*.

DISTRIBUTION (Text-fig. 172). Countries and months of capture, from 245 specimens examined.

INDIA (South): July through to May; CEYLON: January to May, July, September.

Oxya agavisa Tsai, 1931

This species is divided into two subspecies.

Oxya agavisa agavisa Tsai, 1931

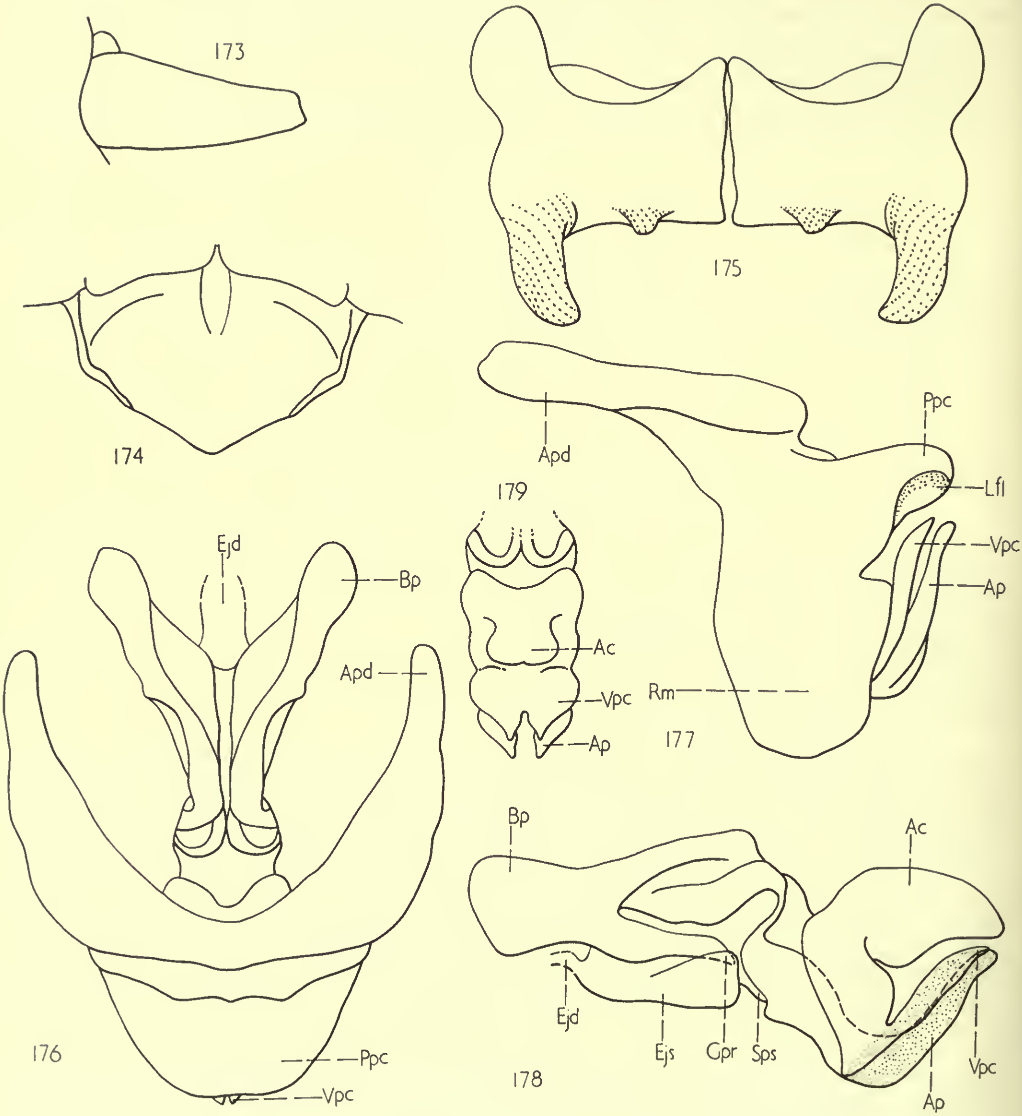
(Text-figs 173–183, 203)

Oxya agavisa Tsai, 1931: 437, fig. 1. Holotype ♀, CHINA 'Kwanhien (Szetschwan Prov.)' (MNHU, Berlin) [examined].
Oxya agavisa f. *robusta* Tsai, 1931: 439.
Oxya agavisa f. *robusta* Tsai; Tinkham, 1940: 296.
Oxya agavisa Tsai; Tinkham, 1940: 296.
Oxya agavisa Tsai; Mishchenko, 1951: 165, fig. 276.
Oxya agavisa Tsai; Mishchenko, 1952: 151, figs 211, 215.

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna longer than combined lengths of head and pronotum, with 26–27 segments. Interocular distance wider than frontal ridge at median ocellus. Dorsum of pronotum flattened, hardly narrowing forwards, posterior margin of metazona obtuse-angular. Tegmen fully developed, not or hardly surpassing apex of hind femur. Supra-anal plate (Text-fig. 174) rounded triangular, with weak basilateral folds; cercus (Text-fig. 173) conical, with broad truncate apex. Epiphallus (Text-fig. 175) with narrow bridge, without ancorae, with slender, hook-like outer lophi and small, tooth-like inner lophi; rest of phallic complex as in Text-figs 176–179; posterior process of cingulum, from above, large and rounded trapezoid; lateral fleshy lobes not visible from above; valvular plate of cingulum with a broad, deep posterior emargination; apical valves of penis long, slender, upcurved.

♀. Larger and more robust than ♂. Antenna slightly shorter than combined lengths of head and pronotum. Anterior margin of tegmen weakly spined. Spermatheca as in Text-fig. 183; valves of ovipositor (Text-fig. 182) with tooth-like spines, posterior ventral basivalvular sclerite with a large spine on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 180) with deep median posterior concavity bordered on either side by a strong lateral longitudinal ridge which bears spines along its length; posterior margin of subgenital plate, excluding spines, with a triangular profile, median pair of spines well developed and closely spaced, two pairs of lateral spines present.

MEASUREMENTS (mm) – Length of body, ♂ 24·4–33·7, ♀ 27·9–33·3; pronotum, ♂ 4·8–6·9, ♀ 6·6–7·6; tegmen, ♂ 14·5–21·1, ♀ 16·7–21·3; hind femur, ♂ 13·9–18·6, ♀ 18·2–21·7; maximum



Figs 173–179. *Oxya agavisa agavisa* Tsai, male terminalia and genitalia; 173, cercus, lateral view, 174; supra-anal plate, dorsal view; 175, epiphallus; 176, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 177, cingulum, lateral view; 178, endophallus, lateral view; 179, apex of penis, dorsal view.

width of hind femur, ♂ 2·9–3·8, ♀ 3·7–4·5; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·05, ♀ 2·75; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·13, ♀ 1·01; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·83, ♀ 4·77.

DISTRIBUTION (Text-fig. 203. Country and months of capture, from 54 specimens examined.

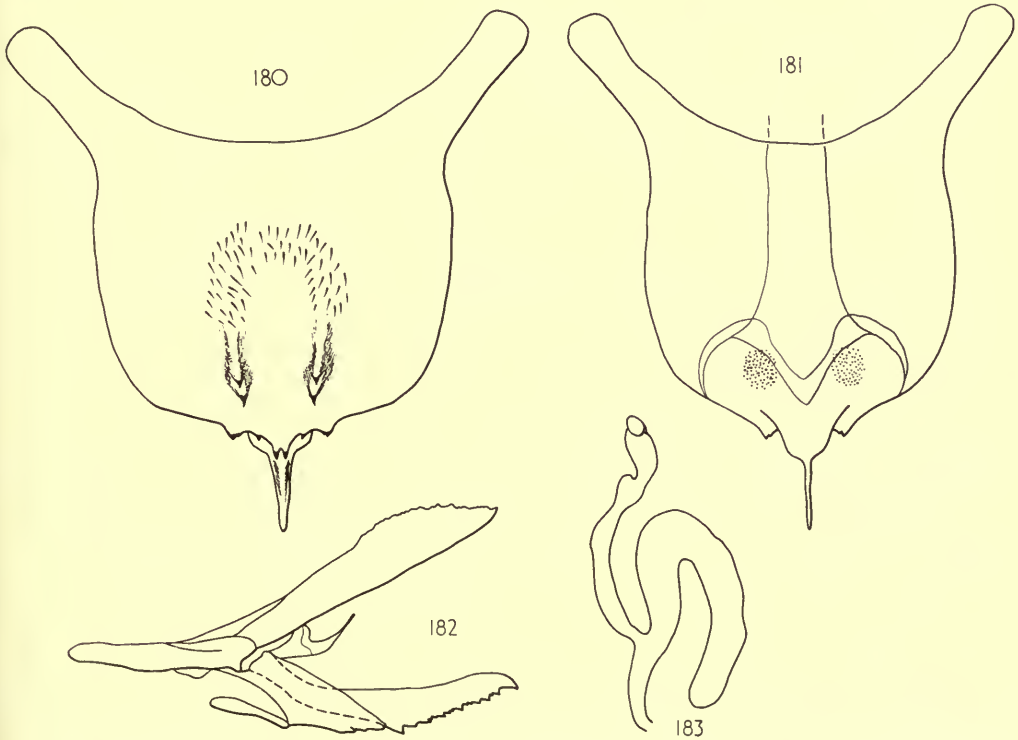
CHINA: July, August.

Oxya agavisa tinkhami **Uvarov, 1935 stat. n.**

(Text-figs 184–187, 203)

Oxya tinkhami Uvarov, 1935: 268, fig. 2. Holotype ♀, CHINA, 'Kwantung, S. China, Loh Fau Shan, alt. 3,800–4,000', Aug. 25. 1933, E. R. Tinkham' (BMNH) [examined].
Oxya tinkhami Uvarov; Tinkham, 1940: 293, 379.

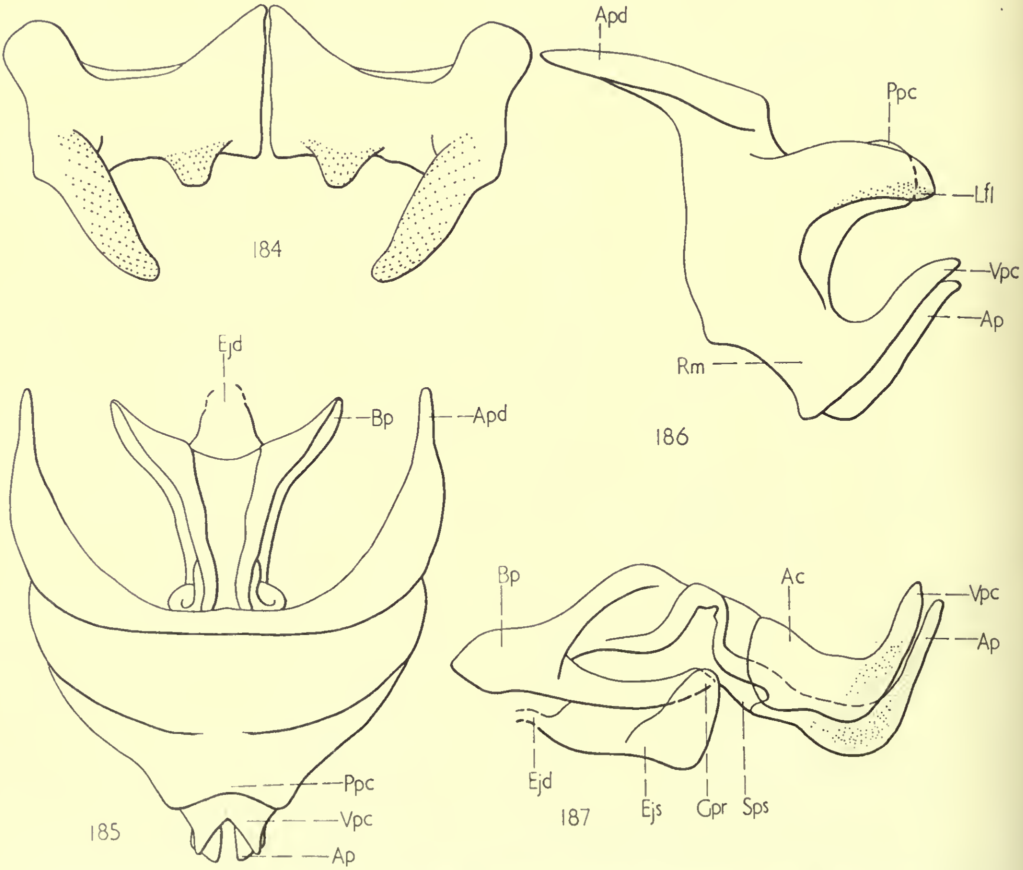
DIAGNOSIS. Differs from nominate subspecies in that antenna, in ♂, is only as long as combined lengths of head and pronotum, and in both sexes the tegmina are strongly reduced to the brachypterous condition.



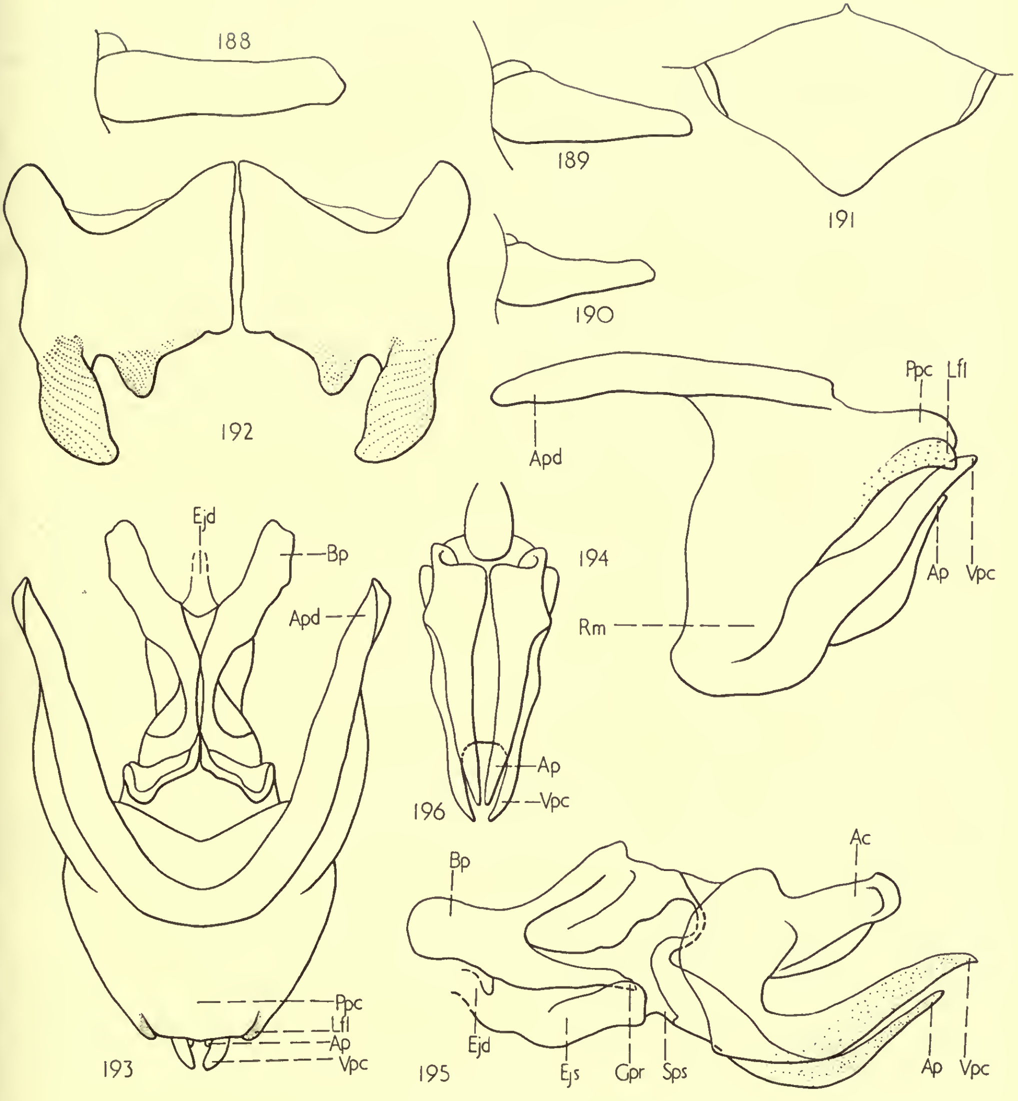
FIGS 180–183. *Oxya agavisa agavisa* Tsai, female terminalia and genitalia; 180, subgenital plate, ventral view; 181, same, dorsal view; 182, ovipositor, lateral view; 183, spermatheca.

Measurements (mm) – Length of body, ♂ 23·7, ♀ 31·7–32·0; pronotum, ♂ 4·9, ♀ 7·2–7·3; tegmen, ♂ 6·5, ♀ 9·8–10·0; hind femur, ♂ 13·8, ♀ 19·7; maximum width of hind femur, ♂ 3·0, ♀ 4·1; ratio of length of tegmen to pronotum (E/P), ♂ 1·33, ♀ 1·36–1·37; ratio of length of tegmen to hind femur (E/F), ♂ 0·47, ♀ 0·50; ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·60, ♀ 4·80.

Discussion. Considering *O. agavisa* as a polytypic species its distribution is restricted to the montane areas of southern China. Very little material is known but Tinkham (1940) records it from 'the mountains bordering the north of Kwangtung and Fukien to Chekiang and Hupeh and west to Szechwan.' Within this range the form *tinkhami* is restricted to the upper slopes of Loh Fau Shan in Kwangtung while the form *agavisa* is not found in this locality (for known distribution of the two



Figs 184–187. *Oxya agavisa tinkhami* Uvarov, male genitalia; 184, epiphallus; 185, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 186, cingulum, lateral view; 187, endophallus, lateral view.



FIGS 188–196. *Oxya chinensis* (Thunberg), male terminalia and genitalia; 188, cercus, lateral view, of specimen from Chinese mainland; 189, same, from Maritime province, USSR; 190, same, from Manchuria; 191, supra-anal plate, dorsal view; 192, epiphallus; 193, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 194, cingulum, lateral view; 195, endophallus, lateral view; 196, apex of penis, ventral view.

subspecies see Text-fig. 203). Morphologically the two forms are only distinguishable on the features mentioned above, there being no significant differences in the structure of the male phallic complex and the female subgenital plate.

In the light of these zoogeographical and morphological points it seems logical to regard the form *tinkhami* as an allopatric population of *O. agavisa* with sufficient identity to warrant subspecific status.

Oxya chinensis (Thunberg, 1815)

(Text-figs 188–203)

Gryllus chinensis Thunberg, 1815: 253. Holotype ♀, CHINA, '*chinensis*, China' (ZIUU, Uppsala) [examined].

Gryllus lutescens Thunberg, 1815: 254. LECTOTYPE ♂, CHINA (ZIUU, Uppsala), here designated [examined]. [Synonymized by Willemse, 1955: 156.]

Oxya chinensis (Thunberg) var. *b;* Stål, 1873: 82.

Oxya vicina Brunner von Wattenwyl, 1893: 152. LECTOTYPE ♀, CHINA: Amoy (NM, Vienna), here designated [examined]. **Syn. n.**

[*Oxya velox* (Fabricius); Kirby, 1910: 393, partim. Misidentification.]

Oxya vicina Brunner von Wattenwyl; Kirby, 1914: 199.

Oxya vicina Brunner von Wattenwyl; I. Bolívar, 1918: 16.

Oxya adentata Willemse, 1925, 26; figs 20–22. Holotype ♂, CHINA, 'China, Shense prov., Taipaishan, 10.10.05' (BMNH) [examined]. **Syn. n.**

[*Oxya velox* (Fabricius); Willemse, 1925: 52, figs 58, 59. Misidentification.]

Oxya shanghaiensis Willemse, 1925: 54, figs 60, 61. Holotype ♀, CHINA: Shanghai, (NM, Vienna) [examined]. **Syn. n.**

Oxya manzhurica Bei-Bienko, 1929: 105, figs 2, 3. Holotype ♂, CHINA, 'Manchuria: Station Mangau, 12. viii. 1926' (ZI, Leningrad) [examined]. **Syn. n.**

Oxya rammei Tsai, 1931, 439: fig. 2. Holotype ♂, CHINA, China, Canton, 1912, Mell, S.V.' (MNHU, Berlin) [examined]. **Syn. n.**

Oxya chinensis (Thunberg); Liu and Li, 1933: 59, 11 figs.

[*Oxya velox* (Fabricius); Chang, 1934: 186. Misidentification.]

Oxya formosana Shiraki, 1937: 21. Syntypes, TAIWAN (lost). **Syn. n.**

Oxya manzhurica nakaii Furukawa, 1939: 84, figs 46, 47, 49–59, 62 (in Japanese); 161, figs 65, pl. 12, figs 3, 12, pl. 18, figs 2, 6, 13, pl. 19, figs 1, 5, 9, 13, 15, 17, 22 (in English). Holotype ♂, CHINA: Jehol (lost),. **Syn. n.**

[*Oxya velox* (Fabricius); Takana and Yanagihara, 1939: 76. Misidentification.]

[*Oxya velox* (Fabricius); Tinkham, 1940: 296. Misidentification.]

Oxya chinensis (Thunberg); Mishchenko, 1951: 167, figs 289, 296, 299, partim.

Oxya sinuosa Mishchenko, 1951 : 167, figs 281, 290, 300. Holotype (sex not given), KOREA (SOUTH): Seoul (ZI, Leningrad). **Syn. n.**

Oxya maritima Mischenko, 1951: 169, figs 313–315. Holotype (sex not given), USSR, Yakovlevka (ZI, Leningrad). **Syn. n.**

Oxya chinensis (Thunberg) Mishchenko, 1952: 155, partim.

[*Oxya velox* (Fabricius); Willemse, 1955: 153. Misidentification.]

Oxya sianensis Cheng Tse-ming, 1964: 885, figs 1–7. Holotype ♀, CHINA: Sian (Chinese Academy of Sciences, N. Region, Entomological Research Institute). **Syn. n.**

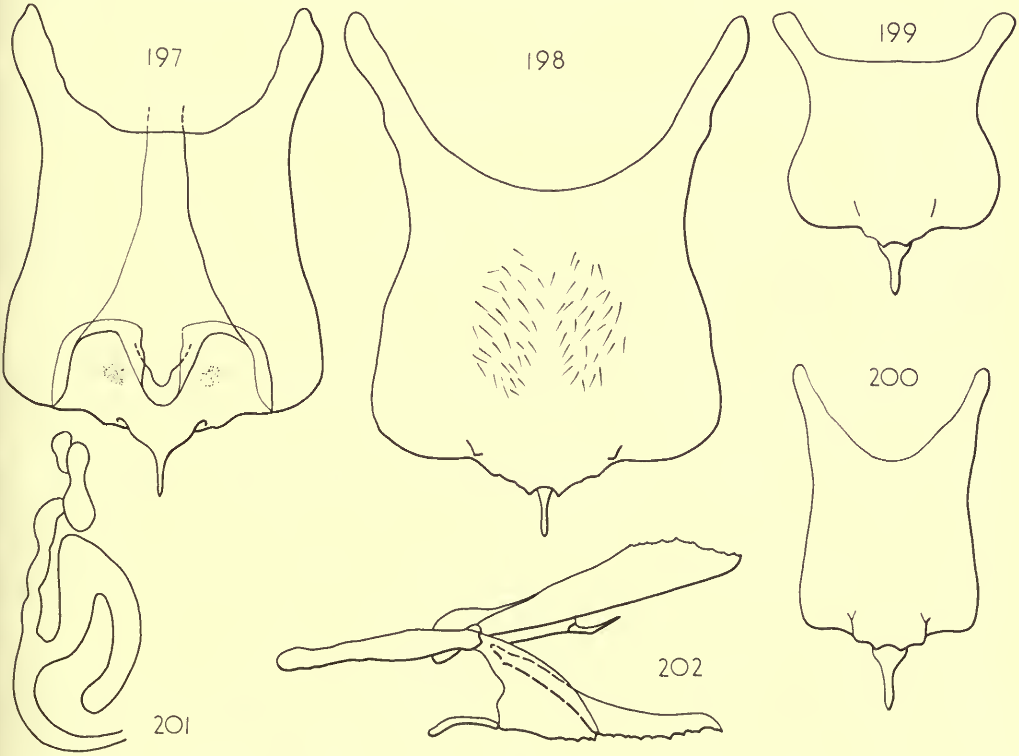
[*Oxya velox* (Fabricius); Yasumatsu and Watanabe, 1965: 1. Misidentification.]

Oxya formosana Shiraki; Fukuhara, 1966: 202.

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna as long as or slightly longer than combined lengths of head and pronotum. Interocular distance as wide as or slightly narrower than frontal ridge at median ocellus. Dorsum of pronotum flattened, almost parallel-sided. Tegmen fully developed. Supra-anal plate (Text-fig. 191) rounded triangular, without basilateral folds; cercus (Text-figs 188–190) conical, apex rounded or subacute. Epiphallus (Text-fig. 192) with narrow bridge, without ancorae, with hook-like outer lophi and moderately sized, tooth-like inner lophi; rest of phallic complex as in Text-figs 193–196; posterior process of cingulum rounded trapezoid in dorsal view; lateral fleshy lobes visible from above; valvular plate of cingulum broadly and deeply emarginate posteriorly; apical valves of penis long, slender, upcurved.

♀. Larger and more robust than ♂. Antenna shorter than combined lengths of head and pronotum. Interocular distance wider than frontal ridge at median ocellus. Anterior margin of tegmen weakly spined. Spermatheca as in Text-fig. 201; valves of ovipositor (Text-fig. 202) with tooth-like spines; posterior ventral basivalvular sclerite with a spine on its inner ventral margin; ventral surface of subgenital plate (Text-figs 198–200) convex, with or without traces of premarginilateral spines, posterior margin almost transverse, medial pair of spines small, closely spaced or absent.

Measurements (mm) – Length of body, ♂ 15·1–33·1, ♀ 19·6–40·5; pronotum, ♂ 3·3–6·6, ♀ 4·1–8·7; tegmen, ♂ 10·4–25·5, ♀ 11·4–32·6; hind femur, ♂ 9·7–18·2, ♀ 11·7–23·0; maximum width of hind femur, ♂ 1·9–3·8, ♀ 2·3–4·4; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·46, ♀ 3·54; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·31, ♀ 1·33; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·99. ♀ 5·00,



Figs 197–202. *Oxya chinensis* (Thunberg), female terminalia and genitalia; 197, subgenital plate, dorsal view; 198, same, ventral view, of specimen from Chinese mainland; 199, same, from Manchuria; 200, same, from Maritime province, USSR; 201, spermatheca; 202, ovipositor, lateral view.

Discussion. From a study of the types and other material of the species synonymized above, it is clear that it represents the ecological and geographical variations of *O. chinensis* (Thunberg). Around the coastal regions of the Chinese mainland individuals are generally larger, have longer tegmina and the male cercus is quite blunt apically (Text-fig. 188). Further inland in the montane regions specimens tend to be smaller, have relatively shorter tegmina and the male cerci appear truncate apically (Text-fig. 189). Island populations, e.g., from Hainan and Taiwan also have these tendencies. Populations from Manchuria and the Maritime province of USSR are even smaller and, the further north the population the shorter the tegmina become, while the male cerci are quite acute apically (Text-fig. 190). However in all these populations the male phallic complex has a remarkably stable morphology and there seems no valid reason for the retention of these specific names.

Material from the Ryuku Is and Japan which has been previously identified as *O. formosa* Shiraki varies very little from populations on the Chinese mainland.

O. chinensis may be identified by the form of the female ovipositor and subgenital plate and the male supra-anal plate and phallic complex. The female subgenital plate of *O. yezoensis* Shiraki is very similar but in the latter species the tegmina are relatively shorter. Japanese specimens of *O. chinensis* always have much longer tegmina.

Biological and economic references to this species may be found in Liu and Li (1933), Takana and Yanagihara (1939), Tinkham (1940) and Yasumatsu and Watanabe (1965).

Synonymy. The type-material of *Gryllus lutescens* Thunberg consists of three male specimens labelled α, β and γ. Specimens α and γ represent *O. japonica* (Thunberg) and specimen β is *O. chinensis* (Thunberg). In order not to disturb established synonymy (Willemse, 1925) specimen β, a male, is selected as LECTOTYPE for *G. lutescens* Thunberg.

Oxya vicina Brunner von Wattenwyl was described from several specimens of both sexes from Amoy, Shanghai, Hainan, Japan and 'Himalayas'. Willemse (1925) did not designate a lectotype from this material but assigned the specimens to various species. The Shanghai specimen was described as a new species, *O. shanghaiensis*. Of the Japanese specimens some were described as a new species, *O. japonica* Willemse (nec Thunberg), and others named as his *O. velox* (Fabricius) as were the specimens from Amoy, Hainan and 'Himalayas'. It is clear that Willemse's interpretation of *O. velox* (Fabricius) is the species identified here as *O. chinensis* (Thunberg). Again in order not to upset published synonymy the Amoy specimen is selected as lectotype for *O. vicina*.

The female holotype of *O. shanghaiensis* and the male holotype of *O. rammei* do not differ significantly from lowland Chinese populations of *O. chinensis* and are synonymized. Also, in my opinion, *O. adentata* Willemse, *O. manzhurica* Bei-Bienko, *O. manzhurica nakaii* Furukawa, *O. sinuosa* and *O. maritima* Mishchenko merely represent local and extreme variations of *O. chinesis* and are synonymized.

Correspondence with colleagues in Japan and Taiwan has established that the type-material of *O. formosana* Shiraki is lost. However the original description clearly separates this species from *O. japonica* (Thunberg) on the lack of lateral longitudinal ridges on the ventral surface of the female subgenital plate; so the above synonymy is made.

I have been unable to examine the type-series of *O. sianensis* Cheng Tse-ming but from the original description and figures there can be little doubt that the above synonymy is correct. The type-details are: Holotype ♀, Sian, Shensi, 450 m, 4.x.1962.

DISTRIBUTION (Text-fig. 203). Countries and months of capture, from 132 specimens examined.

USSR (Maritime Prov.): June, August, September; CHINA: July to December; TAIWAN: August; KOREA: October; JAPAN (including Ryuku Is); July to September; VIETNAM: no dates: 'HIMALAYAS'; no dates.

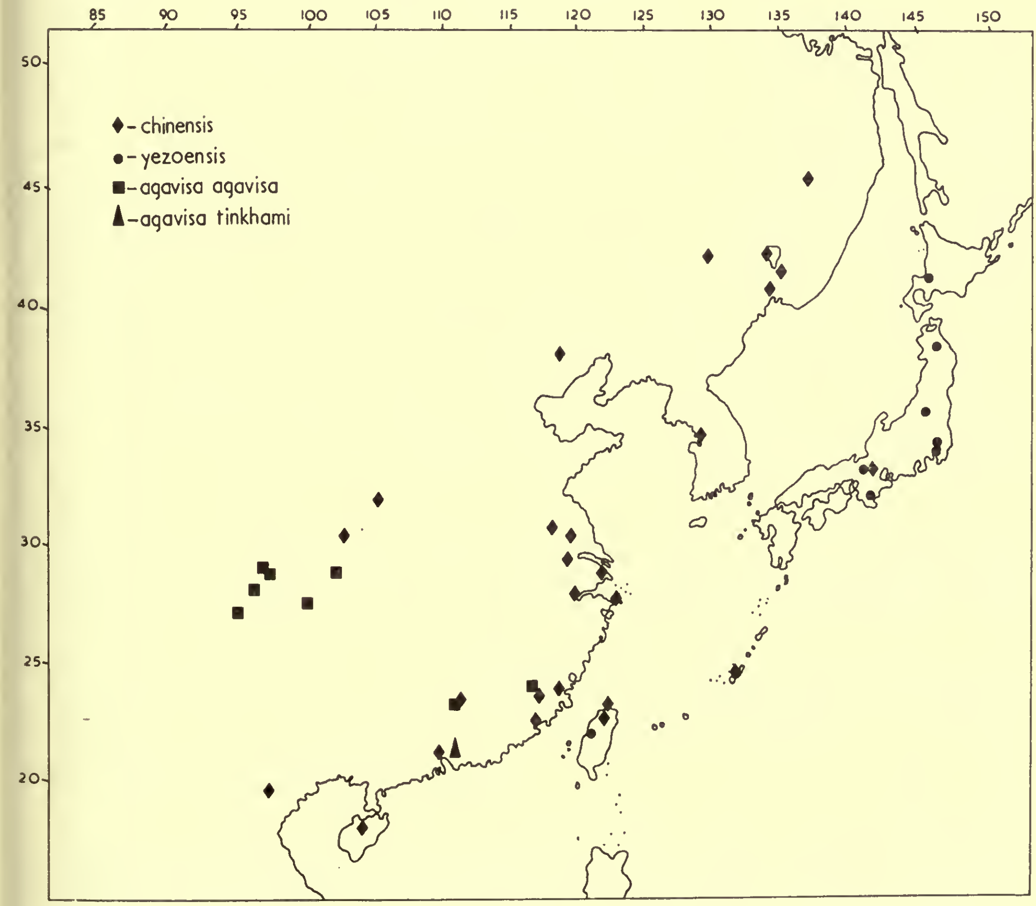


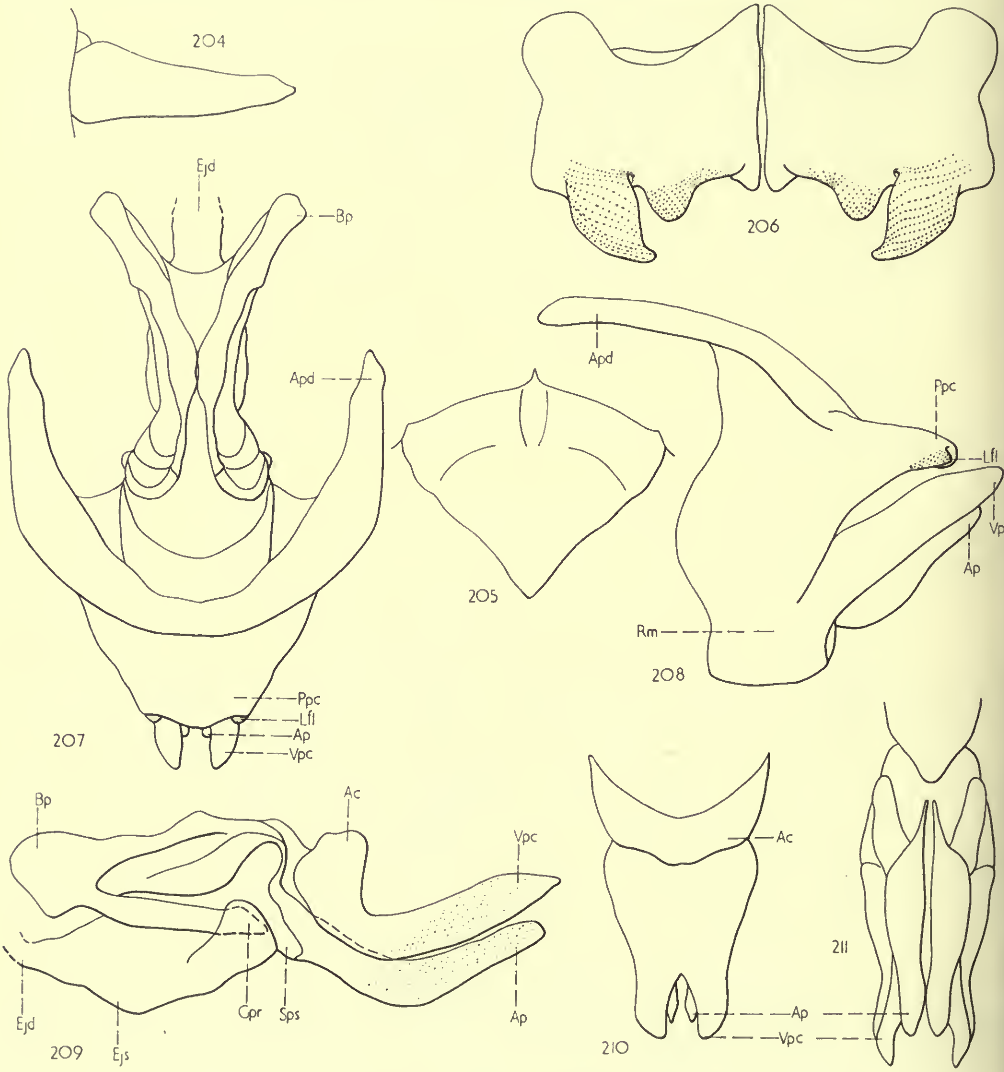
FIG. 203. *Oxya* spp., distribution map.

Oxya yezoensis Shiraki, 1910

(Text-figs 203–215)

Oxya yezoensis Shiraki, 1910: 43. Syntypes, JAPAN: Sapporo (lost). NEOTYPE ♂, 'Japan, Hokkaido, Nopporo Forest, 22.ix.1969 (Takagi, S.)' (ZIHU, Sapporo), here designated [examined].

[*Oxya vicina* Brunner von Wattenwyl, 1893: 152, partim. Mixed type-series.]



FIGS 204–211. *Oxya yezoensis* Shiraki, male terminalia and genitalia; 204, cercus, lateral view; 205, supra-anal plate, dorsal view; 206, epiphallus; 207, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 208, cingulum, lateral view; 209, endophallus, lateral view; 210, apex of penis, dorsal view; 211, same, ventral view.

Oxya podisma Karny, 1915: 86, LECTOTYPE ♂, TAIWAN, 'Hoozan, Formosa, H. Sauter, 1910' (DEI, Eberswalde), here designated [examined]. **Syn. n.**
Oxya yezoensis Shiraki; I. Bolívar, 1918: 43.
Oxya podisma Karny; Willemse, 1925; 17, figs 6–8.
Oxya yezoensis Shiraki; Willemse, 1925: 19, fig. 9.
Oxya japonica Willemse (nec Thunberg), 1925: 31, fig. 28. Holotype ♀, JAPAN, 'Japan, Mus. Caes. Vindobon. *Oxya vicina* Br. v. W.' (NM, Vienna) [examined]. [Synonymized by Fukuhara, 1966: 202.]
Oxya japonica Willemse; Mishchenko, 1951: 171, fig. 322, partim.
Oxya yezoensis Shiraki; Mishchenko, 1951: 171, fig. 323.
Oxya japonica Willemse; Mishchenko, 1952: 167, fig. 257, partim.
Oxya yezoensis Shiraki; Mishchenko, 1952: 168, fig. 258.
Oxya japonica Willemse; Murai, 1954: 1.
Oxya japonica Willemse; Iwata and Nagatomi, 1954: 23.
Oxya japonica Willemse; Murai, 1957: 22.
Oxya japonica Willemse; Suga, 1963: 867.
Oxya yezoensis Shiraki: Yasumatsu and Watanabe, 1965: 1.
Oxya japonica Willemse; Yasumatsu and Watanabe, 1965: 1.
Oxya yezoensis Shiraki; Grist and Lever, 1969: 286.

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna shorter or longer than combined lengths of head and pronotum. Interocular distance wider than frontal ridge at median ocellus. Dorsum of pronotum flattened, hardly narrowing forwards, posterior margin of metazona broadly obtuse-angular. Tegmen fully developed or shortened, never surpassing apex of hind femur and sometimes reduced almost to brachypterous condition. Supra-anal plate (Text-fig. 205) rounded triangular, without or with very weak basilateral folds; cercus (Text-fig. 204) conical, with subacute or weakly truncate apex. Epiphallus (Text-fig. 206) with narrow bridge, without ancorae, with hook-like outer lophi and large tooth-like inner lophi; rest of phallic complex as in Text-figs 207–211; posterior process of cingulum trapezoid from above; lateral fleshy lobes just visible from above; valvular plate of cingulum broadly and quite deeply incised posteriorly; apical valves of penis long and relatively stout.

♀. Larger and more robust than ♂. Antenna shorter than combined lengths of head and pronotum. Anterior margin of tegmen very weakly spined. Spermatheca as in Text-fig. 213; valves of ovipositor (Text-fig. 212) with tooth-like spines; posterior ventral basivalvular sclerite with a spine on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 214) convex, posterior margin almost transverse and either with a pair of small, closely spaced spines medially, or unarmed.

MEASUREMENTS (mm) – Length of body, ♂ 16·4–33·2, ♀ 18·9–38·5; pronotum, ♂ 3·5–6·9, ♀ 4·0–8·5; tegmen, ♂ 7·0–21·3, ♀ 7·7–26·8; hind femur, ♂ 9·4–17·8, ♀ 11·3–22·6; maximum width of hind femur, ♂ 2·1–3·7, ♀ 2·4–4·3; mean ratio of length of tegmen to pronotum (E/P), ♂ 2·35, ♀ 2·31; mean ratio of length of tegmen to hind femur (E/F), ♂ 0·85, ♀ 0·88 mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·62, ♀ 4·78.

DISCUSSION. This species is probably allied to *O. chinensis* (Thunberg), being distinguished from other Japanese species of the genus by the rather flat dorsum of the pronotum, the male phallic complex, and the shorter tegmina which do not extend beyond the apex of the hind femur.

SYNONYMY. Apart from having shorter tegmina, Karny's type-series of *O. podisma* shows no significant morphological difference from populations of *O. yezoensis* found in Hokkaido, Japan, and the above synonymy is made.

Willemse (1925) erected a new species *O. japonica* (nec Thunberg) from some of the Japanese specimens of Brunner von Wattenwyl's type-series of *O. vicina*. It is clear, however, that this material merely represents the more southern Japanese populations of *O. yezoensis* and Fukuhara's (1966) synonymy is accepted.

Biological and economic references on this species may be found in Murai (1954, 1957), Iwata and Nagatomi (1954), Suga (1963), Yasumatsu and Watanabe (1965) and Grist and Lever (1969).

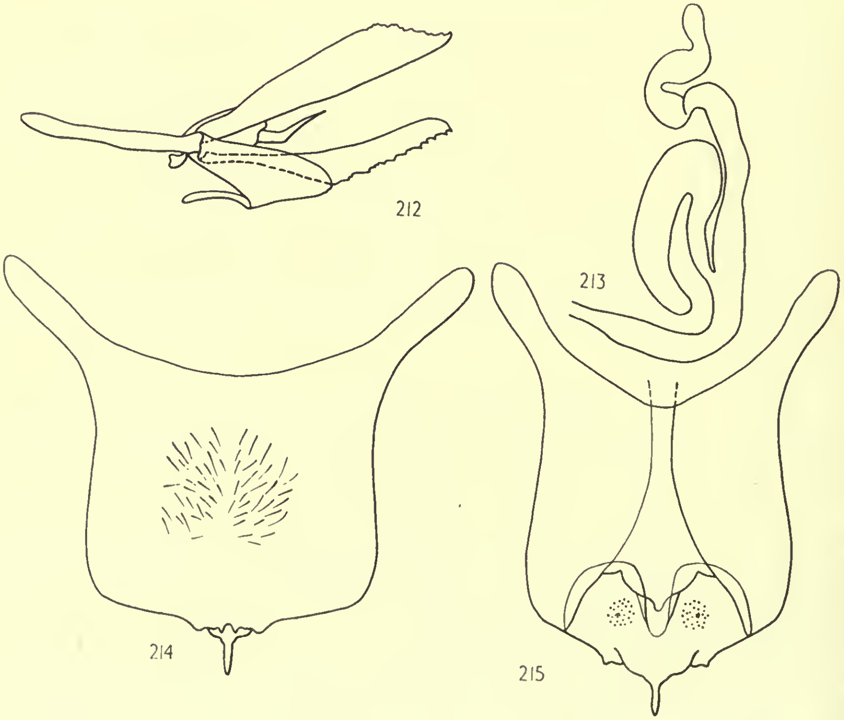
DISTRIBUTION (Text-fig. 203). Countries and months of capture, from 77 specimens examined.

TAIWAN: no dates; JAPAN: August to November.

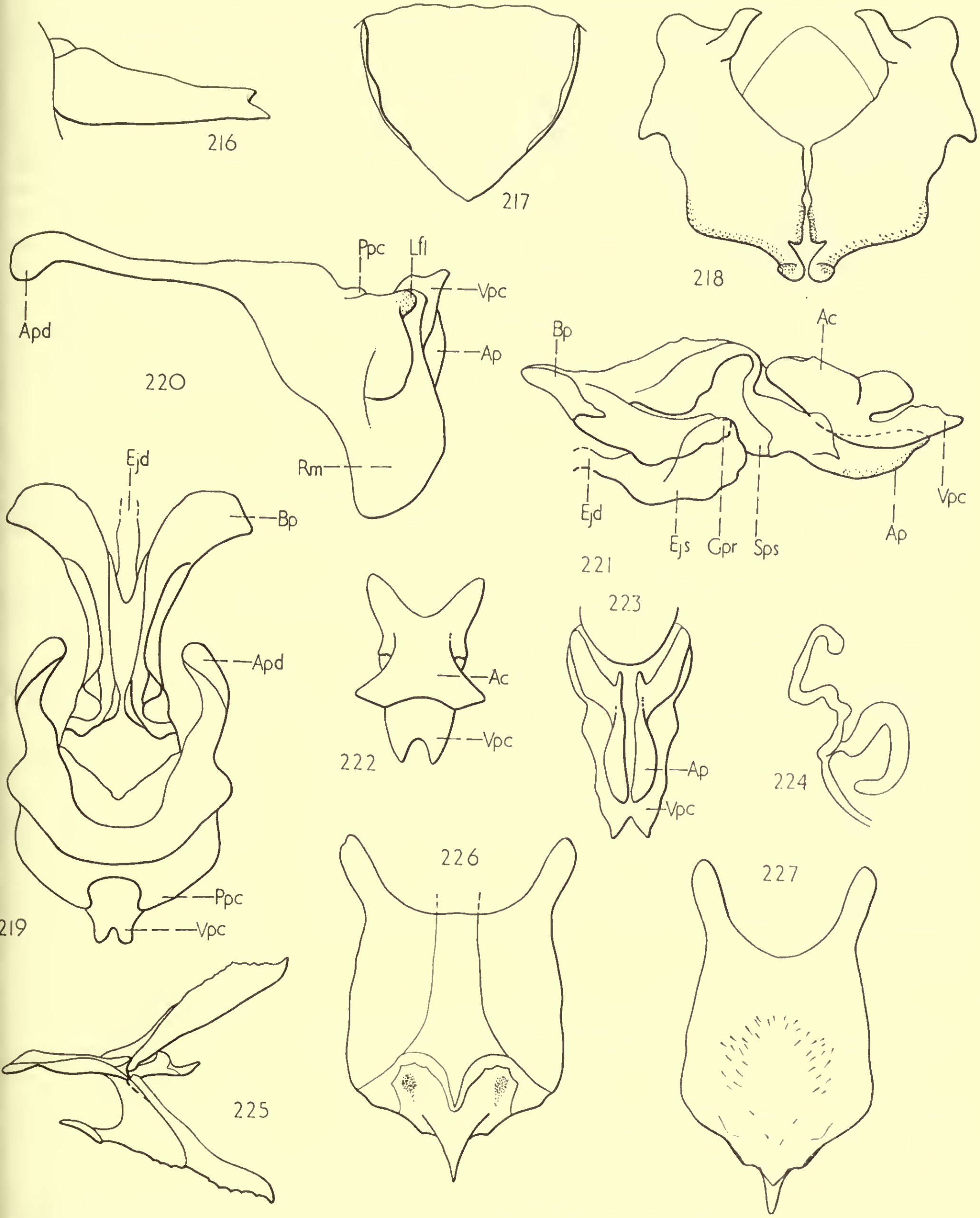
Oxya bidentata Willemse, 1925

(Text-figs 216–227, 245)

Oxya bidentata Willemse, 1925: 24, figs 16, 17. Holotype ♂, PAKISTAN (WEST), 'N.W. India, Peshawar Dist., Taru. 17–21.x.14, Fletcher coll.' (BMNH) [examined].
[*Oxya nitidula* (Walker); Willemse, 1925: 29, fig. 26. Misidentification.]
[*Oxya nitidula* (Walker); Chahal and Sardah Singh, 1966: 23. Misidentification.]
[*Oxya nitidula* (Walker); Chahal and Sardah Singh, 1967: 88. Misidentification.]
[*Oxya nitidula* (Walker); Cejchan, 1970: 246. Misidentification.]



FIGS 212–215. *Oxya yezoensis* Shiraki, female terminalia and genitalia; 212, ovipositor, lateral view; 213, spermatheca, 214, subgenital plate, ventral view, 215, same, dorsal view.



Figs 216–227. *Oxya bidentata* Willemse, terminalia and genitalia; male, 216, cercus, lateral view; 217, supra-anal plate, dorsal view; 218, epiphallus; 219, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 220, cingulum, lateral view; 221, endophallus, lateral view; 222, apex of penis, dorsal view; 223, same, ventral view; female, 224, spermatheca; 225, ovipositor, lateral view; 226, subgenital plate, dorsal view; 227, same, ventral view.

DIAGNOSIS. ♂. Integument finely pitted and shiny. Antenna as long as combined lengths of head and pronotum, with 22–24 segments. Interocular distance narrower than frontal ridge at median ocellus. Dorsum of pronotum flattened, hardly narrowing forwards, posterior margin of metazona rounded. Tegmen fully developed, well surpassing apex of hind femur. Supra-anal (Text-fig. 217) rounded triangular, without basilateral folds; cercus (Text-fig. 216) conical with bifurcate apex, both upper and lower lobes with subacute apices. Epiphallus (Text-fig. 218) with very broad, plate-like bridge, with ancorae, with narrow and strongly hook-like outer lophi and ridge-like inner lophi, epiphallic membrane thickened anteriorly between halves of bridge; rest of phallic complex as in Text-figs 219–223; posterior process of cingulum with broad posterior emargination; lateral fleshy lobes not visible from above; valvular plate of cingulum with broad posterior emargination; apical valves of penis short, stubby.

♀. Larger and more robust than ♂. Antenna slightly shorter than combined lengths of head and pronotum. Interocular distance slightly wider than frontal ridge at median ocellus. Anterior margin of tegmen without spines. Spermatheca as in Text-fig. 224; valves of ovipositor with tooth-like spines; posterior ventral basivascular sclerite without spines on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 227) convex or flat, posterior margin triangular.

MEASUREMENTS (mm) – Length of body, ♂ 18·1–21·9, ♀ 24·3–33·6; pronotum, ♂ 3·5–4·5, ♀ 4·5–6·2; tegmen, ♂ 15·2–20·3, ♀ 19·4–27·2; hind femur. ♂ 9·8–13·6, ♀ 12·5–17·5; maximum width of hind femur, ♂ 2·1–2·8, ♀ 2·8–3·5; mean ratio of length of tegmen to pronotum (E/P), ♂ 4·50, ♀ 4·25; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·64, ♀ 1·56; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·64, ♀ 4·70.

DISCUSSION. *O. bidentata* and the following two species form a distinct group, having in common a plate-like epiphallus which has ancorae and is totally different from that of other species in the genus.

Biological references to this species may be found in Chahal and Sardah Singh (1966 and 1967) under *O. nitidula* (Walker).

SYNONYMY. Uvarov (1926) correctly associated Willemse's 1925 identification and description of *O. nitidula* (Walker) with this species.

DISTRIBUTION (Text-fig. 245). Countries and months of capture, from 38 specimens examined.

AFGHANISTAN: July, August, October; W. PAKISTAN: June to August, October; IRAN: March, July.

***Oxya sinobidentata* sp. n.**

(Text-figs 228–233, 245)

[*Oxya bidentata* Willemse; Chang, 1934: 186. Misidentification.]
[*Oxya bidentata* Willemse; Tsai, 1931: 436. Misidentification.]
[*Oxya bidentata* Willemse; Tinkham, 1940: 293. Misidentification.]

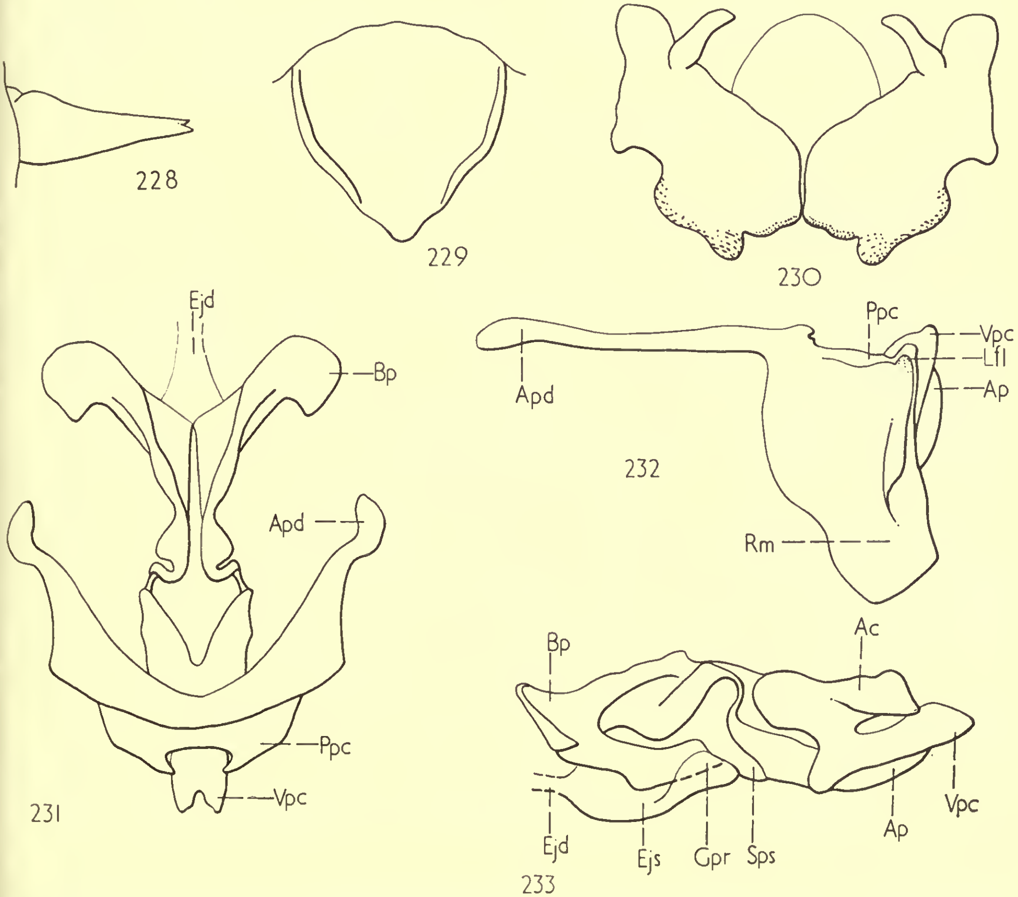
DIAGNOSIS. Very similar to *O. bidentata* Willemse, differing in that the tegmen is relatively shorter, the apical third of the hind femur is reddish brown and, in the male epiphallus, the inner lophi are more widely spaced and the outer lophi are rounded and not at all hook-like (Text-fig. 230).

MEASUREMENTS (mm) – Length of body, ♂ 17·7–19·9, ♀ 25·2–27·3; pronotum, ♂ 3·4–3·7, ♀ 4·4–5·0; tegmen, ♂ 13·7–15·2, ♀ 17·7–19·7; hind femur, ♂ 9·5–10·5, ♀ 12·0–13·9; maximum

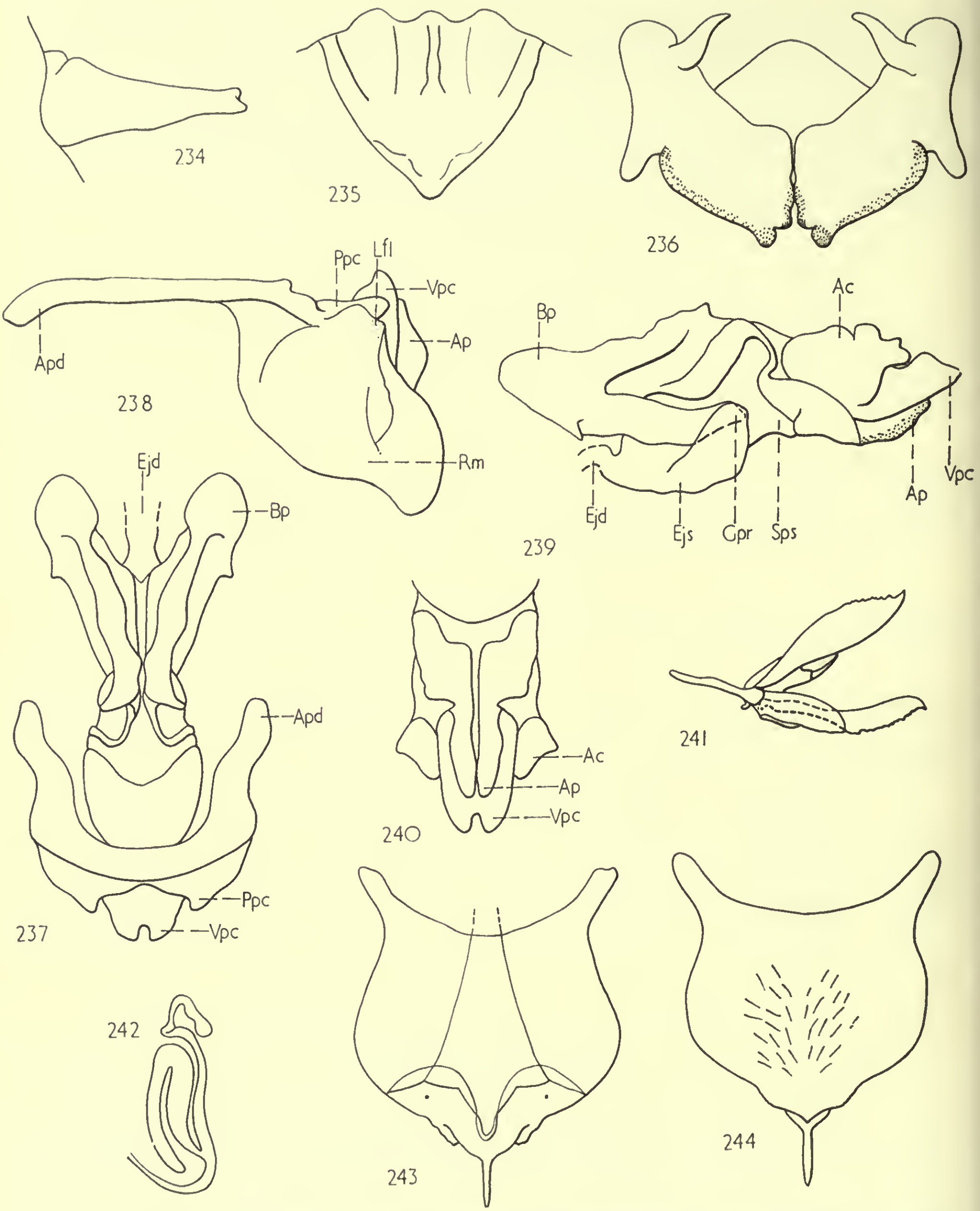
width of hind femur, ♂ 2·0–2·2, ♀ 2·4–2·9; mean ratio of length of tegmen to pronotum (E/P), ♂ 4·10, ♀ 3·98; mean ratio of length of tegmen to hind femur (E/F), ♂ 1·46, ♀ 1·42; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·69, ♀ 4·84.

Holotype ♂, CHINA, 'China: Nanking, vii/ix. 1936, T. L. Tsou,' deposited in BMNH.

Paratypes. CHINA: 1 ♀, same data as holotype (BMNH); 1 ♂, 1 ♀, Kiangsiu, ix (*Kolthoff*) (NM, Maastricht); 6 ♂, 4 ♀, Chekiang, Hangcheou, 1925 (*A. Pichon*) (1 ♂, 1 ♀ in NM, Maastricht, remainder in MNHN, Paris).



FIGS 228–233. *Oxya sinobidentata* sp. n., male terminalia and genitalia; 228, cercus, lateral view; 229, supra-anal plate, dorsal view; 230, epiphallus; 231, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 232, cingulum, lateral view; 233, endophallus, lateral view.



FIGS 234–244. *Oxya javana* Willemse, terminalia and genitalia; male 234, cercus, lateral view; 235, supra-anal plate, dorsal view; 236, epiphallus; 237, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 238, cingulum, lateral view; 239, endophallus, lateral view; 240, apex of penis, ventral view; female, 241, ovipositor, lateral view; 242, spermatheca; 243, subgenital plate, dorsal view; 244, same, ventral view.

Discussion. The differences found in the male epiphallus of this species from *O. bidentata* are constant and the two population groups appear to be reproductively isolated. In ANS, Philadelphia there are four females labelled 'Toungoo, Burma, A. V. B. Crumb'; these specimens have the hind femur reddened apically and their mean E/P and E/F ratios are 3·90 and 14·3 respectively; both characters suggesting *O. sinobidentata* sp. n. However, in the absence of males from this population I hesitate to include them as paratypes of *O. sinobidentata* and prefer to leave them doubtfully determined. Also in ANS, Philadelphia is a single female labelled 'Kwanhsien, China, Sze-chaun, 2800', viii.9.1930.'; this specimen agrees very well with the type-series of *O. sinobidentata* but the tegmina are reduced to a brachypterous condition (E/P = 1·93 and E/F = 0·69). Again in the absence of males this specimen is only doubtfully identified as *O. sinobidentata* and is not included in the type-series.

Biological references to this species may be found in Tinkham (1950) under *O. bidentata* Willemse.

Oxya javana Willemse, 1955

(Text-figs 234–245)

Oxya javana Willemse, 1955: 148, fig. 87, pl. 1, fig. 1. Holotype ♀, Java, 'Centr. Java, 700m., Aug. 1934, Dieng Mts., Telega Pengilon' (RNH, Leiden) [examined].

Diagnosis. Differs from *O. bidentata* in that it is smaller, antenna shorter than combined lengths of head and pronotum, and the tegmen is relatively shorter. Also differs from *O. sinobidentata* sp. n. in that hind femur is unicolourous. The male epiphallus is closer in shape to *bidentata* than *sinobidentata*.

Measurements (mm) – Length of body, ♂ 17·5–20·8, ♀ 23·4–24·9; pronotum, ♂ 3·5–3·9, ♀ 4·8–5·4; tegmen, ♂ 12·9–15·5, ♀ 16·6–18·4; hind femur, ♂ 10·2–10·9, ♀ 13·2–13·9; maximum width of hind femur, ♂ 2·3–2·5, ♀ 2·8–3·0; mean ratio of length of tegmen to pronotum (E/P), ♂ 3·78, ♀ 3·48; mean ratio of length of tegmen to hind femur, ♂ 1·33, ♀ 1·29; mean ratio of length of hind femur to its maximum width, ♂ 4·45, ♀ 4·56.

Discussion. *O. javana* Willemse is known only from the type-locality and has not been recorded since the original description. The form of the male epiphallus, cerci and supra-anal plate (Text-figs 234–236) and the female subgenital plate (Text-fig. 244) place the species in the *bidentata* group where it may be distinguished by the relatively shorter tegmina and unicolorous hind femora.

The evidence would suggest that *javana*, *sinobidentata* and *bidentata* populations are closely related and have undergone divergent evolution through geographical isolation.

Distribution (Text-fig. 245). Known only from the type-series.

Oxya paravicina Willemse, 1925

(Text-figs 245–257)

Oxya paravicina Willemse, 1925: 55, figs 62, 63. Holotype ♂, India, 'Col. Br. v. W., Hinterindien, Thorey' (NM, Vienna) [examined].

Diagnosis. ♂. Integument finely pitted and shiny. Antenna longer than combined lengths of head and pronotum, with 24 segments. Interocular distance narrower than frontal ridge at median ocellus. Dorsum of pronotum almost cylindrical, with parallel sides; posterior margin of metazona rounded. Tegmen strongly reduced, extending to posterior margin of third abdominal tergite, along the dorsal mid line of the tegmina hardly touch; hind wing strap-like, slightly shorter than tegmen. Posterior margin of 10th abdominal tergite (Text-fig. 247) with a rhomboidal projection on either side of the mid line; supra-anal plate (Text-fig. 247) trapezoid with rounded triangular posterior projection; cercus (Text-fig. 246) conical with dorso-ventral flattening apically. Epiphallus (Text-fig. 248) with narrow bridge, with ancorae, with large rounded outer lophi and two pairs of small tooth-like inner lophi, the very inner pair more sharply pointed; rest of phallic complex as in Text-fig. 249–253; posterior process of cingulum with a median emargination posteriorly; lateral fleshy lobes visible from above; valvular plate of cingulum with small median emargination posteriorly; apical valves of penis short, slender.

♀. Larger and more robust than ♂. Antenna with 26 segments, as long as combined lengths of head and pronotum. Interocular distance as wide as or slightly wider than frontal ridge at median ocellus. Tegmina very reduced, extending just past posterior margin of third abdominal tergite. Spermatheca as in Text-fig. 254; pre-apical diverticulum much more convoluted than usual for genus and with several small subdiverticula; valves of ovipositor (Text-fig. 255) with tooth-like spines, posterior ventral basivalvular sclerite without spines on inner ventral margin; ventral surface of subgenital plate (Text-fig. 256) convex or flat, with two very widely spaced spines on posterior margin.

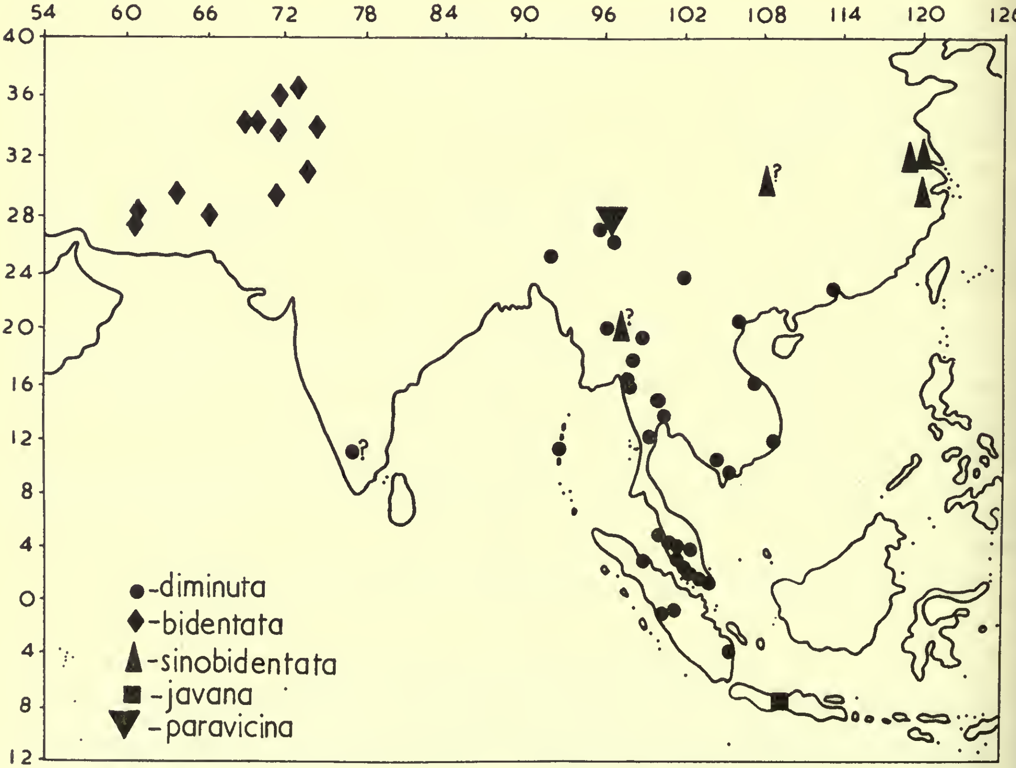
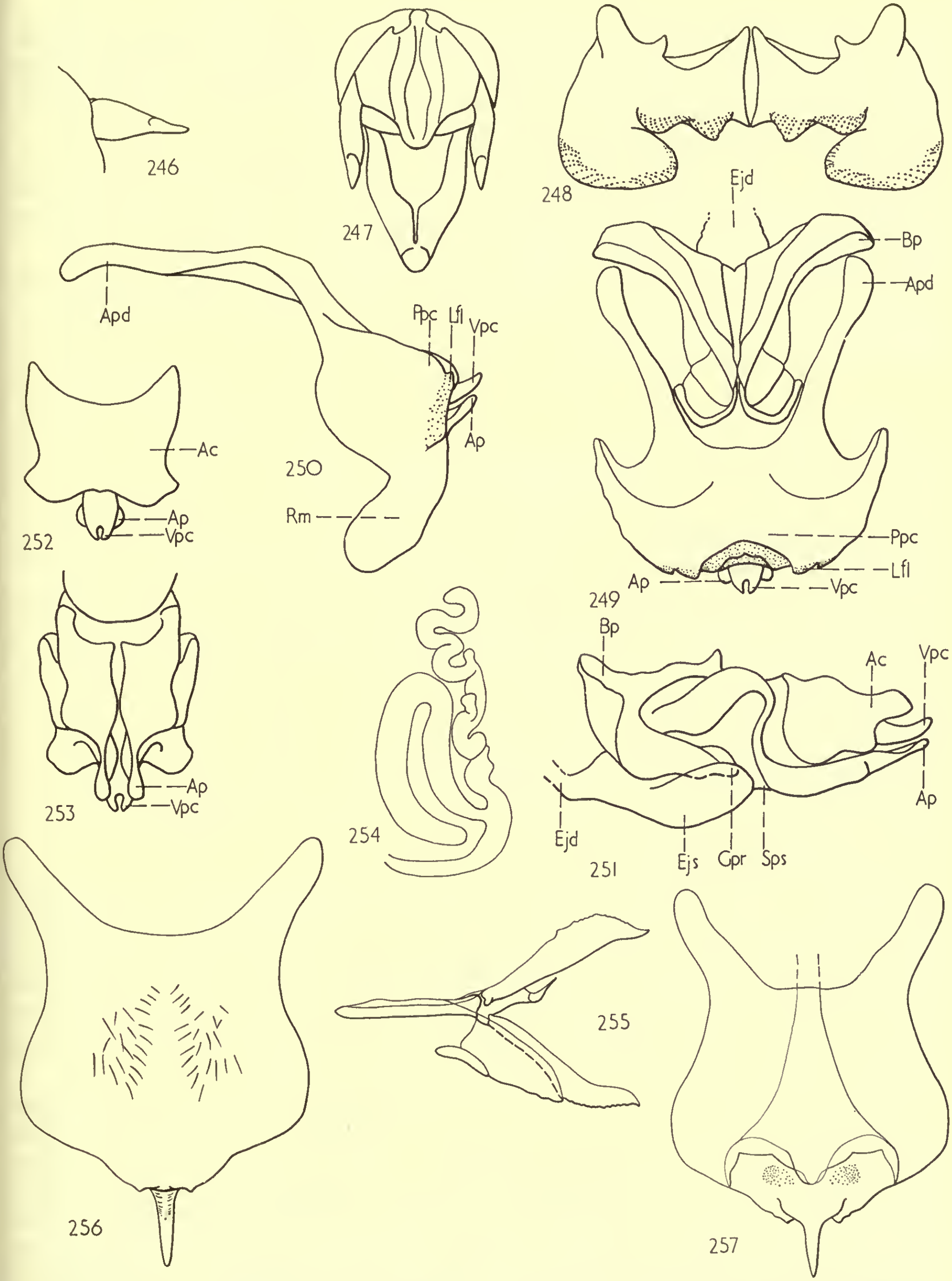


Fig. 245. *Oxya* spp., distribution map.



FIGS 246–257. *Oxya paravicina* Willemse, terminalia and genitalia; male, 246, cercus, lateral view (from dry specimen); 247, apex of abdomen, dorsal view (from dry specimen); 248 epiphallus; 249, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 250, cingulum, lateral view; 251, endophallus, lateral view, 252; apex of penis, dorsal view; 253, same, ventral view; female, 254, spermatheca; 255, ovipositor, lateral view; 256, subgenital plate, ventral view; 257, same, dorsal view.

Measurements (mm) – Length of body, ♂ 22·0–25·3, ♀ 31·5–34·1; pronotum, ♂ 4·8–5·7, ♀ 6·8–7·3; tegmen, ♂ 5·1–6·2, ♀ 8·0–9·4; hind femur, ♂ 13·1–14·3, ♀ 17·2–18·5; maximum width of hind femur, ♂ 2·7–3·1, ♀ 3·4–3·8; mean ratio of length of tegmen to pronotum (E/P) ♂ 1·07, ♀ 1·24; mean ratio of length of tegmen to hind femur (E/F), ♂ 0·41, ♀ 0·50; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·73, ♀ 4·89.

Discussion. *O. paravicina* Willemse is quite distinct from all other species in the genus and may be easily recognized by the almost micropterous condition of the tegmina and hind wings, the form of the hind margin of the ♂ 10th abdominal tergite and the two pairs of inner lophi of the epiphallus.

Distribution (Text-fig. 245). Country and months of capture, from 10 specimens examined.

India (North-east): July, October.

Oxya diminuta Walker, 1871

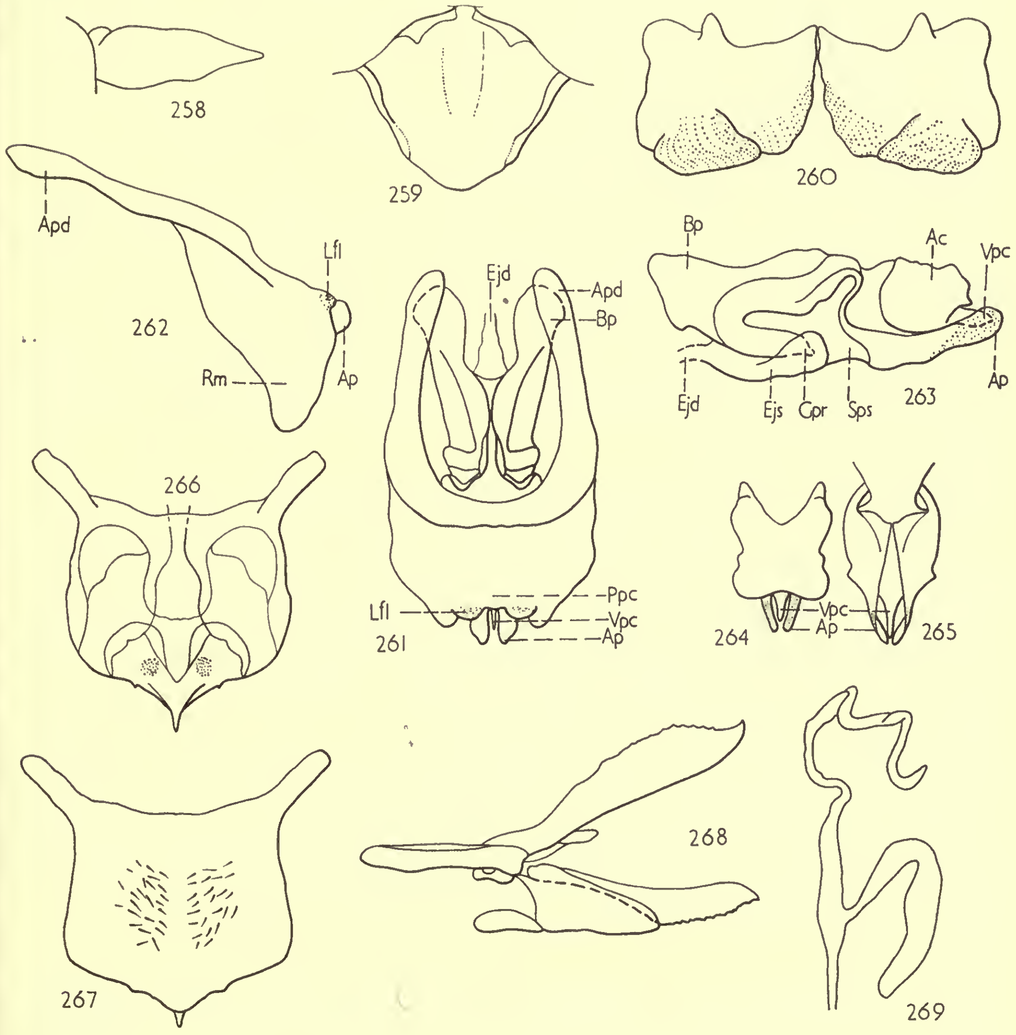
(Text-figs 245, 258–269)

Oxya diminuta Walker, 1871: 64. Holotype ♀ [not ♂ as stated by Walker], China: Yunan, (BMNH) [examined].
Oxya rufipes Brunner von Wattenwyl, 1893: 153. LECTOTYPE ♂, Cambodia (NM, Vienna), here designated [examined]. [Synonymized by Willemse, 1921: 42.]
[*Oxya intricata* (Stål); Brunner von Wattenwyl, 1893: 153, partim. Misidentification.]
Traulia diminuta (Walker) Kirby, 1910: 476.
Oxya rufipes Brunner von Wattenwyl; I. Bolivar, 1918: 16.
Oxya diminuta Walker; Willemse, 1925: 13, figs 1–3.
Oxya diminuta f. *macroptera* Willemse, 1925: 15; Willemse, 1955: 146.
Oxya rufipes Brunner von Wattenwyl; Fulmek, 1926: 2, 4.
Oxya diminuta Walker; Tinkham, 1940: 292.
Oxya diminuta Walker; Kalshoven and Van der Vecht, 1950: 108.
Oxya diminuta Walker; Willemse, 1955: 146.

Type-Data. In the BMNH there is a female bearing a British Museum type-label, and a label on which is written on one side, in F. Moore's handwriting, '*Oxya diminuta* Walk. W. Yunan (type)', and on the other side, in a different hand, the registration number '91 53', and in yet a third hand '80'. Below the specimen is the label 'Yunan' cut out from Walker's catalogue (1871). Walker's original description mentions only a male from 'Yunan, in Dr Anderson's collection'. Willemse (1925 and 1955) mentions the type of *O. diminuta* Walker as a male.

Dr John Anderson was the medical officer and naturalist on the 1867–8 expedition to W. Yunan (Anderson, 1871) and it seems that Walker described *O. diminuta* from a specimen in Dr Anderson's collection. Between 1870 and 1891 Anderson must have passed over his collection to F. Moore as the BMNH registration entry under 1891: 53 includes '17 types of Orthoptera and Neuroptera purchased from F. Moore' and the type of *O. diminuta* Walker appears to be one of these specimens. It seems therefore that Walker misidentified the sex of this specimen and his mistake was copied by Willemse.

Diagnosis. ♂. Integument more coarsely pitted and matt. Antenna about as long as combined lengths of head and pronotum, with 21–23 segments. Interocular distance slightly narrower than frontal ridge at median ocellus. Dorsum of pronotum flattened, parallel-sided. Tegmina normally abreviated and not extending to apex of abdomen, rarely fully developed. Posterior margin of 10th abdominal tergite (Text-fig. 259) with a pair of rectangular projections



Figs 258–269. *Oxya diminuta* Walker, terminalia and genitalia; male, 258, cercus, lateral view; 259, supra-anal plate, dorsal view; 260, epiphallus; 261, phallic complex, dorsal view, epiphallus and ectophallic membrane removed; 262, cingulum, lateral view; 263, endophallus, lateral view; 264, apex of penis, dorsal view; 265, same, ventral view; female, 266, subgenital plate, dorsal view; 267, same, ventral view; 268, ovipositor, lateral view; 269, spermatheca.

medially; supra-anal plate (Text-fig. 259) rounded triangular; cercus (Text-fig. 258) conical with subacute apex. Epiphallus (Text-fig. 260) with narrow bridge, with ancorae, with boot-shaped outer lophi and irregularly shaped inner lophi; rest of phallic complex as in Text-figs 261–265; posterior process of cingulum with a median posterior emargination; lateral fleshy lobes visible from above; valvular plate of cingulum narrow, forming a central rod-like structure apically; apical valves of penis short, laterally flattened and slightly twisted.

♀. Larger and more robust than ♂. Antenna shorter than combined lengths of head and pronotum. Interocular distance as wide as frontal ridge at median ocellus. Anterior margin of tegmen without spines. Spermatheca as in Text-fig. 269; valves ovipositor (Text-fig. 268) with tooth-like spines, posterior ventral basivalvular sclerite without spines on its inner ventral margin; ventral surface of subgenital plate (Text-fig. 267) flat or convex, posterior margin rounded triangular, without spines.

COLORATION. Striking in that hind femur is either all green or yellow with diffuse black markings, and the hind tibia is completely bright red.

MEASUREMENTS (mm) – Length of body, ♂ 15·6–18·3, ♀ 19·9–25·4; pronotum, ♂ 3·6–4·4, ♀ 4·6–5·6; tegmen, ♂ 7·1–10·2, ♀ 8·6–16·4; hind femur, ♂ 9·6–11·8, ♀ 11·9–14·3; maximum width of hind femur, ♂ 2·4–2·8, ♀ 2·8–3·5; mean ratio of length of tegmen to pronotum (E/P), ♂ 2·12, ♀ 2·16; mean ratio of length of tegmen to hind femur (E/F), ♂ 0·80, ♀ 0·84; mean ratio of length of hind femur to its maximum width (FL/FW), ♂ 4·11, ♀ 4·18.

DISCUSSION. *Oxya diminuta* Walker is quite variable in size, general coloration and the relative length of the tegmina. It is quite distinct from all other species in the genus and may be easily identified by its bright red hind tibiae, abbreviated tegmina and matt integument.

Biological and economic references to this species may be found in Fulmek (1926), Tinkham (1940) and Kalshoven and Van der Vecht (1950).

SYNONYMY. Kirby (1910) transferred this species to the genus *Traulia* but Willemse (1921) recombined it with *Oxya* and, at the same time, placed *O. rufipes* Brunner von Wattenwyl into its synonymy. The latter species was described from several specimens of both sexes from Cambodia, Cochinchina, Penang and Sumatra. A male from this series labelled 'Coll. Br. v. W., Cambodia, S. Stevens. *Oxya rufipes* det. Br. v. W'. is selected as LECTOTYPE.

Brunner von Wattenwyl, in his discussion of *O. intricata* (Stål), mentions a variety with red legs from Cambodia. This specimen was described as *O. diminuta* f. *macroptera* by Willemse (1925). Although the usual tendency in this species is towards abbreviated tegmina, several specimens from various localities have been examined where the tegmina extend to at least the apex of the abdomen in the female and this character is thought to be of individual variability.

DISTRIBUTION (Text-fig. 245). Countries and months of capture, from 201 specimens examined.

INDIA (North-east): July, December; BURMA: February, March, September; ANDAMAN IS: February, August; CHINA: March, November, December; THAILAND: January to June, September, October; LAOS: no dates; CAMBODIA: no dates; VIETNAM: no dates; WEST MALAYSIA: all year round; SINGAPORE: no dates; SUMATRA: September through to January, March, April, June, July.

(In ANS, Philadelphia there are two males labelled 'Coonoor, S. India, 5,000', v.19.1923 (P. S. Nathan)'; this labelling is regarded as very doubtful.)

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D. Hollis, B.Sc.
Department of Entomology
British Museum (Natural History)
Cromwell Road
London, SW7 5BD

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K. G. V. SMITH

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A REVISION OF FRANCIS WALKER'S TYPES OF NORTH AMERICAN EMPIDIDAE (DIPTERA)

BY

KENNETH GEORGE VALENTINE SMITH

Pp. 345–370; 3 *Plates*; 16 *Text-figures*

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THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

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A REVISION OF FRANCIS WALKER'S TYPES OF NORTH AMERICAN EMPIDIDAE (DIPTERA)

By K. G. V. SMITH

CONTENTS

SYNOPSIS

Francis Walker's types of Nearctic Empididae are revised, and illustrated; redescriptions, new combinations and lectotype designations are given where necessary. Seven specific synonyms are newly established. One Jamaican species is included.

INTRODUCTION

WALKER described 42 Nearctic Empididae, 34 in his 'List of the specimens of Dipterous insects in the collection of the British Museum' (1848–1854) and a further 8 from W. W. Saunders' collections (Walker, 1852, 1857). These species have been variously interpreted by American workers, while some have remained unrecognized.

During a curatorial revision of the collection of Empididae in the British Museum (Natural History) (BMNH), types of 38 of Walker's species of Nearctic Empididae have been located. Since the recent Catalogue of Nearctic Diptera (Stone *et al.*, 1965) contains several errors of interpretation of Walker species, a revision of his types is given here and where necessary lectotypes are designated, new combinations made and new synonymy established. One Jamaican species (*Platypalpus bacis* Walker) previously misinterpreted is also included.

Certain genera such as *Rhamphomyia* have as yet received little critical attention in North America and it is possible that further new synonymy involving Walker species will eventually be established. However, adequate illustrated redescriptions are given here to render such synonymy obvious to future revisers of Nearctic Empididae.

The arrangement of subfamilies and genera follows that of the Nearctic Catalogue (Stone *et al.*, 1965). Within each genus, species are arranged in alphabetical order of Walker's names, irrespective of synonymy, except in the case where two Walker names are involved, when the valid one is taken. For convenience, Walker's original binomina are indexed at the end of this paper, with their present equivalents and synonyms.

Detailed redescriptions are deliberately not given since future Nearctic revisers with fresh material will be better able to provide these. The types are available, but their generally poor condition precludes the possibility of a consistent standard of redescription. Where possible wing photographs, genitalia figures and brief redescriptions based on major characters, relevant to existing keys, are given. These are considered adequate for accurate identification by future revisers, but in some genera, especially where associated females are little known, the types may need further careful study. Where types are unlocated, Walker's descriptions are given for convenience since the original works are rare.

To avoid repetition, collectors and data labels present on the type-specimens dealt with in this paper are referred to only briefly in the text, but are explained fully below. Further notes on these collections and donors are given by C. O. Waterhouse (1902).

Abbot labels are rectangular, with 'Georgia' printed on them.

Barnston labels are circular with 'Huds. Bay' on one side and the accession number '47.4' on the other.

Doubleday labels are circular or rectangular with 'Trenton Doubleday' or 'N. York Doubleday' handwritten upon them.

Entomological Club specimens bear a printed label 'Ent. Club. 44-12'.

Gosse labels are circular with handwritten 'Jamaica' on one side and B.M. accession number 45.110 on the other.

Redman labels are usually diamond-shaped, with a handwritten 'R' upon them, or circular with 'Redman' on one side and 'Nova Scotia' on the other.

Saunders labels are circular or rectangular with 'U.S.' handwritten upon them.

Walker labels are rectangular folded strips, usually with just the specific (trivial) name handwritten.

Waterhouse labels are printed 'One of Walker's series so named', signed 'EAW' and with the name of the species neatly written by Waterhouse on the verso.

The green-margined Walker Type labels and printed locality and species names are not mentioned since these have been subsequently and sometimes arbitrarily attached. A lectotype label and a lectotype designation label have been added where necessary.

WALKER'S TYPES OF NORTH AMERICAN EMPIDIDAE

Subfamily **HYBOTINAE**

Hybos reversus Walker

(Pl. 1, fig. 1)

Hybos reversus Walker, 1848 : 487. [No sex given.] Holotype ♂, U.S.A.: New York, Trenton Falls (*E. Doubleday*).

The holotype was very mouldy, but has now been cleaned and is in quite good condition, except that the distal half of the abdomen is missing. Doubleday and Waterhouse labels are present.

The wings (Pl. 1, fig. 1) are distinctly brownish on the distal two-thirds, a feature of the male sex in this species.

There seems little doubt that this species has been correctly interpreted in the literature and the type runs without difficulty to *H. reversus* in Melander's (1928) key to Nearctic *Hybos*.

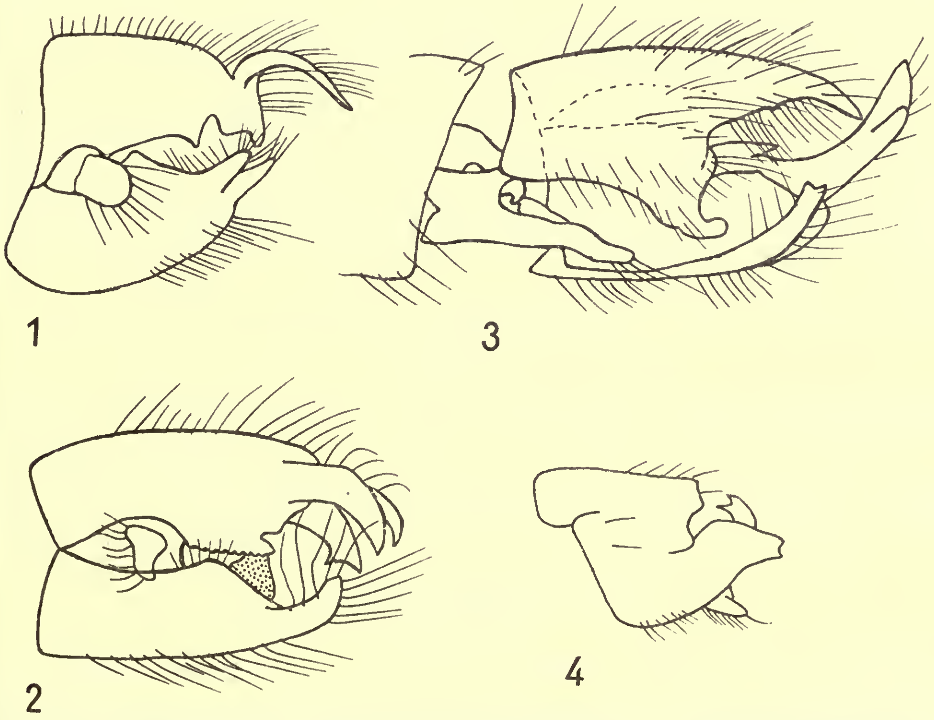
Euhybus duplex (Walker)

(Pl. 1, fig. 2; Text-fig. 1)

Hybos duplex Walker, 1848 : 486. Holotype ♂, U.S.A.: New York, Trenton Falls (*E. Doubleday*).

The holotype does not fit the interpretation given by Melander (1928) and is therefore redescribed. It bears a circular 'N. York, Doubleday' label and a Waterhouse label. The redescription includes only major characters of value for differentiating the species from others in the genus.

Thorax apparently without strong dorsocentrals, but pinned through this area. Wing (Pl. 1, fig. 2) brownish on basal half and stigma, greyish distally. Legs black with tarsi and knees yellowish. Front legs with pulvilli normal and basitarsus longer than second tarsal



FIGS 1–4. Male genitalia. 1, *Euhybus duplex*, holotype. 2, *E. subjectus*, lectotype. 3, *E. triplex*, holotype. 4, *Syneches phthia*, holotype.

segment. Hind femur strongly bristled, but without strong spinigerous tubercles and hind tibia not excavated or prominently margined. Hind basitarsus *with* 4 short strong anterior bristles. Genitalia as illustrated (Text-fig. 1).

Length: 3·5 mm.

Euhybus purpureus (Walker)

(Pl. 1, fig. 3)

Hybos purpureus Walker, 1848 : 486. Holotype ♀, U.S.A.: Georgia (*Mr Abbot*).

Coquillett (1895) erected *Euhybus* to receive three Walker *Hybos* of which *H. purpureus* is the type-species (Coquillett, 1903).

The holotype ♀ is in fair condition and exhibits well the characters of the genus. An Abbot label is present. The species has the basal half of the wing brownish (Pl. 1, fig. 3) and appears to have been correctly interpreted in the literature.

Euhybus subjectus (Walker)

(Pl. 1, fig. 4; Text-fig. 2)

Hybos subjectus Walker, 1848 : 487. [No sex given.] LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

There are three Walker specimens labelled as *subjectus*, a male, female, and a damaged specimen of uncertain sex. They appear conspecific, and all bear Barnston and Waterhouse labels. The male bears a green Walker label and is designated lectotype. It is in poor condition, lacking a head and three legs.

Thorax apparently without strong dorsocentrals, but the specimen is pinned through this area. Wing (Pl. 1, fig. 4) distinctly brown on a little more than basal half and greyish distally and without distinct stigma. Legs black with tarsi and knees yellowish. Front legs with pulvilli normal and basitarsus longer than second tarsal segment. Hind femur strongly bristled, but without strong spinigerous tubercles and hind tibia not excavated or prominently margined. Hind basitarsus *without* strong anterior bristles. Genitalia as illustrated (Text-fig. 2).

Length: *ca* 3 mm.

Euhybus triplex (Walker)

(Text-fig. 3)

Hybos triplex Walker, 1849 : 486. Holotype ♂, U.S.A.: New York, Trenton (*E. Doubleday*).

The holotype male is in rather a crumpled state and mouldy, but appears to be correctly interpreted in the American literature. Doubleday and Waterhouse labels are present. The genitalia are illustrated (Text-fig. 3).

Syneches bacis (Walker) **comb. n.**

(Pl. 1, fig. 5)

Platypalpus bacis Walker, 1849 : 510. [No sex given.] Holotype, sex uncertain, JAMAICA (*P. H. Gosse*).

This species, described in *Platypalpus*, was regarded as a *Tachypeza* by Bezzi (1905 : 460) and later placed in *Elaphropeza* (=*Ctenodrapetis*) by Bezzi (1909*b*) and

Melander (1910, 1928), where it was included in the Empididae section of the Catalogue of Neotropical Diptera (Smith, 1967). I have now located and examined the holotype and it is a *Syneches*, bearing Gosse and Waterhouse labels. Only one *Syneches* has been recorded from Jamaica, *S. inversus* Curran (1928), but this is a larger darker species. The species appears to be distinct from any other Nearctic and Neotropical species and, although damaged, sufficient remains for a future reviser of the genus to work on. Since existing keys give mostly colour characters, the following brief description should suffice to indicate its approximate taxonomic position, which from the keys of Melander (1902) and Smith (1962) would appear to be near *S. debilis* Coquillett or *S. luteus* (Wiedemann).

Basal antennal segments yellowish, third segment and arista brownish. Proboscis and palpi yellowish. Thorax completely reddish yellow. Abdomen missing but Walker described this as 'piceous above'. The legs are completely yellow, except for the hind tibia, which is brownish at tip. The wing is clear (Pl. 1, fig. 5) with a well-defined oval stigma. Halteres broken off.

Length: *ca* 3·5 mm.

There is a *Sphaerophoria* sp. on the same pin, presumably taken as prey.

Syneches phthia (Walker)

(Pl. 1, fig. 6; Text-fig. 4)

Gloma phthia Walker, 1849 : 492. Holotype ♂, U.S.A.: New York, Trenton Falls (*E. Doubleday*).

The holotype male is badly damaged and bears a Doubleday label, a Waterhouse label and a pencil ms label 'Syneches S.W.W.', the last being by Professor S. W. Williston. As I have indicated elsewhere (Smith, 1962) this specimen is not conspecific with *simplex* Walker, the type-species of *Syneches* Walker (1852 : 165) (see under *simplex*, below), as can be seen from the description and illustrations given here.

Melander (1928 : 39) states 'This insect was previously described as *Gloma phthia*, according to Dr. Williston who examined Walker's type. The enigmatical crossveins in the description of *phthia* refer to the two stigmal markings'. Actually Walker's comments were given as a note after the description as follows.

> 'Note.—The wings of this species have two crossveins, which do not appear in the wings of *G. fuscipennis*, and the fork of the vein at the tip is missing.'

The only explanation I can offer for these comments is that the veins closing the discal and anal cells, being more vertical in the *Syneches* wing, were referred to as cross-veins by Walker.

Head missing. Thorax and abdomen dull brown with pale hairs, genitalia as illustrated (Text-fig. 4). Wings (Pl. 1, fig. 6) greyish with brown stigma. Halteres dark. Legs missing except for one hind leg, in which the femur and tibia are brown and the tarsus yellow.

Syneches simplex Walker

(Pl. 1, fig. 7)

Syneches simplex Walker, 1852 : 165. ♂, 'United States' (*W. W. Saunders*).

The type of this species appears to be lost and since this is the type-species of the genus, I repeat Walker's description here and figure the wing (Pl. 1, fig. 7) of a recent

American specimen. The species is quite distinct from *phthia*, with which it has previously been synonymized as discussed under that species, but has otherwise been correctly interpreted in the literature.

'SYNECHES, n. g.

'Antennis articuli breves; 3us 2o multo latior vix longior; seta capite vix brevior articulis 1o ad 3um triplo longior; alae costa incisa; areolae undecim, duo marginales, una submarginalis, una apicalis, duo posteriores, una inferior, tres basales, una discoidalis.

'Joints of the feelers short; third joint nearly round, much broader but hardly longer than the second joint; bristle very slender, about thrice the length of all the preceding joints, nearly as long as the head: chest gibbous: fore border of the wing slightly notched towards the brand: two marginal areolets, one submarginal, one apical, two posterior, one inferior, three basal, and one discoidal.

'SYNECHES SIMPLEX, Mas, Plate 5, fig. 7

'Fusca, thorace vittis indistinctis fulvis ornato, abdomine nigro, antennis pedibusque fulvis, alis cinereis fusco flavoque variis.

'Body dark brown, clothed with black hairs: eyes red, meeting above; facets large: mouth and feelers tawny; bristle of the feeler black: chest adorned with tawny stripes which are nearly confluent: abdomen linear, rather flat, black, longer and much narrower than the chest; tip dark tawny, shining: legs tawny; thighs and fore-shanks partly pitchy: wings pale gray, brownish on the borders of the cross-veins and beneath the brand, which is dark brown; the wing is yellow on each side of the latter, and there is a dark brown spot beyond it; wing-ribs and veins brown; poisers large, tawny. Length of the body 1½ line; of the wings 3 lines.

'United States.'

Subfamily **OCYDROMIINAE**

Ocydromia peregrinata Walker

(Pl. 1, fig. 10)

Ocydromia peregrinata Walker, 1849 : 488. [No sex given.] Holotype ♀, U.S.A.: New York, Trenton Falls (*E. Doubleday*).

The type female is in poor condition, but appears conspecific with *O. glabricula* (Fallén) as interpreted by North American authors. Doubleday and Waterhouse labels are present. The wing is illustrated (Pl. 1, fig. 10).

Bicellaria drapetoides (Walker) **comb. n.**

(Pl. 1, fig. 8; Text-fig. 5)

Microphorus drapetoides Walker, 1849 : 489. LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

Melander (1928 : 105, 1940 : 5) suggested that *Microphorus drapetoides* Walker possibly belonged to *Anthepiscopus*. In the recent catalogue of North American Diptera (Stone *et al.*, 1965 : 453) it is referred under *Microphorus* as unrecognized.

In the BMNH are two males, one of which bears a label 'Dolichopus nob. holosericeus' and the other bears a label 'Hybos niger or drapetoides' and a Barnston label. Both are *Bicellaria* and the latter specimen is designated as lectotype.

The lectotype lacks hind legs and most of the thorax is destroyed by the pin, and will not therefore run out in Melander's key (1928 : 74). It is a blackish species with faintly infumated wings (Pl. 1, fig. 8), black halteres, and male genitalia as illustrated (Text-fig. 5).

Bicellaria expulsa (Walker) **comb. n.**

Rhamphomyia expulsa Walker, 1857 : 148. Holotype ♂, 'United States' (*W. W. Saunders*).

The holotype male is crushed into gum and the whole specimen will have to be floated off and mounted in fragments for study. I feel that this is best left to some future reviser of the genus and the genitalia are not therefore illustrated. Walker and Saunders labels are present.

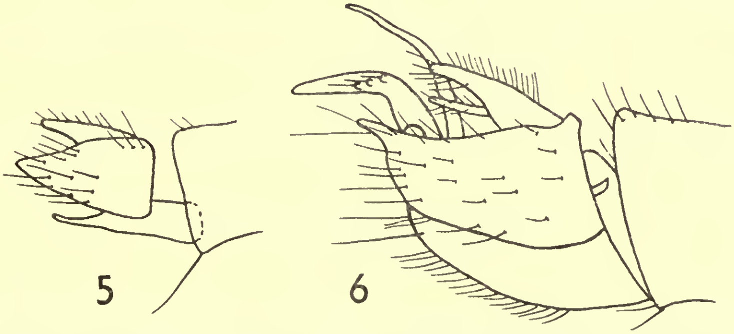
It is not possible to say if this species is synonymous with any of the other described Nearctic species until the genus is properly revised and good illustrations of the male genitalia made available.

Since there was nothing to indicate otherwise in Walker's very brief and inadequate description, this species was included as described, in the Nearctic catalogue, under *Rhamphomyia*. The holotype is in a poor condition, but the following characters are visible and indicate its relationships within *Bicellaria* as indicated in Melander's (1928) key.

♂ Body and legs black; arista as long as third antennal segment; thorax black, unstriped and shorter haired in front; hind tibiae dark haired and thickened towards apex and hind basitarsi slightly thickened. Bristling of hind legs not clear. Wings pale brownish, halteres broken off.

Subfamily **EMPIDINAE**

In the genera *Empis* and *Rhamphomyia*, European authors, particularly Frey (1922) and Bezzi (1909*a*), have erected many subgenera. Some of these may not be valid on a world basis and as yet no attempt has been made to subdivide these genera



FIGS 5–6. Male genitalia. 5, *Bicellaria drapetoides*, lectotype. 6, *Iteaphila transfuga*, lectotype.

in the Nearctic Region. Steyskal (in Stone *et al.*, 1965 : 458) suggests some new subgenera may be needed for some Nearctic species and that of the existing subgenera of *Empis, Empis* s.s., *Pachymeria* Stephens, *Platyptera* Meigen and *Argyrandrus* Bezzi are unlikely to be represented in the North American fauna.

In the present paper very few species fit comfortably into existing subgenera and for this reason only obvious subgeneric assignments are suggested.

Iteaphila cormus (Walker)

(Pl. 1, fig. 9)

Empis cormus Walker, 1849 : 496. LECTOTYPE ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.
Iteaphila cormus (Walker); Melander, 1928 : 103; 1946 : 32 (key), 34.

There are four females in Walker's series, all with Barnston and Waterhouse labels. I have designated as lectotype the one in the best condition. The species is very close to *I. macquarti* Zetterstedt and *I. cana* Melander, but appears to be distinct on the character of the subshining frons.

♀ Frons subshining, lightly dusted. The proboscis is a little shorter than the head height; there are ten scutellar bristles and while the body hairs are pale, the bristles are black. The wing is illustrated (Pl. 1, fig. 9)

Length: 4 mm.

Also standing over the *cormus* label were two males and a headless female without data. The males are *I. macquarti.* Although Walker included both sexes in his original description I am reluctant to regard these three specimens as part of the type-series.

Iteaphila migrata (Walker) **comb. n.**

Hilara migrata Walker, 1848 : 491. Holotype ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).
Iteaphila americana Melander, 1946 : 32. Holotype ♂, U.S.A.: Wyoming, Thumb of Yellowstone Lake, 16.vii.1923 (*A. L. Melander*). In USNM, Washington. **Syn. n.**

The holotype of *migrata* bears Barnston and Waterhouse labels.

Melander's description of *americana* agrees well with Walker's holotype, though the acrostichals are short rather than minute. The genitalia are very distinctive and are figured by Melander. Through the kindness of Dr Lloyd Knutson I have also compared Melander's paratypes with Walker's type.

Tuomikoski (1958) synonymises *I. americana* with *I. nitidula* Zetterstedt, 1849, which would take priority over Walker's name. I have not seen Zetterstedt's type.

Iteaphila macquarti Zetterstedt

(Text-fig. 6)

Iteaphila macquarti Zetterstedt, 1838 : 541. Syntypes ♂♀, Swedish and Norwegian Lapland, many localities (*J. W. Zetterstedt & D. Boheman*). In Lund and Stockholm.
Hilara transfuga Walker, 1848 : 491. [♀]. LECTOTYPE ♂, CANADA: St. Martin's Falsl, Albany River, Hudson's Bay (*G. Barnston*), here designated. **Syn. n.**

There are two damaged specimens and a male in fair condition labelled as *transfuga* in Walker's series. All have Barnston and Waterhouse labels. The species is clearly synonymous with *I. macquarti* Zetterstedt (1838), the type-species of the genus, whose name has priority (see Tuomikoski, 1958). The male genitalia are illustrated (Text-fig. 6).

Hilara plebeia Walker

Hilara plebeia Walker, 1857 : 148. ♀, 'United States' (*W. W. Saunders*).

I have been unable to find this type and Walker's description is therefore repeated here.

'Foem.—Nigra, pedibus anticis ferrugineis, alis limpidis, venis stigmateque nigris, halteribus fulvis.

'Female.—Black; fore legs ferruginous; wings limpid, veins and stigma black; halteres tawny.

'Length of the body 1¼ line; of the wings 3 lines.'

Empis abcirus Walker

(Pl. 2, fig. 1; Text-fig. 7)

Empis abcirus Walker, 1849 : 494. Holotype ♂, U.S.A.: Georgia (*Mr Abbot*).

The holotype male is in very good condition, and bears Waterston and Abbot labels; it is referable to the subgenus *Polyblepharis* Bezzi and is closely related to *E. eudamides* Walker (see below), differing only as follows.

♂ Thorax black, heavily dusted light greyish, not yellow at sides or on humeri and postalar calli. Acrostichals distinctly biserial, dorsocentrals bi-triserial ending stronger and uniserial. Scutellum concolorous with thorax without yellowish margin. Abdomen similarly shining blackish with genitalia (Text-fig. 7) differing as illustrated. Wings (Pl. 2, fig. 1) greyish, a little shorter than in *E. eudamides*. Legs similarly bristled but femoral bristles a little shorter.

Length: 5 mm.

Empis agasthus Walker

(Pl. 2, fig. 2)

Empis agasthus Walker, 1849 : 496. LECTOTYPE ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

Rhamphomyia ficana Walker, 1849 : 501. LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated. **Syn. n.**

There are four females standing over this name mounted in 2 pairs, each pair impaled on the same pin. One pair is labelled *agasthus* and bears a Barnston label. The upper of these two specimens being the more perfect, it is here designated lectotype. The second pair of specimens is labelled 'Empis albipes' without other data and is conspecific. All the specimens are clumsily impaled on large pins and are very dirty.

The two syntype females labelled *Rhamphomyia ficana* bear the same data, are mounted similarly and are clearly synonymous. The upper specimen is designated lectotype.

In Melander's (1902) key all these females run to *varipes* Loew and compare fairly closely with the description and specimens of this species as can be seen from the following redescription. However, without a more thorough knowledge of the females of the Nearctic species in this group I am reluctant to synonymize them formally.

♀ Head black, dusted greyish. Proboscis a little longer than head. Antennae with basal segments dark brownish, third segment blackish.

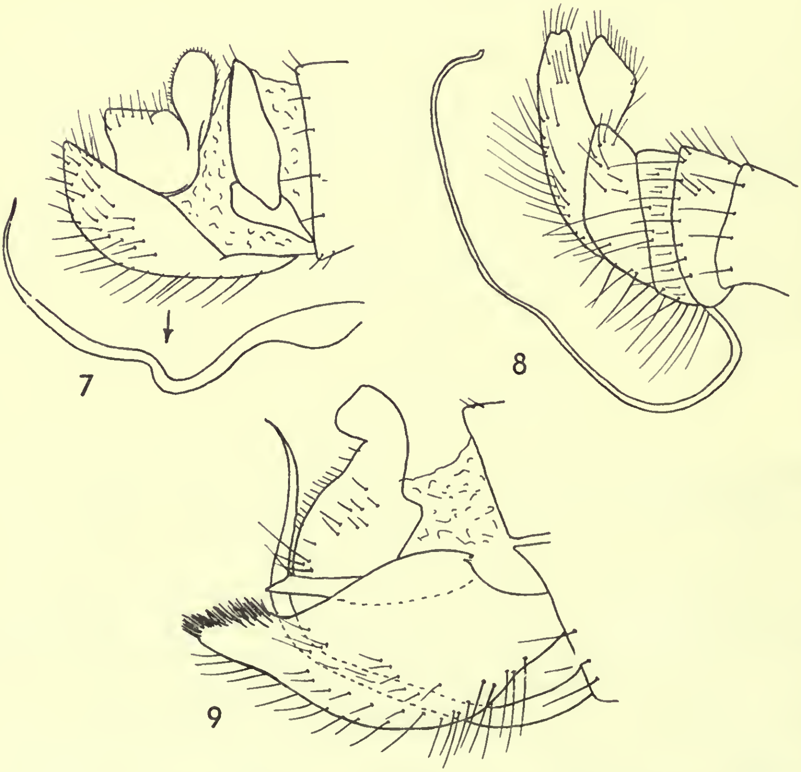
Thorax black, dusted greyish with 3 black stripes in acrostichal and dorsocentral positions. Acrostichal bristles apparently absent, dorsocentral bristles uniserial.

Abdomen shining dark brown with short sparse pale hairs.

Wings (Pl. 2, fig. 2) pale with pale veins. Halteres yellow.

Legs front coxae yellowish, middle and hind coxae blackish, dusted greyish; front femora yellowish, middle and hind femora with broad dark ring; tibiae yellowish with dark tips; tarsal segments somewhat darker apically. Front femora with short stout bristles distally; middle and hind femora with short stout bristles on more than distal half. Hind femora distinctly curved posteriorly when viewed from above.

Length: 3 mm.



Figs 7–9. Male genitalia. 7, *Empis abcirus*, holotype. 8, *E. colonica*, holotype. 9, *E. eudamides*, holotype.

Empis amytis Walker

(Pl. 2, fig. 3)

Empis amytis Walker, 1849 : 493. Holotype ♂, U.S.A.: New York (*Entomological Club*).

The holotype male is in poor condition, lacking antennae, some legs and most bristles, but it keys out readily to *amytis* in Melander's (1902) key. A Waterhouse label, a handwritten Doubleday label and a further handwritten label 'Apparently insect referred to by Walker presented by E. Doubleday not Ent. Club. E. A. W[aterhouse]. 31.3.00' are present.

♂ Head black, dusted greyish. Proboscis reddish yellow, longer than head. Thorax deep black on disc, yellow at sides including humeri and postalar calli. Scutellum and pleurae reddish yellow. Abdomen black on disc, reddish yellow at sides and below, tip missing. Wings (Pl. 2, fig. 3) clear with faint stigma. Halteres yellowish. Legs yellow and weakly bristled.
Length: *ca* 5 mm.

Empis colonica Walker

(Text-fig. 8)

Empis colonica Walker, 1849 : 498. Holotype ♂, CANADA: Nova Scotia (*Lieut. Redman*).
Empis rufescens Loew, 1864 : 76. Holotype ♂, U.S.A.: New Hampshire (*C. R. Osten-Sacken*). In USNM, Washington. **Syn. n.**

The holotype male is in good condition except for the missing front legs, and obviously belongs to the subgenus *Xanthempis*, although the axillary angle of the wing is acute. Waterhouse and Redman labels are present. In Melander's (1902) key the species runs to couplet 20, containing *armipes* Loew and *colonica* Walker, if one regards the occiput as yellow; otherwise, with a dark occiput the species runs to *rufescens* Loew. The genitalia of Walker's type closely resemble Melander's figure of *rufescens* Loew.

The following redescription stresses the major characters given in the descriptions of the species mentioned above.

♂ Head blackish, only narrowly yellow about neck, dusted greyish. Eyes narrowly separated, by less than ocellar width at middle. First and second antennal segments dirty yellowish, third segment blackish. Proboscis yellow, about 3 times as long as head is deep. Palpi yellow.

Thorax yellow, dulled by dust on disc, subshining laterally; acrostichal bristles absent, dorsocentrals uniserial. Scutellum and pleurae yellow.

Abdomen brownish yellow, short black haired, with long slender hindmarginal bristles. Genitalia as illustrated (Text-fig. 8).

Wings clear, stigma faint. Halteres yellow.

Legs yellow, front legs missing, except for one femur which lacks strong bristles. Middle femur with short anterior, antero- and posteroventral bristles; hind femur with 2 weak anterodorsal bristles distally and series of anterior, antero- and posterodorsals and posterior bristles. Middle tibia with weak antero- and posteroventrals, stronger antero- and posterodorsals; hind tibia with weak anterodorsals becoming stronger distally, stronger antero- and posterodorsals. Tarsi of middle and hind legs yellowish, darker distally.

I have compared Walker's type with specimens sent by Dr L. Knutson and find them to be conspecific with *Empis rufescens* Loew (1864).

Empis eudamides Walker

(Text-fig. 9)

Empis eudamides Walker, 1849 : 493. Holotype ♂, 'North America' (*Entomological Club*).

The holotype male is in quite good condition and is referable to the subgenus *Polyblepharis* Bezzi. Waterhouse and 'Ent. Club' labels are present. The species runs out to the correct couplet (15) in Melander's (1902) key but is separated from *abcirus* Walker as having the tip of the femora black. In fact both species are very narrowly black at the tip, but not sufficiently to warrant the description 'knees black' used by Walker for *eudamides*. The two species are distinct, however, as is indicated by the redescription given below.

♂ Head black, dusted greyish, eyes broadly separated. First and second antennal segments and third segment at extreme base yellow, remainder black. Proboscis yellowish brown, about twice as long as head is deep.

Thorax black, dusted greyish with two narrow black stripes each side of the acrostichal row and two broader black lateral stripes. Humeri, sides of thorax and postalar calli yellow. Acrostichal bristles irregularly bi-quadriserial, dorsocentral bristles biserial ending longer and uniserial. Scutellum black on disc with yellowish margin and 4 marginal bristles. Pleurae largely blackish, dusted greyish with propleuron and metapleuron largely reddish yellow.

Abdomen shining blackish, short dark-haired with longer black bristly hairs laterally. Genitalia (Text-fig. 9) yellowish.

Wings clear with dark veins and faint stigma. Halteres yellow.

Legs with coxae all dark. Femora yellow, but front and middle femora with broad dark dorsal patch about middle; tibiae and tarsi yellow. Front legs weakly bristled, middle and hind femora with black anteroventral and posteroventral bristles, middle tibia with anterodorsals, hind tibia with antero- and posterodorsals.

Length: 7 mm.

Empis ollius Walker

(Pl. 2, fig. 4)

Empis ollius Walker, 1849 : 493. Holotype ♀, CANADA: Nova Scotia (*Lieut. Redman*).

The holotype female lacks a head, but is otherwise in good condition and is clearly very similar to *eudamides* Walker and *abcirus* Walker and may well prove to be conspecific with one of them when both sexes of these species are found in association. Waterhouse and circular Redman labels are present.

Head missing. Thorax completely greyish dusted, except for two narrow black stripes, one each side of acrostichal bristles and a broader less distinct lateral stripe. Pleurae and scutellum concolorous with thorax. Abdomen dark brown, shining with short dark hairs and longer marginal and lateral bristly hairs. Wings (Pl. 2, fig. 4) faintly brownish. Halteres yellow. Legs with coxae dark, dusted greyish, otherwise yellowish except for darkened last two tarsal segments; hind femora with weak anteroventrals, otherwise femora unarmed. Front tibiae with weak anterodorsal bristles, middle and hind tibiae with distinct antero- and posterodorsal bristles.

Length: *ca* 4 mm.

Empis reciproca Walker

(Pl. 2, fig. 5)

Empis reciproca Walker, 1857 : 147. Holotype ♀, 'United States' (*W. W. Saunders*).

The holotype female is in good condition apart from missing third antennal segments. Walker and Waterhouse labels are present. In Melander's (1902) key the species runs to *ravida* Coquillett, but appears to be distinct from that species as the following redescription shows.

♀ A pale yellowish grey species. Head completely and heavily dusted grey. First and second antennal segments brownish, third segment missing. Proboscis nearly twice as long as head is deep. Palpi yellow.

Thorax heavily dusted greyish with two narrow dark stripes, one each side of centre and two broader outer stripes. Acrostichal bristles absent; dorsocentrals uniserial. Scutellum dusted greyish, with yellowish corners and 8 marginal bristles comprised of 2 strong pairs and 2 weak pairs. Pleurae completely greyish dusted.

Abdomen completely dusted yellowish grey, with short sparse dark hairs above, longer at sides.

Wings (Pl. 2, fig. 5) faintly brownish tinged, with faint stigma. Halteres yellow.

Legs, including coxae, yellow. Front femora with weak hair-like anteroventrals, middle femora with antero- and posteroventrals, hind femora with some distinct anteroventrals distally, otherwise bristles long and hair-like. Tibiae with rather long bristles and hairs above. First two tarsal segments brownish distally, remaining segments brownish.

Length: 5 mm.

Rhamphomyia agasicles Walker

(Pl. 2, fig. 6)

Rhamphomyia agasicles Walker, 1849 : 499. LECTOTYPE ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

Walker gives a size-range for this species, suggesting that he had more than one specimen before him. There is only one specimen, a female, present in the collection, which I designate as lectotype. Only a Waterhouse label is present.

In Coquillett's (1895) key this species runs to *angustipennis* Loew if one interprets the wings as being pale basally; otherwise the species runs to *polita* Loew. The following brief redescription indicates its distinctions from both the species mentioned.

A shining blackish species, frons, thoracic disc, abdomen and legs all shining. Wings (Pl. 2, fig. 6) brownish, somewhat paler at base, especially if viewed with the naked eye; rather broad; anal vein indistinct on distal third. Halteres yellow. Legs without pennate hairs.

Length: 3·5 mm.

Rhamphomyia cophas Walker

(Pl. 2, fig. 7)

Rhamphomyia cophas Walker, 1848 : 499. [No sex given.] Holotype ♀, U.S.A.: New York (*Entomological Club*).

The holotype female is very greasy and badly damaged with the abdomen and most of the legs missing. Waterhouse and Doubleday labels are present, together with a handwritten label 'Walker's measurements in error. E. A. W[aterhouse]. 3.3.00'.

The acrostichal bristles are biserial, the dorsocentrals uniserial. One middle and one hind leg are intact and neither has pennate hairs. The femora are dark brown, the tibiae more yellowish. The middle tibia has some short antero- and posteroventral bristles and some longer antero- and posterodorsal bristles; the front and middle basitarsi have short antero- and posteroventral bristles. The wing (Pl. 2, fig. 7) is greyish and the halteres are yellow.

Length: *ca* 5–6 mm.

Rhamphomyia dana Walker

(Pl. 2, fig. 8)

Rhamphomyia dana Walker, 1849 : 502. Holotype ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).

The holotype ♀ is in quite good condition and belongs to the subgenus *Pararhamphomyia*. Only a Waterhouse label is present. In Coquillett's (1895) key this species runs to *abdita* Coquillett, but differs in having no pennate hairs on the front legs. The following description of the major features should help a future reviser.

Colour pale brownish, probably darker in life. Antennal style about one quarter the length of third antennal segment. Thorax dulled by dust, with 3 indistinct dark lines under the rows of bristles, acrostichals biserial, dorsocentrals uniserial. Abdomen paler than rest of body and dark-haired. Wing as illustrated (Pl. 2, fig. 8), halteres yellow. No pennate hairs on the front legs, but middle and hind femora and tibiae with pennate hairs above and below, those of hind legs particularly long. All tarsi without pennate hairs.

Length: 3·5 mm.

Rhamphomyia daria Walker

(Pl. 2, figs 9, 10; Text-fig. 10)

Rhamphomyia daria Walker, 1849 : 503. Holotype ♂, U.S.A.: New York (*E. Doubleday*).
Rhamphomyia gracilis Loew, 1861 : 329. Syntypes ♂ ♀, U.S.A.: Pennsylvania (*C. R. Osten-Sacken*). In USNM, Washington. **Syn. n.**
Rhamphomyia bipunctata Curran, 1930 : 47.

The holotype male is in good condition apart from a few strands of mould and bears Doubleday and Waterhouse labels. In Coquillett's (1895) key the species runs straight out to *gracilis* Loew with which it is obviously synonymous. As this species has already been described three times no redescription is given here, but it is easily distinguished by its yellow coxae and femora, shining thorax and abdomen and the female wing markings. The male genitalia (Text-fig. 10) and wings (Pl. 2, figs 9 & 10) (of specimens compared with the type) are illustrated.

Rhamphomyia ecetra Walker

(Pl. 3, fig. 1)

Rhamphomyia ecetra Walker, 1849 : 500. [♂ error.] Holotype ♀, U.S.A.: Georgia (*Mr Abbot*).

The holotype female has only the femora of the hind legs present and the knobs of both halteres missing so that it will not run out satisfactorily in Coquillett's (1895) key. It appears close to *sudigeronis* Coquillett as the brief redescription below indicates. Only a Waterhouse label is present.

Head and thorax including pleurae black, dusted light greyish. Acrostichals irregularly bi-triserial; dorsocentrals pluriserial, ending stronger uniserial. Scutellum with 6 marginal bristles. Abdomen dark brown, dusted dorsally, but subshining laterally. Wings (Pl. 3, fig. 1) uniformly brownish. Halteres with yellow stem, knobs broken off. Legs dark brown; front tibiae and basitarsi pennate above, middle femora and tibiae pennate above and below, middle basitarsi pennate above; hind femora pennate above and below, tibiae and tarsi missing.

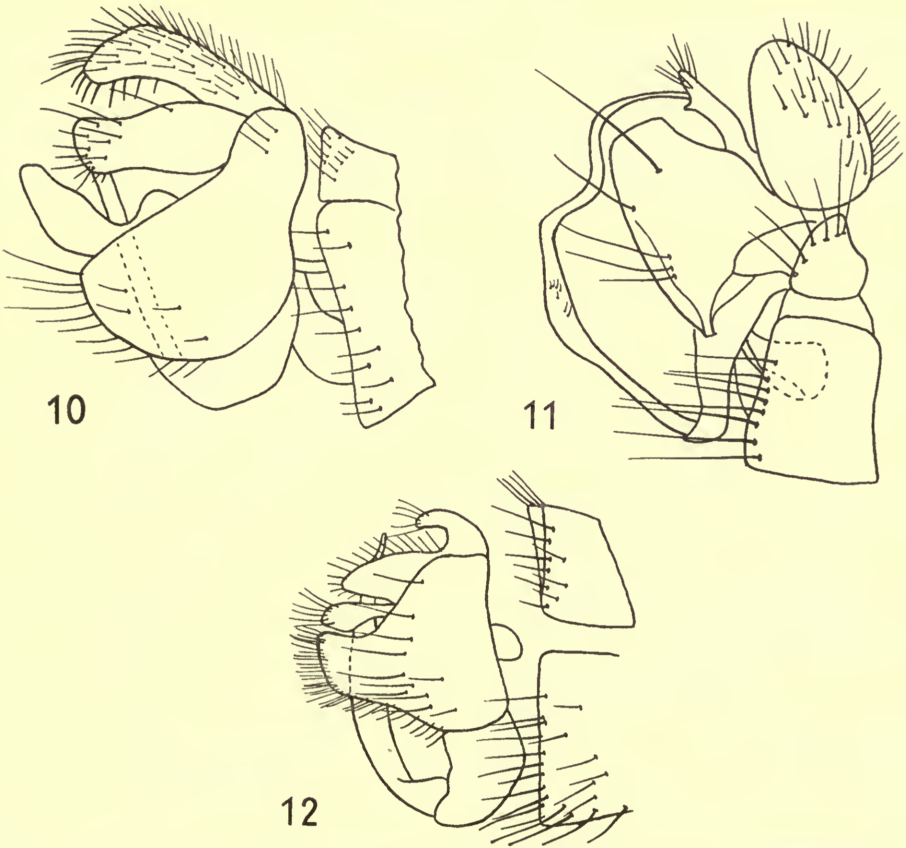
Length: 4 mm.

Rhamphomyia flavirostris Walker

(Text-fig. 11)

Rhamphomyia flavirostris Walker, 1849 : 501. LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

There are two specimens (♂, ♀) standing over this name and I designate the male as lectotype. Barnston and Waterhouse labels are present on both specimens.



FIGS 10–12. Male genitalia. 10, *Rhamphomyia daria*, holotype. 11, *R. flavirostris*, lectotype. 12, *R. phemius* (=*anaxo*), lectotype.

Both appear referable to *Pararhamphomyia*, but the anal vein of the female is complete.

The male keys to *leucoptera* Loew in Coquillett's (1895) key, but is a little larger. The female runs to couplet 41, where it is eliminated by having a normal discal cell, yet silvery pollinose abdomen.

The following redescriptions include only the major taxonomic characters.

♂ Eyes touching. Head and thorax black, dusted greyish with black bristles and hairs. Abdomen brownish, dark haired, with longer pale hairs at sides. Genitalia as illustrated (Text-fig. 11). Wings clear with yellowish veins, discal cell shorter than middle vein issuing from its end. Anal vein fading away about half way from wing-margin. Legs yellowish, possibly darker in life (Walker says tawny).

Length: 5 mm.

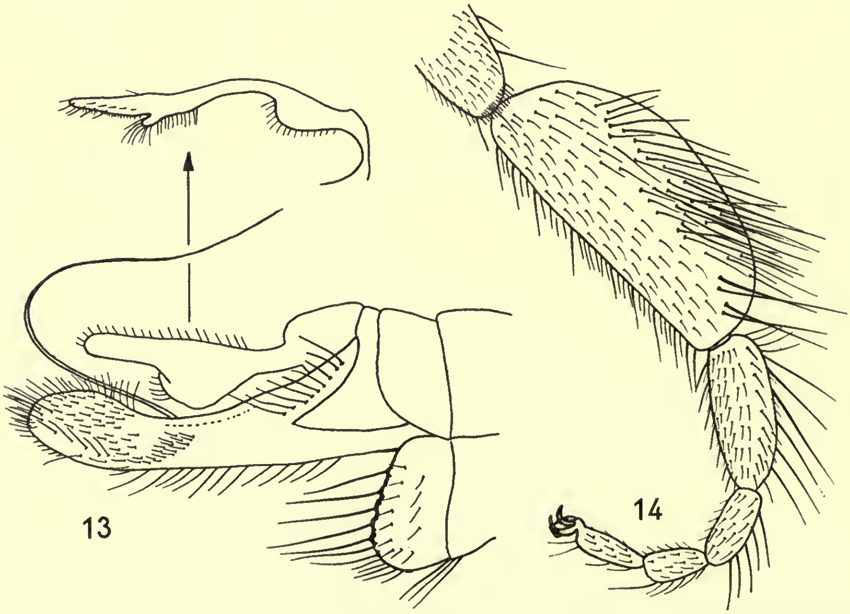
♀ Similar to male, but abdomen shorter and coarser haired and silvery tomentose in shifting light. Legs without pennate hairs.

Rhamphomyia mallos Walker

(Pl. 3, fig. 2)

Rhamphomyia mallos Walker, 1849 : 502. Holotype ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).

The holotype female is in fair condition and bears Barnston and Waterhouse labels. Although the anal vein is distinct to the wing-margin it is somewhat paler about the middle. The prothoracic episternum is bare and the sides of the sternum have



FIGS 13–14. *Rhamphomyia minytus*, holotype. 13, male genitalia. 14, male right hind tarsus in posterior view.

3 bristly hairs. This combination of characters places the species in the subgenus *Pararhamphomyia*.

Coquillett's (1895) interpretation of the species does not appear to be correct. The species is of the *basalis*-group and appears to be close to *valga* Coquillett, but the hind metatarsus is not pennate above (see Chilcott, 1959). The following diagnostic points should help a future reviser of the genus.

♀ Third antennal segment less than twice as long as broad. Thorax pale grey pollinose with 3 narrow brown stripes under the line of bristles, acrostichals biserial, dorsocentrals irregularly biserial to uniserial, biserial about middle. Abdomen with brown pennate hairs at sides of segments 3 and 4. Anal cerci long. Wings (Pl. 3, fig. 2) light brownish with axillary angle a little less than 90°. Hind femora pennate above and below, longer below. Hind tibia equally pennate above and below. Hind metatarsus not pennate. Middle femora pennate below. Middle tibia pennate above and below.

Length: 6 mm.

Rhamphomyia minytus Walker

(Text-figs 13, 14)

Rhamphomyia minytus Walker, 1849 : 502. Holotype ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).

Rhamphomyia minutus Walker [error]; Johnson, 1910 : 760.

The holotype ♂ is in fair condition, is of the subgenus *Pararhamphomyia* and runs to *minytus* in Coquillett's (1895) key. Barnston and Waterhouse labels are present. The genitalia and distinctive hind leg are illustrated (Text-figs 13 & 14).

Rhamphomyia phemius Walker

(Pl. 3, fig. 3; Text-fig. 12)

Rhamphomyia phemius Walker, 1849 : 500. LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

Rhamphomyia anaxo Walker, 1849 : 500. LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated. **Syn. n.**

These specimens are referable to *Pararhamphomyia* and a pair (♂ ♀) stands over each name; the males of each species are designated lectotypes. All the specimens bear Barnston and Waterhouse labels.

Although described on the same page *phemius* was described first and the types of *phemius* are also in better condition. The illustrations given here are of the ♂ *anaxo* as I had already dissected and illustrated this specimen before the synonymy was discovered. The female is not conspecific (see below).

In Coquillett's (1895) key the males run to couplet 75, which includes *piligeronis* Coquillett and *leucoptera* Loew, but it clearly belongs to neither. The female *phemius* runs out correctly, but does not appear to warrant the description 'legs bearing long bristles'.

The following redescription mentions only major taxonomic characters relevant to Coquillett's (1895) key.

♂ Blackish species. Eyes touching above. Thorax black, dusted greyish with three dark stripes under lines of bristles; acrostichals biserial, as long as dorsocentrals; dorsocentrals irregularly bi-triserial, ending uniserial and strong. Abdomen dull, black, dusted greyish and with black hairs. Genitalia as illustrated (Text-fig. 12). Wings (Pl. 3, fig. 3) greyish with brown stigma. Anal vein distinct only on distal third. Halteres yellow. Legs dark, brown, with slender ventrals.

♀ Resembling in male in colour of thorax and abdomen, but bristles and hairs shorter. Wings faintly brownish tinged, halteres yellow. Anal vein faint about middle, but distinct right to wing margin. Legs without pennate hairs; distinct posterodorsals on front tibiae and antero- and posterodrosal bristles on middle and hind tibiae, but none twice as long as their respective tibia is deep.

Length: 4 mm.

The female standing over *anaxo* does not appear to be conspecific as can be seen from the following redescription.

Thorax lightly dusted, subshining, pleurae greyish dusted. Abdomen shining, only lightly dusted except for last 4 segments, which are heavily dusted. Wings (Pl. 3, fig. 4) faintly brownish tinged, anal vein faint basally, but distinct on more than apical half. Halteres yellow. Legs brown, shining and without pennate hairs.

Length: 3·5 mm.

Rhamphomyia tristis Walker

Rhamphomyia tristis Walker, 1857 : 148. ♀, 'United States' (*W. W. Saunders*).

There is no specimen labelled or identifiable as this species in the BMNH collection. There is no evidence that the type is in Oxford as has been shown for some other Walker species coming from W. W. Saunders' collection (Smith & Taylor, 1964).

For convenience Walker's description is repeated here.

'Foem.—Nigra thorace cinereo vittis duabus nigris, alis limpidis, venis nigris, halteribus albis.

'Female.—Black; thorax with cinereus tomentum, which is interrupted by two black stripes; wings limpid, veins black; halteres white.

'Length of body 2 lines; of the wings 4 lines.'

Subfamily **CLINOCERINAE**

Trichoclinocera longipes (Walker) **comb. n.**

(Pl. 3, fig. 5)

Heliodromia longipes Walker, 1849 : 504. [No sex given.] Holotype ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).

There is one female in quite good condition standing over this name and bearing a Barnston label. The face and jowls are coalescent beneath the eyes and vein r_1 is hairy above, which with other characters places the species in *Trichoclinocera* Collin (1941 : 237) and not *Clinocera* subgenus *Hydrodromia* as indicated by Melander (1928; in Stone *et al.*, 1965).

In Melander's (1928) key the species runs out to *Wiedemannia* (*Chamaedipsia*) *gubernans* Melander, described from British Columbia.

The following brief description of Walker's type indicates the affinity of the two species with reference to Melander's key characters.

♀ Face unicolorous greyish except for dark tubercle with carinate lower margin. Thorax olive-brown above, without distinct stripes, greyish below. Acrostichal bristles absent. Two scutellar bristles (broken off but sockets obvious). Wings (Pl. 3, fig. 5) greyish with veins not undulating and without stigma. Vein r_1 hairy above; only two submarginal cells, i.e. no cross-vein joining r_4 to r_{2+3}. Discal cell about equal to second posterior cell. Halteres black. Legs entirely black. Front femora with 2 short black anterior bristles distally and a series of anteroventral bristles. There is no anterior preapical comb of tiny bristles.

W. gubernans was described as having no scutellar bristles, with the wings faintly clouded. Melander did not mention the wing stigma, but his inclusion of the species in the subgenus *Chamaedipsia* indicated that it should be elongate and faint.

Through the kindness of Dr Lloyd Knutson I have been able to examine the type of *W. gubernans* and it is certainly not a *Trichoclinocera*. It has two scutellar bristles, the wing is without bristles on vein r_1, the stigma is elongate and faint and there are faint clouds over the base of the cubital fork and the end of the discal cell.

Other Nearctic species now correctly placed in *Trichoclinocera* (see Sabrosky, 1967) are: *Clinocera dolicheretma* Melander, *C. brunnipennis* Melander, *Wiedemannia hamifera* Melander, *W. ctenistes* Melander and *W. minor* Melander.

Subfamily **HEMERODROMIINAE**

Metachela albipes (Walker)

(Text-fig. 15)

Hemerodromia albipes Walker, 1849 : 505. LECTOTYPE ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

There are four specimens standing over *albipes*. A male and a female bear Barnston labels; of these the male, covered in glue, after soaking in KOH proved to be a *Metachela* conforming with Walker's description. The female of this pair is very badly damaged, but appears to be conspecific. The other two specimens, a male and a female, lack data. Of this pair, the male is in fact *Neoplasta scapularis* Loew, but the female is in reasonable condition and is a *Metachela* conforming to Walker's description.

. I designate the data-bearing male as lectotype.

The male genitalia (Text-fig. 15) appear to conform with Melander's (1947) interpretation of the species. Melander (1928) first placed the species in *Metachela*.

Subfamily **TACHYDROMIINAE**

Tachypeza portaecola (Walker)

(Text-fig. 16)

Tachydromia portaecola Walker, 1849 : 506. Holotype ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).

Melander (1902 : 227) regarded this as a distinct species, but later (1928 : 276) doubtfully listed it as a synonym of his own *T. corticalis*. However, Walker's holotype ♂ has no black spots on the front femora and cannot therefore be conspecific. It bears a Waterhouse label.

The mesopleurae of *T. portaecola* are shining and the palpi, legs and halteres are brownish and the antennae dark brownish. The wings are brownish with unequal basal cells. The genitalia are illustrated (Text-fig. 16).

Length: 3 mm.

Tachypeza postica (Walker)

(Pl. 3, fig. 6)

Tachydromia postica Walker, 1857 : 149. [No sex given.] Holotype ♀, 'United States' (*W. W. Saunders*).

The holotype female bears Saunders, Walker's handwritten 'postica' and printed '68.4' accession labels.

In his key to Nearctic *Tachypeza* Melander (1928 : 274) described the wings of *T. postica* as uniformly grey and the tibiae of uniform colour. The Walker specimen differs as follows.

♀ Wings (Pl. 3, fig. 6) are pale at base and the legs are yellow with the hind femur darkened anteriorly and posteriorly and the hind tibia brownish.

Length: 3 mm.

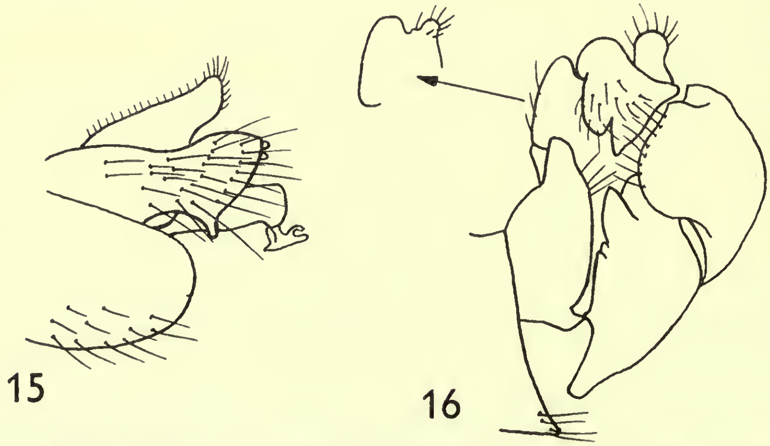
Tachypeza fenestrata (Say)

Sicus fenestrata Say, 1823 : 95.

Tachydromia similis Walker 1849 : 506. Holotype ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).

In 1902 (under *Tachydromia*, p. 228) Melander regarded *T. fenestrata* (Say) (1823 : 95) and *T. similis* Walker as distinct species, but later (1928 : 276–7) synonymized them. Walker's holotype ♀ is in poor condition and bears Barnston and Waterhouse labels.

The front femur is dark brown on the posterior face, the hind femur is entirely dark brown, the front tibia is entirely dark brown and the hind tibia is blackish on about the distal one-fifth.



FIGS 15–16. Male genitalia. 15, *Metachela albipes*, lectotype. 16, *Tachypeza portaecola*, holotype.

Length: 4 mm.

Dr Lloyd Knutson has kindly checked that females of *T. fenestrata* (Say) agree with this redescription, thus confirming the synonymy.

Ischnomyia albicosta (Walker) (Anthomyzidae)

?*Diastata albicosta* Walker, 1849 : 1113. Holotype ♂, no locality (*Entomological Club*) (not located).
Tachydromia vittipennis Walker, 1857 : 149. [No sex given.] Holotype ♂, 'United States' (*W. W. Saunders*). **Syn. n.**
Ischnomyia vittula Loew, 1863 : 325.
Ischnomyia vittata Loew [error], Curran, 1934 : 330.

The type of *Tachypeza vittipennis* is not an Empid at all, but an acalyptrate of the family Anthomyzidae determined by Mr B. H. Cogan as a ♀ *Ischnomyia albicosta* (Walker, 1849) (=*vittula* Loew). The holotype bears Saunders and Walker labels and a printed accession label '68.4'. The type of *albicosta* Walker has not been located; the synonymy with *vittula* Loew follows the Nearctic Catalogue.

Tachydromia maculipennis Walker

Tachydromia maculipennis Walker, 1849 : 507. Holotype ♂, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*).
Tachypeza pusilla Loew, 1864 : 87.
[*Phoneutisca bimaculata* Loew *sensu* Melander 1902 : 204. Misidentification.]

All that remains of the type is two legs in a blob of gum, which indicate only that it is a *Tachydromia* Meigen.

Walker's description is as follows:—

'Nigra, antennis nigris, pedicus piceis, alis sublimpidis, fusco bimaculatis basi albis.

'Body black, shining: eyes piceous: feelers and mouth black: legs piceous: wings nearly colourless, white at the base, each with a large brown spot on the fore border at two-thirds of the length from the base; wing ribs and veins piceous, the latter yellow towards the base. Length of the body 1¾ line; of the wings 1½ line.'

Platypalpus alexippus Walker

Platypalpus alexippus Walker, 1849 : 510. [No sex given.] LECTOTYPE ♀, CANADA: St. Martin's Falls, Albany River, Hudson's Bay (*G. Barnston*), here designated.

Two specimens bearing Barnston and Waterhouse labels stand over this name, but they clearly belong to different species. One specimen, a female, has entirely yellow legs and is designated lectotype. The other specimen lacks an abdomen but has broad dark pre-apical bands around the middle and hind femora and appears to be related to *P. pilatus* Melander.

P. alexippus appears related to *P. crassifemoris* Fitch.

The antennae are dark with third segment broad and triangular and a little shorter than arista. Thorax dusted. Abdomen only very lightly dusted. Legs yellow, with the mid-tibial spur short.

Length: 2 mm.

The lectotype is rather clumsily gummed to a piece of card, but would probably be in reasonable condition if carefully soaked off.

Platypalpus vicarius Walker

Platypalpus vicarius Walker, 1857 : 148. ♀, 'United States' (*W. W. Saunders*).

The type of this species is not present in the collection. Melander included it in his earlier key (1902), but omitted it in his Genera Insectorum volume (1928). In the keys cited and in the key of Coquillett (1895) the character of the subequal legs [femora] is used, obviously based on Walker's description, which is repeated here for what it is worth.

'Foem.—Niger, nitens, pedibus testaceis gracilibus subaequalibus, alis limpidis, venis testaceis.

'Female.—Black, shining; legs testaceous, slender, nearly equal in size; wings limpid, veins testaceous, externo-medial veins very slightly curved. Length of body 1 line; of the wings 3 lines.'

ACKNOWLEDGEMENTS

I thank Dr Lloyd V. Knutson for his kindness in answering my queries on Melander types, for loans and exchanges of Nearctic Empididae; and Mr J. V. Brown for his careful preparation of the wing photographs of this old, fragile and often dirty material.

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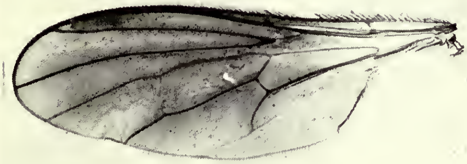
Modern generic placements are indicated. The authorities are quoted only for names other than Walker's.

K. G. V. Smith,
Department of Entomology
British Museum (Natural History)
Cromwell Road
London, SW7 5BD

PLATE 1

Fig. 1. *Hybos reversus* Walker, ♂ holotype wing.
Fig. 2. *Euhybus duplex* (Walker), ♂ holotype wing.
Fig. 3. *E. purpureus* (Walker), ♀ holotype wing.
Fig. 4. *E. subjectus* (Walker), ♂ lectotype wing.
Fig. 5. *Synches bacis* (Walker), ? sex, holotype wing.
Fig. 6. *S. phthia* (Walker), ♂ holotype wing.
Fig. 7. *S. simplex* Walker, wing of recent specimen.
Fig. 8. *Bicellaria drapetoides* (Walker), ♂ lectotype wing.
Fig. 9. *Iteaphila cormus* (Walker), ♀ lectotype wing.
Fig. 10. *Ocydromia peregrinata* Walker, ♀ holotype wing.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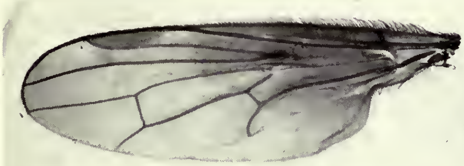
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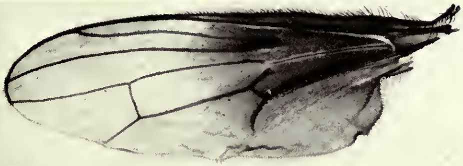
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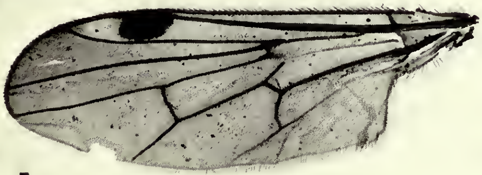
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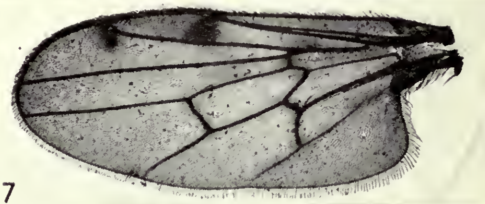
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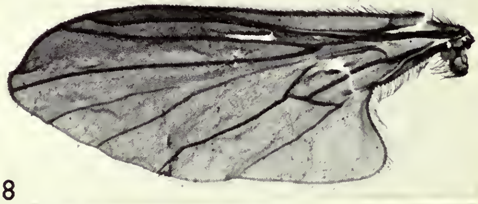
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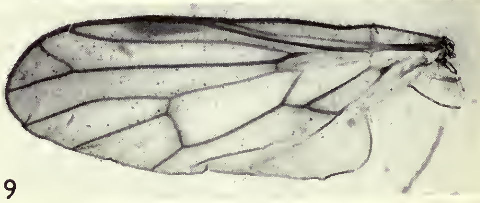
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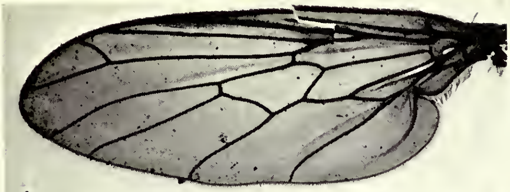
PLATE 2

Fig. 1. *Empis abcirus* Walker, ♂ holotype wing.
Fig. 2. *E. agasthus* Walker, ♀ lectotype wing.
Fig. 3. *E. amytis* Walker, ♀ holotype wing.
Fig. 4. *E. ollius* Walker, ♀ holotype wing.
Fig. 5. *E. reciproca* Walker, ♀ holotype wing.
Fig. 6. *Rhamphomyia agasicles* Walker, ♀ lectotype wing.
Fig. 7. *R. cophas* Walker, ♀ holotype wing.
Fig. 8. *R. dana* Walker, ♀ holotype wing.
Fig. 9. *R. daria* Walker, ♂ recent specimen wing.
Fig. 10. *R. daria* Walker, ♀ recent specimen wing.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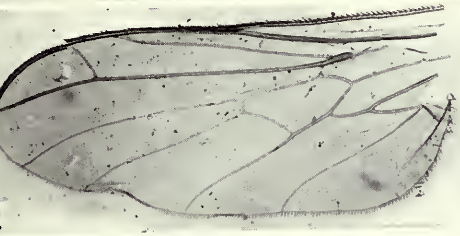
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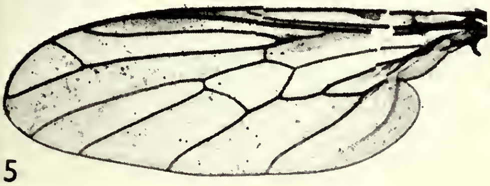
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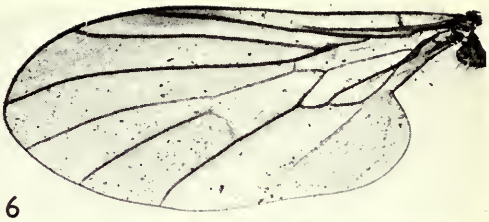
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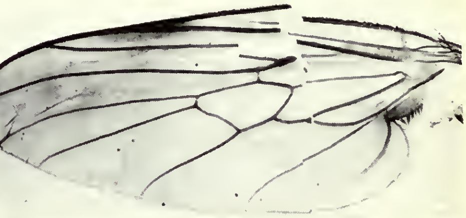
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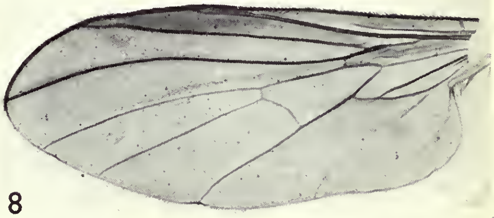
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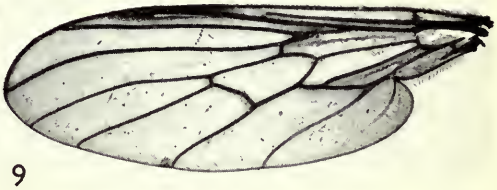
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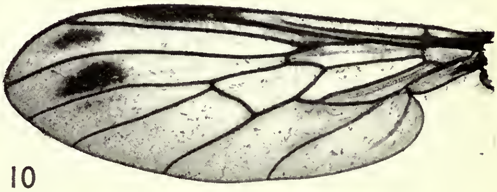
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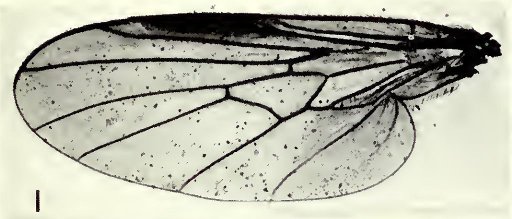
PLATE 3

Fig. 1. *Rhamphomyia ecetra* Walker, ♀ holotype wing.
Fig. 2. *R. mallos* Walker, ♀ holotype wing.
Fig. 3. *R. phemius* Walker (=*anaxo* Walker), ♂ lectotype wing.
Fig. 4. *R. anaxo* Walker, ♀ wing (? not conspecific with ♂).
Fig. 5. *Trichoclinocera longipes* (Walker), ♀ holotype wing.
Fig. 6. *Tachypeza postica* (Walker), ♀ holotype wing.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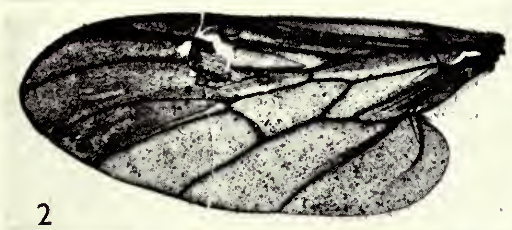
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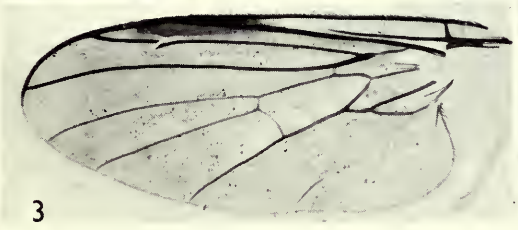
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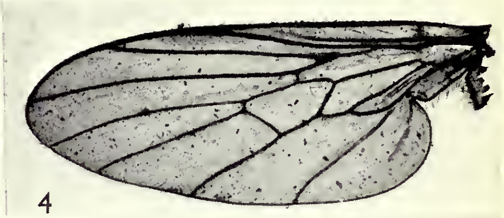
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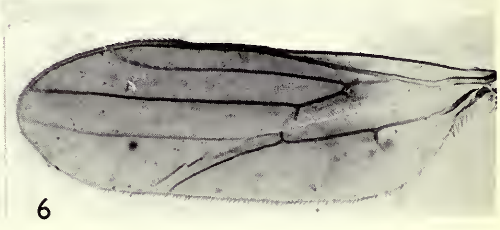
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A REVISION OF THE FLOWER-LIVING GENUS *ODONTOTHRIPS* AMYOT & SERVILLE (THYSANOPTERA : THRIPIDAE)

B. R. PITKIN

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ENTOMOLOGY Vol. 26 No. 9
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BY

BRIAN ROY PITKIN

Pp. 371–402; 5 *Maps*, 27 *Text-figures*

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CONTENTS

SYNOPSIS

The genus *Odontothrips* Amyot & Serville is redefined and a key to 21 species is provided; four nominal species and one nominal variety cannot be recognized satisfactorily at present. One former variety (*retamae*) is here regarded as a distinct species, and one species (*ignobilis*) is removed from synonymy (with *meridionalis*). The male phallic armature is described for 13 species and this character is used in species-recognition for the first time in the Terebrantian Thysanoptera. Notes are given on the life histories, and maps of the known distribution are provided. A table is given showing the relationships between the species-groups of *Odontothrips* and the tribes of Papilionaceae.

INTRODUCTION

SPECIES of the genus *Odontothrips* are typical flower-feeding Thripidae ranging in size from 1·3 mm to 2·0 mm. All but two of these species are Palaearctic and the majority feed in the flowers of Papilionaceae. Probably all species cause superficial damage to the flowers in which they feed, but *confusus* is the only known pest. It is quite likely that they act as cross-pollinating agents for their hosts as the present author has observed pollen adhering to numerous individuals. The adults are always macropterous and fly readily in warm weather. Due to their small size however it is unlikely that they are able to fly actively from flower to flower. The monophagous species are univoltine as a result of the limited flowering period, but polyphagous species are apparently multivoltine if conditions are favourable.

Thirty-four nominal species and three nominal varieties of *Odontothrips* have been described but only twenty-five are here regarded as valid species and one variety cannot be satisfactorily recognized. This study began in an attempt to find stable diagnostic characters for certain closely related British species, of which the females could not be identified readily using existing keys, i.e., those of Morison (1948) and Priesner (1964). It was found that the male genitalia are significantly different between species. These studies were therefore extended to include the World species. Unfortunately nine species are known from females only and no males of a further two species were available for examination. It is hoped that this study will stimulate further collecting and examination of males, particularly of those species which are known from females only.

ACKNOWLEDGEMENTS

I should like to thank Mr E. R. Speyer, who first drew my attention to the differences between the male genitalia of certain species; Prof. Dr H. Priesner, Dr G. D. Morison, Dr R. zur Strassen, Dr L. J. Stannard, and Miss K. O'Neill, who kindly lent material; and Mr L. A. Mound for his advice and criticism.

MATERIAL STUDIED

Unless stated to the contrary all material examined is deposited in the British Museum (Natural History), London (BMNH). The following abbreviations have been used for other depositories: INHS, Illinois Natural History Survey, Urbana; SMF, Senckenberg Museum, Frankfurt; USNM, United States National Museum, Washington.

HOST RELATIONSHIP AND DISTRIBUTION

Twenty-one of the twenty-five species of *Odontothrips* are found in Europe and North Africa, and of these seventeen are known to occur in the flowers of Papilionaceae. *O. pictipennis* is apparently indigenous to North America, feeding in the flowers of plants such as violets and strawberries, although Morgan (1913) recorded specimens from *Acacia*. *O. moerens* is known only from West Africa. These two non-Palaearctic species do not have the sense cone on the sixth antennal segment greatly enlarged at its base. The distribution of the Palaearctic species is shown in Maps 1–5, and has been compiled from the data of the material examined. Published records have been ignored, except those of type-material, because of the confusion over the identity of many species. Recorded distribution is discussed later under each species. Due to the paucity of records, the distribution maps of many species reflect not only those localities in which species occur but also the distribution of thysanopterists in Europe, i.e., Morison in Scotland, von Oettingen in Germany, and zur Strassen in the Canary Islands.

No host-records are known for *elbaensis* and *paraconfusus*. A further two species, known from single records only, from plants other than Papilionaceae are *phlomidinus* on *Phlomis* (Labiatae) and *edentulus* on *Tilia* (Tiliaceae). Like other species of the genus, it is quite conceivable that these four species also feed in the flowers of Papilionaceae.

Table 1 shows the relationship between the Palaearctic species and their respective Papilionaceae hosts. For the purpose of this table the thrips are arranged in groups of species with similar fore limbs and the host-genera are arranged in tribes after Clapham, Tutin & Warburg (1962) and Baker (1926). It is

TABLE 1 Host plants of some *Odontothrips* species.

	Distal fore tarsal segment with small hooks or tubercles.									Distal fore tarsal segment without small hooks or tubercles.							
	biuncus	*loti*	*karnyi*	*retamae*	*ignobilis*	*meridionalis*	*meliloti*	*vuilletia*	*ononidis*	*cytisi*	*ulicis*	*phaleratus*	*intermedius*	*aemulans*	*confusus*	*dorycnii*	*viciae*
Number of stout tibial claws	2	1	0	0	0	0	0	0	0	2	2	1	1	0	0	0	1
GENISTEAE																	
Spartium	.	.	×	.	.	×											
Lupinus	.	.	×														
Genista	.	.	×	×													
Cytisus	.	.	.	.	.	.	.	.	.	×							
Ulex	.	.	.	.	×	.	.	.	.	.	×						
Adenocarpus	.	.	.	×													
Spartocytisus	.	.	.	×													
Retama	.	.	×	×													
GALEGEAE																	
Astragalus	.	.	.	.	.	.	.	×									
Sesbania	.	.	×														
Acacia	.	.	×														
PHASEOLEAE																	
Cajanus	.	.	×														
TRIFOLIEAE																	
Ononis	.	×	.	.	.	.	.	.	×								
Medicago	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×		
Melilotus	.	.	.	.	.	.	×										
Trifolium	.	×															
LOTEAE																	
Anthyllis	.	×															
Lotus	.	×															
Dorycnium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	
VICIEAE																	
Vicia	×	.	.	.	.	.	.	.	.	.	.	×	.	×	.	.	×
Lathyrus	.	.	.	.	.	.	.	.	.	.	.	×	×				

not suggested that these *Odontothrips* species-groups are natural. However, certain groups of species, i.e., *ulicis* and *cytisi* do have similar fore limbs and genitalia and feed on closely related hosts. In contrast some species with similar genitalia have different fore limbs, i.e., *biuncus* with two stout tibial claws, *loti* with one stout claw, and *karnyi* without stout tibial claws. These three species occur on different tribes or groups of tribes of host-plant. It is therefore conceivable that the fore limb has become adapted in relation to the respective host, but not all species occurring on the same host-tribes have similar fore limbs. Clearly the host is not the only influencing factor, although there does appear to be a relationship between the structure of the fore limb and the host.

The *ignobilis* group of species appears to be associated with the tribes Genisteae, Phaseoleae, Galegeae and Trifolieae; the *aemulans* and *loti* groups with the tribes Trifolieae, Loteae, and Vicieae; the *phaleratus* and *viciae* groups with the tribe Vicieae; and the *ulicis* group with the Genisteae. Further it would appear that the species-groups *biuncus*, *phaleratus*, *aemulans* and *viciae* are associated with herbs, and the *ignobilis* and *ulicis* groups with larger shrubs.

The distribution of *ignobilis* in England, Wales, the Channel Islands, France, Spain and Portugal follows closely the distribution of *Ulex minor*, one of its hosts; *Ulex gallii*, an alternative host of *ignobilis*, occurs in England, Wales, Ireland, the Channel Islands, North West France and North West Spain. One might reasonably expect to find *ignobilis* on *Ulex gallii* in Ireland or from North West France on either of its hosts.

Apart from a single record from France, *ulicis* is apparently unknown outside the British Isles, although its host *Ulex europaeus* is found throughout Western Europe. Similarly the host of *cytisi* (*Cytisus*) occurs throughout Western Europe although *cytisi* is known only from Scotland and Norfolk. Climatic factors obviously to some extent influence the range of these two species of *Odontothrips* but it is quite probable that both occur in Scandinavia.

LIFE HISTORY

Morison (1928), Orbtel (1963) and Bournier & Khochbav (1965) give accounts of the life histories of named species of *Odontothrips*. Most species feed exclusively in the flowers of Papilionaceae as discussed above. Some monophagous species such as *meliloti*, *cytisi* and *ulicis* are apparently univoltine in the British Isles (Morison, 1928). The polyphagous species *loti* is apparently multivoltine in Central Europe (Orbtel, 1963). The eggs are laid in a cut made by the female with her saw-like ovipositor in the epidermis of the flower (Bournier & Khochbav, 1963). The present author has examined an egg reputedly of *meliloti* in the sepal of *Sarothamnus*. The eggs of *confusus* hatch within seven to nine days (Bournier, 1965).

As in all thrips there are two active larval instars. The first and second instars of *ulicis* and *cytisi* feed in the flowers of *Ulex europaeus* and *Cytisus scoparius* respectively. The injury which they cause appears as a silvery sheen on the staminal sheath, but apparently only the superficial cells are damaged and the host does not suffer any serious effects (Morison, 1928). The mature second instar larvae pass to the ground to complete their metamorphosis.

Bournier & Khockbav (1965) records *confusus* as a pest of lucerne in France, causing 30% of the flowers of infested plants to droop, and decreasing the number of flowers which are likely to be pollinated by bees. The first instar larvae of *confusus* moult after five to six days. The second instar larvae pass to ground after fifteen to eighteen days. They descend to a depth of about twenty-five centimetres, where they remain until the following April. Pupation takes place in the ground and the adults emerge a few days later.

The second instar larvae of *loti* observed by Orbtel descended only to a depth of twenty to twenty-five millimetres, where they selected a suitable cavity amongst the soil particles. This chamber was subsequently reinforced by fastening the surrounding soil particles together with a sparse cobweb-like tissue spun from the anus. The larvae moulted after about four hours to produce the prepupae. This stage is agile and often changes position within the subterranean chamber, although there are periods of immobility often lasting for several hours. The prepupae moulted after about three days to give rise to the pupae. The adults emerged after about three and a half days. It is quite possible that *loti* overwinters in the larval condition, as does *confusus*. Morison has collected adults during the colder months of the year but these may appear as the result of a short period of milder weather. Females emerge slightly before males, and up to three eggs may develop at one time.

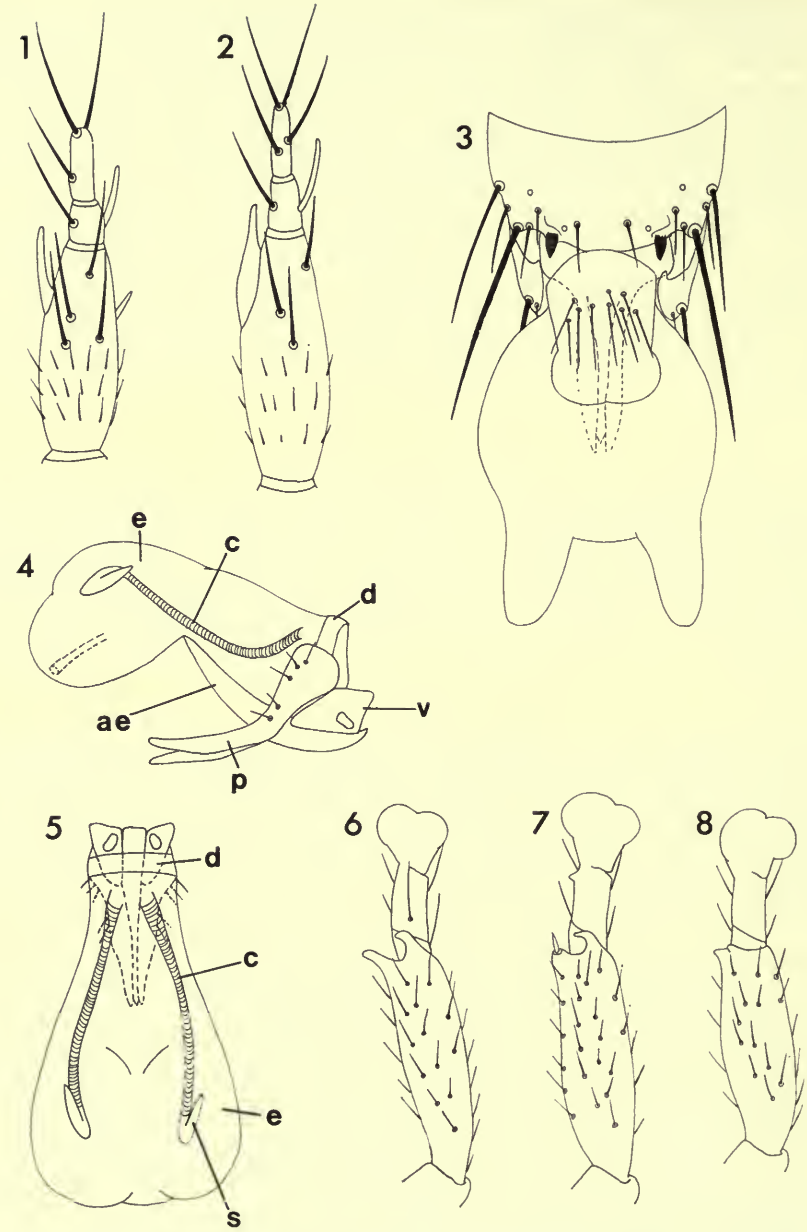
MALE GENITALIA

Several authors have referred to the structure of the external genitalia of Thysanoptera. However their accounts have been confined either to the morphological study of a few species from each major group, i.e., Doeksen (1941), Hartwig (1952), and Priesner (1960), or to the taxonomy of the genus *Haplothrips* of the suborder Tubulifera, i.e., Priesner (1938), Fabian (1938) and Klimt (1969). This is the first attempt to use the structure of the male genitalia in the taxonomy of the Terebrantia.

The terminology of the parts of the male genitalia is confused. This is largely due to earlier workers, i.e., De Gryse & Treherne (1924), who were apparently unaware that in the Terebrantia as well as in the Tubulifera the male genitalia consist for the greater part of a large extrusible membranous vesicle. The terminology suggested by Heming (1970), in his account of the postembryological development of *Haplothrips verbasci* and *Frankliniella fusca*, has been adopted throughout this paper.

The major component of the male intromittent organ is, as stated above, a large extrusible membranous vesicle which is called the endotheca (Text-figs 4 & 5). During copulation this lies dorsal to the paired parameres and median 'primitive aedeagus', all three of which are solid chitinous processes. These processes, which taper distally, are attached at their bases to the two ventral plates of the phallobase. The dorsal plate of the phallobase is narrow and is attached to the antero-lateral margins of the ventral plates. The ventral plates have a large foramen near the anterior end. The parameres bear numerous hair-like structures corresponding to the 'sensilla trichodea' of Heming (1970).

The endotheca of *phaleratus* and *pictipennis* is bilobed and does not bear any spines. All other species of *Odontothrips* examined bear one or more pairs of spines on the endotheca, which is not as markedly bilobed as in *phaleratus* or *pictipennis*. The arrangement of the endothecal spines is variable and in some species the spines are supported by canaliculate structures. These structures, which are here called canaliculi, arise dorsally as an extension of the theca. The pair of caniculi are



Figs 1–8. 1 & 2. Antennal segments VI to VIII: 1, *pictipennis*. 2, *intermedius*. 3. *pictipennis*, male genitalia and terminal abdominal segments. 4 & 5. *biuncus*, male genitalia: 4, lateral, 5, dorsal. ae – 'primitive aedeagus', c – canaliculi, d – dorsal plate, e – endotheca, p – parameres, s – endothecal spines, v – ventral plates. 6–8. Fore tibia and tarsus: 6, *ulicis*. 7, *loti*. 8, *confusus*.

supported throughout their length by small transverse hoop-like chitinous thickenings which give them the appearance of tracheae. These transverse thickenings are not actually hoop-shaped but are incomplete rings. It is probably one of these canaliculi to which Priesner (1970) refers as the 'taenidia like' ejaculatory duct. Actually the ejaculatory duct is normally only visible within the endotheca, where it opens to the exterior through the gonopore. The aedeagus proper is reduced to an incomplete ring of chitin supporting the gonopore. A similar reduction of the aedeagus is found in *Chirothrips manicatus* Haliday, which also bears large endothecal spines, see Pitkin (1972, in press).

Most of the *Odontothrips* species which have been studied differ from each other in the number and distribution of endothecal spines and the chaetotaxy of the ninth tergite. With experience these structures are often visible in poorly mounted specimens, but care should be taken, when fresh material is collected and mounted, to prepare males with these characters displayed as fully as possible. Specimens should be collected either into A.G.A. (a mixture of glacial acetic acid – 1 part; glycerine – 1 part; 60% alcohol – 10 parts) or into a low concentration alcohol (50–60%) as these fluids cause most specimens to become distended and remain relaxed and soft. The A.G.A. mixture must be removed by washing for several hours in 60% alcohol. Dehydration is best carried out through a progression of alcohols to absolute alcohol in the minimum effective time, and to facilitate this it is usually necessary to pierce the body with a fine needle in several places. Specimens may be cleared in clove oil prior to mounting in Canada Balsam. Where possible I have used the above techniques, but both Heming (1969) and Hartwig (1952) give detailed alternatives, which are apparently as effective.

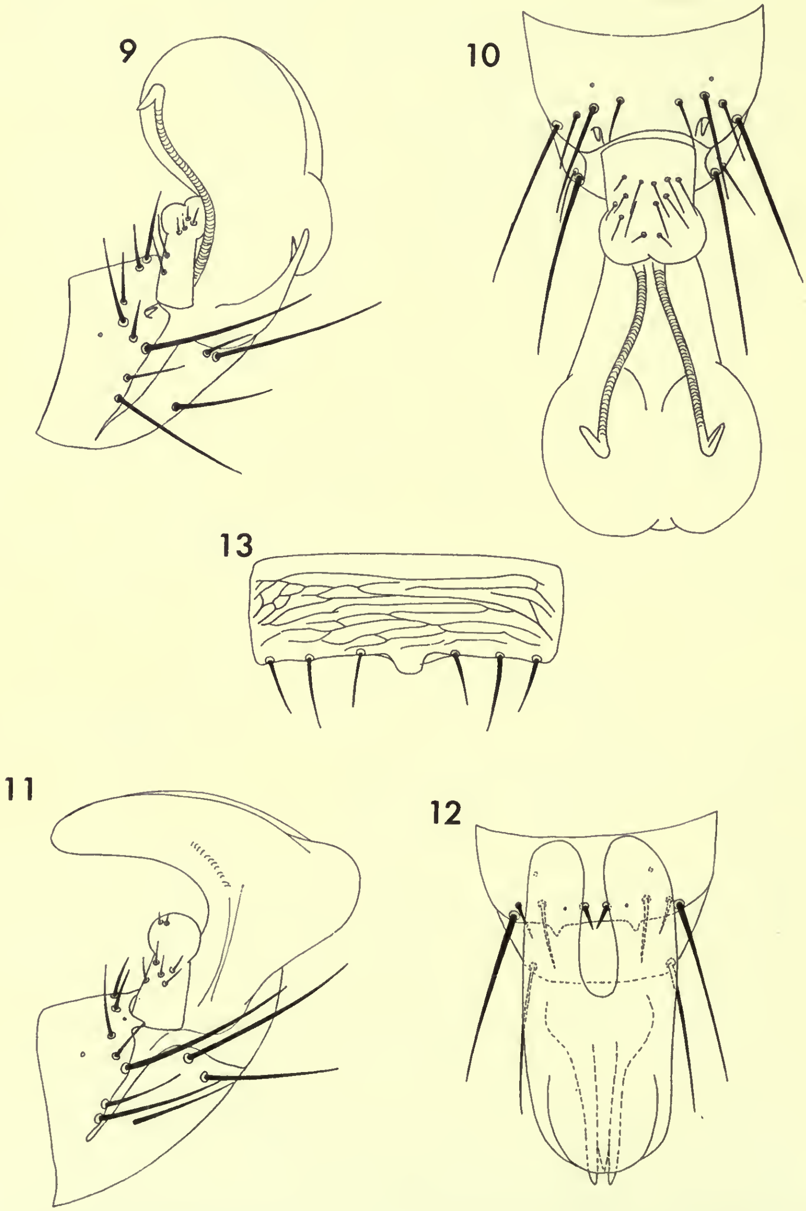
ODONTOTHRIPS Amyot & Serville

Odontothrips Amyot & Serville, 1843 : 642. Type-species, by subsequent designation by Karny (1907 : 45), *Thrips palerata* Haliday.
Odontothrips Amyot & Serville; Priesner, 1951 : 357–9.
Odontothrips Amyot & Serville; Priesner, 1964 : 65–69.

Body-length 1·3 to 2·0 mm, males smaller than females. Colour brown to very dark brown, almost black; antennal segments III and often part of IV yellow; tarsi and fore tibiae yellow. Antennae eight-segmented, the last two segments forming a style; segments III and IV with forked sense cones; the sense cone on VI with the base greatly enlarged in all species except *pictipennis* and *moerens* (Text-figs 1 & 2). Maxillary palps three-segmented, labial palps two-segmented. Three pairs of ocellar setae, pair III longer than one side of the ocellar triangle and arising within the triangle or on its anterior margin.

Pronotum with two pairs of elongate posteroangular setae; metanotum with two pairs of setae very close to or on the anterior margin, the median pair longer than the lateral pair. Always macropterous, fore wings with two veins, setal row on fore vein interupted sub-apically, usually shaded except for a pale band near the base, a few species also have a pale sub-apical band. Fore tibiae usually with one or two claw-like processes at the apex, but these may be reduced; tarsi two-segmented; the distal segment often with one or two small hooks or tubercles (claws and tubercles are more easily seen in lateral view).

Abdominal tergites I to VII and IX and X resemble the sternites in lacking microtrichia; tergite VIII of female with a posteromarginal comb of microtrichia, which is broadly interrupted medially, and a small number of microtrichia anterolaterally near the spiracle; tergite X of female with an incomplete longitudinal split. Sternites without accessory setae. Males without sternal glands, with or without a pair of thornlike processes on tergite IX, endotheca of phallus usually bearing spines.



Figs 9–13. 9–12. Male genitalia and terminal abdominal segments: 9 & 10, *loti*, lateral and dorsal. 11 & 12, *phaleratus*. 13. *phaleratus*, sternite V.

The genus *Odontothrips* is most closely related to the Australian genera *Odontothripiella* Bagnall and *Odontothripoides* Bagnall. Species of these genera however either have a single pair of posteroangular setae on the pronotum or lack them entirely. The males of all three species of *Odontothripiella*, and apparently *Odontothripoides morisoni*, lack endothecal spines.

KEY TO SPECIES

1 Base of sense cone on antennal segment VI small, maximum diameter less than one-third of total length of the sense cone (Text-fig. 1) 2

– Base of sense cone on antennal segment VI greatly enlarged, maximum diameter more than one-third of total length of the sense cone (Text-fig. 2) 3

2 Fore tibiae with one stout claw at the apex. Fore wings without a pale sub-apical band, upper vein with about 4 + 11 + 2 setae, lower vein with 14 to 18 setae. Male unknown. From West Africa . . . . . **moerens** Priesner (p. 393)

– Fore tibia with two stout claws at apex. Fore wings with a pale sub-apical band, upper vein with about 4 + 8 to 11 + 2 setae, lower vein with 11 to 16 setae. Male genitalia bilobed and without endothecal spines (Text-fix. 3). From North America . . . . **pictipennis** Hood (p. 396)

3 Distal fore tarsal segment with one or two small hooks or tubercles on inner margin (Text-fig. 7) 4

– Distal fore tarsal segment without small hooks or tubercles (Text-figs 6 & 8) . . 11[1]

4 Fore tibia with one or two stout claws at apex (Text-fig. 7) . . . . . . 5[2]

– Fore tibia without stout claws, but with two small claws or one small claw and a bristle-bearing tubercle (Text-fig. 8) 6

5 Fore tibia with one stout claw (Text-fig. 7). ♀ abdominal tergites II to VIII weakly striate lateral to the median setae only. Male genitalia with a single pair of stout endothecal spines supported by a well developed canaliculus (Text-figs 9 & 10) .
On *Lotus*, *Anthyllis*, *Ononis* or *Trifolium* throughout Europe and introduced into North America . . . . **loti** (Haliday) (p. 391)

– Fore tibia with two stout claws. ♀ abdominal tergites II to VIII with sculpture between the median setae as well as laterally. Male genitalia (Text-fig. 19) similar to *loti*.
On *Vicia*, throughout Europe . . . . **biuncus** John (p. 383)

6 Fore tibia with two small claws . . . . . **paraconfusus** Pelikan[3] (p. 395)

– Fore tibia with one small claw and a bristle-bearing tubercle . . . . . 7[4]

7 Male genitalia with one pair of stout endothecal spines, which are supported by canaliculi (Text-fig. 21) . . . .
On various Papilionaceae in the Mediterranean region, common in North Africa **karnyi** Priesner (p. 390)

– Male genitalia with more than one pair of endothecal spines 8

8 Male genitalia with needle-like endothecal spines (Text-figs 22 & 23).
On various Papilionaceae flowers in the Canary Islands and Morocco **retamae** Priesner (p. 397)

– Male genitalia with stout endothecal spines 9

9 Median pair of spines on abdominal tergite IX of male very stout (Text-fig. 18). Male genitalia with two to three pairs of endothecal spines, the distal pair set apart from the basal one or two pairs.
On *Spartium*, from Albania, Turkey and Cyprus . **meridionalis** Priesner (p. 393)

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[1] see text-notes for *phaseoli* (p. 396)
[2] see text-notes for *konumensis* (p. 391)
[3] ex description
[4] see text-notes for *ononidis* (p. 395), *vuilletia* (p. 400) and *karnyi* subsp. *rivnayi* (p. 391).

– Median pair of spines on tergite IX of male setiform 10

10 Median area of pronotum of males and females without lines of sculpture. Male genitalia with three to four pairs of endothecal spines, the distal two or three pairs set apart from the basal pair, which are usually larger (Text-figs 16 & 17).
On *Melilotus*, from southern England, France, Germany, Hungary and Czechoslovakia . . . . ***meliloti*** Priesner (p. 392)

– Median area of pronotum with lines of sculpture. Male genitalia with four to five pairs of endothecal spines, rarely more, decreasing in size distally and spaced fairly regularly (Text-figs 14 & 15).
On *Ulex minor* or *U. gallii*, in Western Europe . . . .
ignobilis Priesner (p. 387)

11 Fore tibia with one or two stout claws at the apex 12

– Fore tibia without stout claws, but with small teeth or a small tooth and a bristle-bearing tubercle (Text-fig. 8) 16

12 Fore tibia with two stout claws 13

– Fore tibia with one stout claw 14

13 Hind margin of abdominal tergite IX of male with a pair of strong dark processes laterally (Text-fig. 26). Male genitalia with three or four pairs of endothecal spines, the basal pair not much larger than the two or three distal pairs (Text-figs 26 & 27). Fore wing with 14 to 18 setae on the lower vein.
On *Cytisus*, from Scotland and Norfolk . . . . . ***cytisi*** Morison (p. 385)

– Hind margin of abdominal tergite IX of male without processes laterally. Male genitalia with three pairs of endothecal spines, the basal pair larger than the distal two pairs (Text-figs 24 & 25). Fore wing with 17 to 23 setae on the lower vein.
On *Ulex europaeus*, in the British Isles and France . ***ulicis*** (Haliday) (p. 399)

14 Fore tarsus with a curved terminal claw . . . . . ***viciae*** Priesner (p. 400)

– Fore tarsus without terminal claw 15

15 Sternites IV to VII of male each with a median posterior lobe (Text-fig. 13). Male genitalia with a bilobed endotheca which lacks endothecal spines (Text-figs 11 & 12).
On *Lathyrus*, *Vicia*, throughout Europe . . . ***phaleratus*** (Haliday) (p. 395)

– Sternites of male without median lobes. Structure of male genitalia not known.
On *Lathyrus niger* and *Lathyrus tuberosum* from North and Central Europe, Rumania and the U.S.S.R. . . . . . . ***intermedius*** (Uzel) (p. 389)

16 Fore wings distinctly shaded 17

– Fore wings pale except at the extreme apex 20

17 Apex of fore tibia with two small teeth 18

– Apex of fore tibia with one small tooth.
Upper vein of fore wing with 4 + 14 + 2 setae, lower vein with 15 to 16 setae.
On *Tilia cordata*, from Hungary, Czechoslovakia and the U.S.S.R.
edentulus Priesner (p. 387)

18 Hind tibia 130 to 155 μ, smallest species of *Odontothrips*.
Antennal segment II dark, III pale. On *Dorycnium*, in France
dorycnii Priesner (p. 387)

– Hind tibia more than 160 μ, larger species 19

19 Antennal segment II dark, III pale. Male with two pairs of fairly stout endothecal spines on the genitalia, which are supported by canaliculi (Text-fig. 20).
On *Medicago* spp. and *Eryngium*, from Germany, Hungary, Czechoslovakia, Jugoslavia and the U.S.S.R. . . . . . . ***confusus*** Priesner (p. 384)

– Antennal segments II and III pale, IV darker than III but paler than V. Male genitalia not known.
On *Vicia cracca*, similar distribution to *confusus* . ***aemulans*** Priesner (p. 383)

20 Pronotum and abdominal tergites II to VIII with lines of sculpture medially **_elbaensis_** Priesner (p. 387)

– Pronotum and abdominal tergites II to VIII without lines of sculpture medially **_phlomidinus_** Priesner (p. 396)

DESCRIPTIONS OF SPECIES

Odontothrips aemulans Priesner

(Map 5)

Odontothrips aemulans Priesner, 1924 : 1. ? Syntype ♀♀, RUMANIA: Visau, Iasi, on meadow grass, May (*W. Knetchel*) (Priesner coll.). [not examined].

This species is related to *dorycnii* and *confusus* but can be distinguished by the colour of antennal segments II to IV. The lower vein of the fore wing bears a row of 14 to 15 setae. *O. aemulans* is recorded by Priesner (1964) from Czechoslovakia, Germany, Hungary, Rumania and Yugoslavia, and by Dyadechko (1964) from the U.S.S.R. The host-plant is apparently *Vicia cracca.*

MATERIAL EXAMINED. CZECHOSLOVAKIA: Pourdrany, 3 ♀, 1938; HUNGARY: Simontornya, on *Vicia cracca,* 2 ♂, 5 ♀, [incorrectly labelled as 'Cotypes'], 25.iv.1926 (*F. Pillich*) (Priesner coll. and BMNH).

Odontothrips biuncus John

(Text-figs 4, 5, & 19; Map 1)

Odontothrips biuncus John, 1921 : 7–8. 2 ♂, 54 ♀, syntypes, U.S.S.R.: Leningrad, on *Vicia cracca* (2 ♀ in BMNH, depository of remainder unknown) [2 ♀ examined].

[*Odontothrips uzeli* Bagnall; Bagnall, 1924 : 272. Misidentification.]

Odontothrips biuncus John; Mound, 1968 : 45.

Bagnall (1924) misidentified specimens of *biuncus* from Durham and he labelled these incorrectly as 'types' of *uzeli,* although they were collected several years after *uzeli* was described. Bagnall's specimens, with two stout tibial claws, have been compared with females of the type-series of *biuncus.*

The male genitalia of *biuncus* (Text-fig. 19) are similar to *loti* and *karnyi,* but the species may be distinguished by the presence of two stout tibial claws. Priesner records *biuncus* throughout Western Europe. This species apparently breeds on *Vicia cracca,* although both males and females may be numerous on *V. sepium* and *Lathyrus pratensis.*

MATERIAL EXAMINED. 2 ♀ syntypes, U.S.S.R.: Leningrad (Tzarskoje Selo), on *Vicia cracca,* 26.vi.1921 (*O. John*).

ENGLAND: Durham, Gibside, on *V. cracca,* 2 ♂, 4 ♀, vii.1924; Devon, Falmouth, on *V. cracca,* 4 ♂, 11 ♀, 28.vi.1970 (*J. Palmer*); Herts., Sawbridgeworth, 2 ♀, 19.vii.1970 (*B. R. Pitkin*); N. E. SCOTLAND: on *V. cracca,* 8 ♂, 14 ♀, 1950–1964 (*G. D. Morison*); FRANCE: Anse, on *V. cracca* and *Agrimonium eupatorium* (Rosaceae); PORTUGAL: Oporto, on *Genista,* 1 ♀, 4.v.1960 (*E. R. Speyer*).

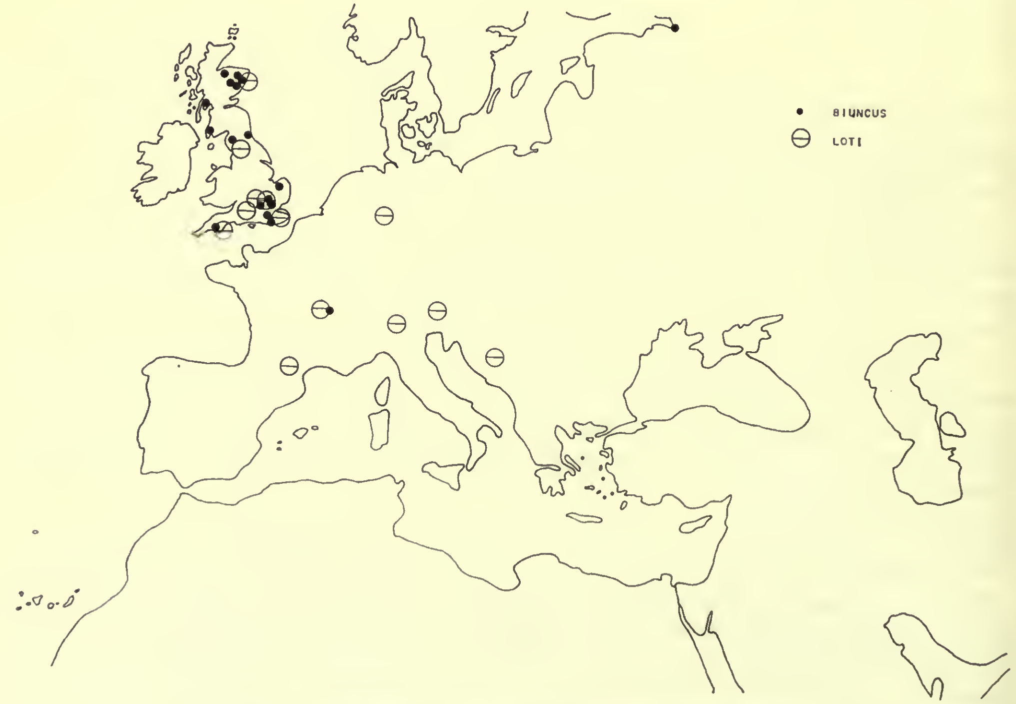
Odontothrips confusus Priesner

(Text-figs 8 & 20; Map 5)

Odontothrips confusus Priesner, 1926 : 237, ?♂♂ and ♀♀ syntypes, HUNGARY: on flowers of *Medicago falcata* (!) and *Trifolium rubens*. June and July (*Pillich*) (Priesner coll.) [not examined].

This species may be distinguished from *dorycnii* only by its larger size. The antennae differ in colouration from *aemulans* as stated earlier. The fore wings bear 14 to 15 setae on the lower vein. The male genitalia of *confusus* (Text-fig. 20) bear two pairs of stout endothecal spines which are supported by canaliculi. Recorded from Southern, Central, and Eastern Europe by Priesner (1964), *O. confusus* is a pest of *Medicago sativa* in France and has also been recorded from *M. media*, *M. falcata* and *Trifolium rubens* (Bournier, 1965).

MATERIAL EXAMINED. HUNGARY: Simontoryna, 'Trockener Waldiseg Rasen', 1 ♂, 1 ♀, 'Cotypes' [?sic], 21.vii.1924 (*F. Pillich*) (Priesner coll.); Simontornya, on *Eryngium campestre*, 2 ♀, 'Cotypes' [?sic], 31.vii.1927 (1 ♀ in Priesner coll. and 1 ♀ in BMNH); FRANCE: Rhone, Liergues, on *Medicago sativa* and *Trifolium repens*, 5 ♀, 5.vii.1927 (*O. John*); GERMANY: Eisleben, on *Medicago falcata*, 2 ♀, 13.vi.1950 (*H. von Oettingen*); Frankfurt/Main Bergen, on *Medicago sativa*, 2 ♂, 29.vii.1962 (*R. zur Strassen*) (SMF); Hessen Florsheim/Main, on *Coronilla vulgaris*, 4 ♂, 10.vii.1962



MAP 1. Distribution of *Odontothrips biuncus* and *loti*.

(*R. zur Strassen*) (SMF); SWITZERLAND: Tessin, Lago Maggiore, Ascone, on *Lotus corniculatus*, 2 ♂, 20.vii.1963 (*R. zur Strassen*) (SMF); CZECHOSLOVAKIA: Brno, on Lucerne, 2 ♂, 3 ♀, 24.vii.1961; Pourdrany, and Koogli, 2 ♂, 1 ♀, 1938; Pourdrany, 1 ♂, 1 ♀, 3.vii.1955 (*J. Pelikan*) (USNM); YUGOSLAVIA: Golija-kaskovo, on *Artemisia absinthium*, 3.viii.1964 (*G. D. Morison* leg.); Sabac, on *Trifolium pratensis*, 1 ♂, 10.vi.1960 (*G. D. Morison* leg.); Zemun, 1 ♂, 3 ♀, 5.vii.1962 and 21.vi.1962 (*G. D. Morison* leg.); TURKEY: Bursa, on *Medicago*, 3 ♂, 25.vi.1949 (*Tomer*) (Priesner coll.).

Odontothrips cytisi Morison

(Text-figs 26 & 27; Map 3)

Odontothrips cytisi Morison, 1928 : 38. Holotype ♀, SCOTLAND: Aberdeenshire and Kincardineshire, on *Cytisus scoparius* (BMNH) [examined].

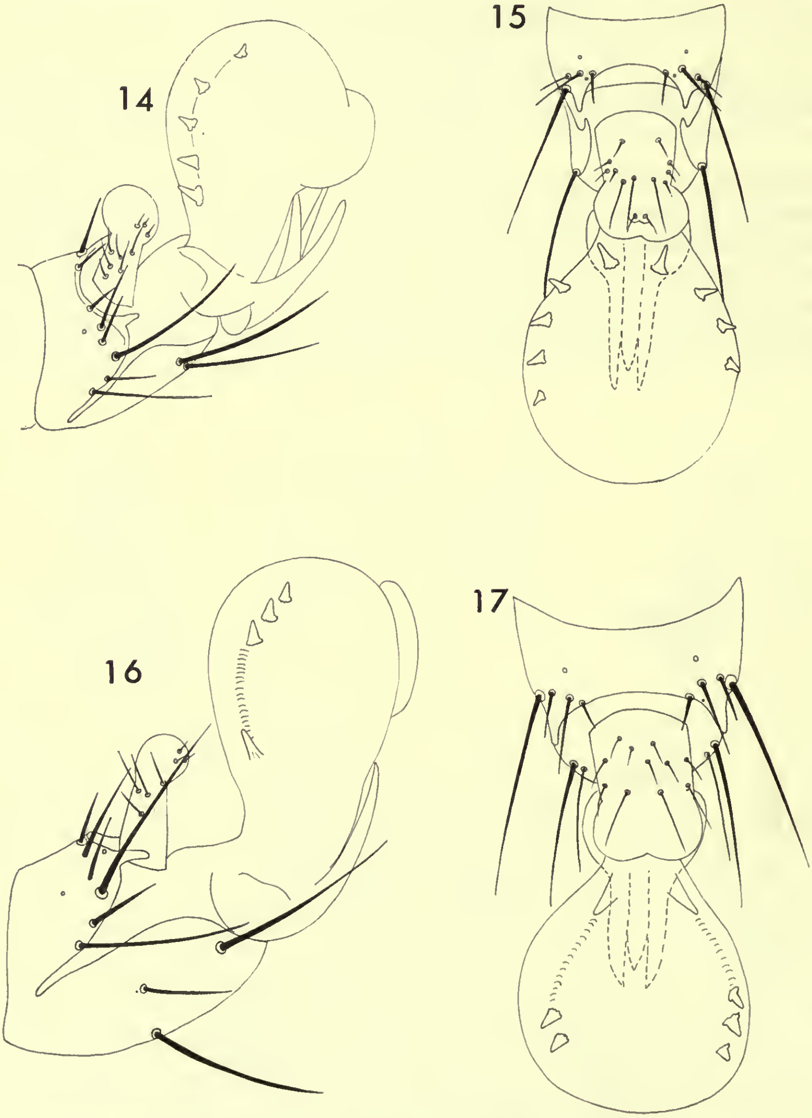
This species is related to *ulicis*. Females of *cytisi* and *ulicis* cannot be readily distinguished. The lower vein of the fore wing has 14 to 18 setae. Males may be distinguished by the presence of a pair of stout processes on the ninth abdominal tergite and the smaller pair of spines at the base of the endotheca of the genitalia (Text-figs 26 & 27). Morison (1948) records this species from eleven counties in Scotland and from Norfolk, breeding in the flowers of *Cytisus scoparius*.

MAP 2. Distribution of the *ignobilis* group.[5]

[5] Specimens of *karnyi* from S. Portugal have been examined since this map was prepared.

MATERIAL EXAMINED. Holotype ♀, paratypes, 5 ♂, 8 ♀, SCOTLAND: Aberdeenshire and Kincardineshire, on *Cytisus*, 1924–1927 (*G. D. Morison*).

SCOTLAND: Kincardineshire, Blaire, on *Vaccinium myrtillus*, 4 ♂, 4 ♀, 2.v.1927 (*G. D. Morison*); Aberdeen., Dyce, on *Cytisus*, 7 ♀, 3.iv.1964 (*L. A. Mound*); Aberdeen., Deskry, on *Cytisus*, 3 ♀, 25.v.1966 (*L. A. Mound & B. R. Pitkin*); Aberdeen., Bucksburn, on *Cytisus*, 9 ♀, 24.v.1966 (*L. A. Mound & B. R. Pitkin*); Aberdeen, on



FIGS 14–17. Male genitalia and terminal abdominal segments: 14 & 15, *ignobilis*, lateral and dorsal. 16 & 17, *meliloti*, lateral and dorsal.

Cytisus, 1 ♂, 11 ♀, 23.v.1966 (*L. A. Mound & B. R. Pitkin*); N. E. SCOTLAND: on *Cytisus scoparius*, 66 ♂, 69 ♀, 1950–1964 (*G. D. Morison*).

Odontothrips dorycnii Priesner

(Map 5)

Odontothrips dorycnii Priesner, 1951 : 355. 4 ♀ syntypes, FRANCE: Camargues, Bouches du Rhone, on *Dorycnium jordani* (Priesner coll.) [2 ♀ examined].

This species, described from females only, may be distinguished from *confusus* by its smaller size.

MATERIAL EXAMINED. 2 ♀ syntypes, FRANCE: Camargues, Bouches du Rhone, on *Dorycnium jordani* (*R. de Mallman*) (Priesner coll.).

Odontothrips edentulus Priesner

(Map 5)

Odontothrips edentulus Priesner, 1926 : 238. Holotype ♀, HUNGARY: Simontornya, on *Tilia cordata* (Priesner coll.) [examined].

The fore wings of the unique female holotype bear 4 + 14 + 2 setae on the upper vein, and 15 to 16 setae on the lower vein. This species bears one small tooth at the apex of the fore tibia.

MATERIAL EXAMINED. Holotype ♀, HUNGARY: Simontornya, on *Tilia cordata* (Tiliaceae), 22.vi.1925 (*F. Pillich*) (Priesner coll.).

Odontothrips elbaensis Priesner

(Map 5)

Odontothrips elbaensis Priesner, 1933 : 6. Holotype ♀, EGYPT: Wadi Rabdet, Elba Mountains, swept from weeds at the bottom of Wadi, 2.i.1933 (*H. Priesner*) (Ministry of Agriculture, Egypt) [not examined].

This species, described from two females collected in the Elba Mountains, has wings hyaline, except at the extreme apex of the fore wing, which is tinged with brown.

MATERIAL EXAMINED. Paratype ♀, EGYPT: Wadi Rabdet, Elba Mountains, swept from weeds at the bottom of Wadi, 2.i.1933 (Priesner coll.).

Odontothrips ignobilis Bagnall **sp. rev.**

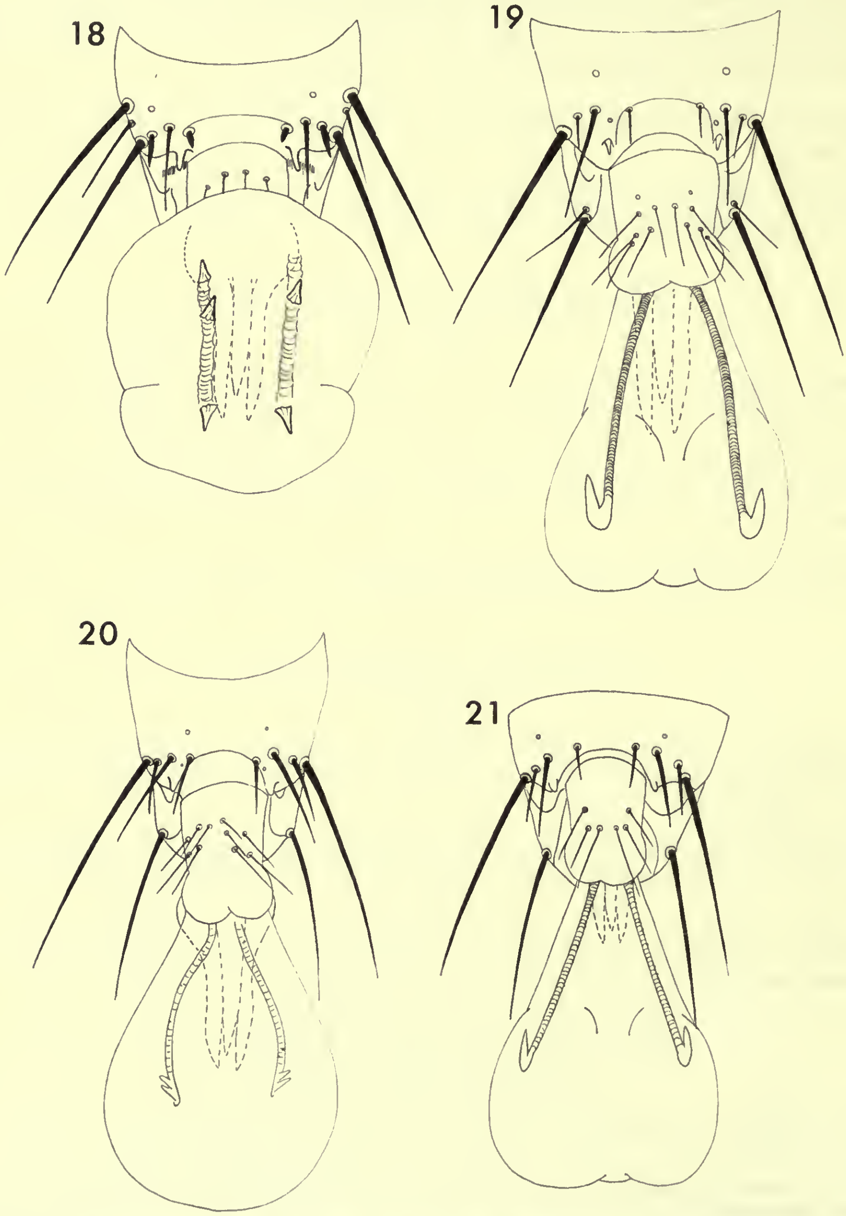
(Text-figs 14 & 15; Map 2)

Odontothrips ignobilis Bagnall, 1919 : 262–263. Holotype ♀, SPAIN: Ortigosa, Logrosa [examined].

Odontothrips mutabilis Bagnall, 1924 : 271–272. 7 ♀ syntypes, ENGLAND: Hants, Bournemouth, on *Ulex* [examined].

Odontothrips inermis Bagnall, 1928 : 95–96. Holotype ♂, ENGLAND: Cheshire, Delamere [examined].

O. ignobilis, which Mound (1968) synonymized with *meridionalis*, may be distinguished from *meliloti* and *meridionalis* by the presence of lines of sculpture on the median area of the pronotum. The male genitalia of *ignobilis* (Text-figs 14 & 15) bear four or five pairs of endothecal spines which decrease in size distally and are



FIGS 18–21. Male genitalia and terminal abdominal segments: 18, *meridionalis*, 19, *biuncus*, 20, *confusus*, 21, *karnyi*.

arranged at fairly regular intervals. The partially extruded genitalia of the holotype male of *inermis* are identical with genitalia of *ignobilis* and like the females of the type-series of *mutabilis*, this specimen has lines of sculpture on the median area of the pronotum.

O. ignobilis breeds on *Ulex gallii* and *U. minor* and is here recorded from England, the Channel Islands, France, Spain and Portugal.

MATERIAL EXAMINED. Holotype ♀ of *ignobilis*, SPAIN: Ortigosa, Logrosa, 1892, (Coll. Navás). Syntypes, 7 ♀, of *mutabilis*, ENGLAND: Hants, Bournemouth, on *Ulex*, ix.1924 (*R. S. Bagnall*). Holotype ♂ of *inermis*, ENGLAND: Cheshire, Delamere, 25.viii.1925 (*H. Britten*).

ENGLAND: Surrey, Ham, on *Melilotus*, 4 ♀, 28.v.1966 (*L. A. Mound*); Surrey, Ham, on *Sarothamnus*, 1 ♀, 28.v.1966 (*L. A. Mound*); Surrey, Ham, on *Sarothamnus*, 2 ♂, 3 ♀, 28.vi.1970 (*B. R. Pitkin & M. S. Steel*); London, Buckingham Palace Grounds, 1 ♂, 25.iv.1961 (*V. F. Eastop*); ENGLAND: on *Ulex galli* and *U. minor*, 6 ♂, 92 ♀, (*G. D. Morison*); CHANNEL ISLANDS; Jersey, St. Brelade's Bay, on *Ulex*, 4 ♀, (*B. R. Pitkin*); FRANCE: Gers, Ornezon, on *Ulex nanus*, 3 ♂, 7 ♀, 4.viii.1913; Pyrenees, Col de Puymerons, 5,500 ft, on *Genista*, 1 ♀, viii.1926 (*R. S. Bagnall*); SPAIN: Pyrenees, Urtg, nr Puigicerda, in flowers of 'Stachelginster', 37 ♀, 28.v.1930 (*F. Diehl*) (Priesner coll.); PORTUGAL: Oporto, on *Ulex gallii*, *U. australis*, *Genista* and *Sarothamnus*, 12 ♂, 11 ♀, v.1960 (*E. R. Speyer*); Algarve, in yellow flowers of Legume, 8 ♀, 12.vi.1963 (*E. R. Speyer*); Lousa Beira, Litoral, on *Ulex*, 12.vii.1966 (*N. H. L. Krauss*); Maiorca, on *Ulex jassiaci* flowers, 2 ♂, 2 ♀, 15.iv.1958 (*C. J. Davis*) (USNM); Boa Nova, on *Ulex europaeus* flowers, 3 ♂, 3 ♀, 14 & 18. vii.1960 (*N. H. L. Krauss*) (USNM); nr Santo Antonio de Oliveis, Dianteiro, on *Ulex micranthus*, terminal shoots and leaves, 1 ♂, 1 ♀, (*Davis & Silva*) (USNM).

Odontothrips intermedius (Uzel)

(Text-fig. 2; Map 4)

Physopus intermedia Uzel, 1895 : 114–115. Syntypes of both sexes, CZECHOSLOVAKIA: (Bohemia), in flowers, June (Uzel coll.) [not examined].
Odontothrips intermedius (Uzel) Karny, 1912 : 329.

The fore wings of *intermedius* bear 4 + 9 + 2 setae on the upper vein, and 14 to 17 setae on the lower vein. In addition to the pale band near the base, the fore wings have a pale sub-apical band which in some specimens is almost hyaline. Bagnall recorded a single female from the British Isles, but this specimen has apparently been lost (Mound, 1968). The structure of the male genitalia is unknown.

Priesner (1964) records *intermedius* from North and Central Europe and Rumania, and Dyadechko (1964) recorded it from the U.S.S.R. The host plants are apparently *Lathyrus tuberosus* and *L. niger*.

MATERIAL EXAMINED. AUSTRIA: Linz, on *Lathyrus niger*, 1 ♂, 2 ♀, 17.iv.1926 and on *L. niger*, 3 ♀, 13.v.1926 (ex Priesner coll.) (USMN); HUNGARY: Simontornya, on *L. niger*, 2 ♀, 14.v.1926 (*F. Pillich*): CZECHOSLOVAKIA: Pourdrany, 1 ♀.

Odontothrips karnyi Priesner

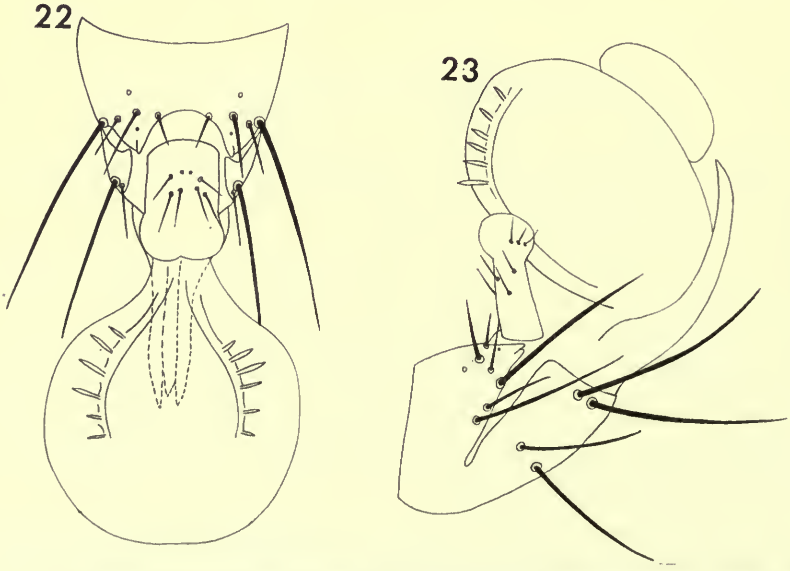
(Text-fig. 21; Map 2)

Odontothrips karnyi Priesner, 1924 : 1. Syntypes of both sexes, Egypt: ('Anglo-aegyptian Sudan' according to Priesner) Assuan, Shellal, on *Lupinus* sp. (Priesner coll.) [2 ♂, 3 ♀, syntypes examined].

Priesner described two varieties of *karnyi*, namely var. *rivnayi* from Israel and var. *retamae* from the Canary Islands. The latter variety Priesner (1933) referred to as 'var. *retamae* Enderlein (*in schedis*)' since the specimens on which the variety was described had been originally misidentified by Enderlein as *karnyi*. R. zur Strassen (1969) indicated that he could see no obvious differences between specimens collected in the Canary Islands and *karnyi* from Eygpt. Examination of material from both localities including syntypes of *karnyi* has led to a different interpretation. Although females from the Canary Islands are at present indistinguishable from *karnyi*, the males of the two species have distinct genitalia. The male genitalia of *karnyi* sensu stricto (Text-fig. 21) bear a single pair of stout endothecal spines which are supported by poorly developed canaliculi. All the males examined from the Canary Islands have numerous needle-like endothecal spines. *O. retamae* is therefore here regarded as a distinct species.

O. karnyi is recorded here from Israel, Egypt, Tunisia, Algeria and Morocco, and apparently feeds in the flowers of various Papilionaceae.

Material examined. Syntypes, 2 ♂, 3 ♀, Egypt: Assuan, Shellal, on *Lupinus* sp., 7.ii.1914 (*Prof. R. Ebner*) (Priesner coll.).



Figs 22–23. *O. retamae*, male genitalia and terminal abdominal segments, dorsal and lateral.

EGYPT: Luxor, on *Sesbania*, 1 ♀, 5.ii.1914 (*Prof. R. Ebner*); Montazah, on sweet peas, 2 ♂, iii.1939 (*H. Priesner*) (Priesner coll.); Sinai, W. Gederat, on *Nitraria retusa* (Zygophyllaceae), 1 ♂, 7.iv.1937 (*H. Priesner*)(Priesner coll.); Egypt, 2 ♀ (ex coll. C. B. Williams) (USNM); ISRAEL: Rehovath, on Alfalfa, 1 ♂, 1 ♀, 22.iii.1945 (*Rivnay*); TUNISIA: Tunis, on *Medicago*, 1 ♀ (ex coll. C. B. Williams) (USNM); ALGERIA: on *Melilotus* and Leguminosae, 3 ♀ (ex coll. C. B. Williams) (USNM); MOROCCO: Cap Blanc, nr Mazagan, on flowering *Retama monosperma webbii*, 15 ♂, 8 ♀, 11.ii.1965 (*R. zur Strassen*); Rabat, on *Ulex*, 3 ♂, 20.iv.1960 (*Kramer & Drea*) (USNM); PORTUGAL: Monte Gordo, 6 ♂, 6 ♀, 17.v.1971 (*D. J. Williams*).

Odontothrips karnyi rivnayi Priesner

(Map 2)

Odontothrips karnyi var. *rivnayi* Priesner, 1933 : 8. Numerous syntypes of both sexes, ISRAEL: Various localities, dates and hosts (*Rivnay*) (Priesner coll.) [not examined].

This variety is apparently smaller than *karnyi* sensu stricto and according to Priesner (1964) may be distinguished by having fewer wing setae on the lower vein of the fore wing and some specimens lack tarsal teeth. Three females and one male from Israel have been recently examined. The fore wings bear 4 + 14 to 17 + 2 setae on the upper vein, all specimens lack tarsal teeth. The male genitalia are identical with *karnyi* sensu stricto. The published data are ISRAEL: Palestine, Mikveh, on flowers of *Cajanus indicus*, ♀ and ♀, xi.1931; further specimens from Zichron, Jakov, on *Citrus medica*, 29.xii.1931; Tel Aviv, on composites, 26.xii.1931; Ramath Gan, on *Pisum sativum*, 21.xii.1931; Tel Aviv, on *Acacia* flowers, 8.i.1932 (all in Priesner coll.).

MATERIAL EXAMINED. ISRAEL: Tel Aviv University Botanical Gdns., on *Retama*, 3 ♀, 1 ♂, 26.iv.1971 (*D. Gerling*).

Odontothrips konumensis (Ishida) **comb. n.**

Taeniothrips konumensis Ishida, 1931 : 37–39. Holotype ♀, JAPAN: Saghalien, on flowers of the meadow grasses and clover, 2.vii.1930 (*C. Watanabe*) (Entomological Institute, Faculty of Agriculture, Hokkaido University, Japan) [not examined].

The unique female of *konumensis* was not available to the author but the description suggests that this species may well represent *biuncus* John.

Odontothrips loti (Haliday)

(Text-figs 9 & 10; Map 1)

Thrips loti Haliday, 1852 : 1108. Syntypes of ? both sexes, ? GREAT BRITAIN: on *Lotus corniculatus* [lost].

[*Odontothrips ulicis* (Haliday); Uzel, 1895 : 115. Misidentification.]

Euthrips ulicis californicus Moulton, 1907 : 56. Syntypes 4 ♂, 3 ♀, U.S.A.: California, Wrights Station, Santa Clara County, vetch sweepings (*D. Moulton*) (California Academy of Sciences, San Francisco) [not examined].

Odontothrips loti (Haliday); Williams, 1916 : 277.

Odontothrips uzeli Bagnall, 1919 : 262. Lectotype ♀, CZECHOSLOVAKIA: Bohemia (BMNH), here designated [examined]. [Synonymized by Mound, 1968 : 45.].

Odontothrips anthyllidis Bagnall, 1928 : 96–97. Holotype ♀, SCOTLAND: Aberdeen, on *Anthyllis* (BMNH) [examined]. [Synonymized by Priesner, 1964 : 66.].

Odontothrips thoracicus Bagnall, 1934*a*: 59–60. Holotype ♀, ENGLAND: W. Grimstead, nr Salisbury, on *Ononis* (BMNH) [examined]. [Synonymized by Priesner, 1964 : 66.]

Odontothrips quadrimanus Bagnall, 1934*a* : 60. Holotype ♀, ENGLAND: Kent, Tankerton, on *Ononis spinosa* (BMNH) [examined]. [Synonymized by Priesner, 1964 : 66.]

Ondontothrips brevis Bagnall, 1934*b* : 488. [Lapsus calami for *brevipes*.]

Odontothrips brevipes Bagnall, 1934*b* : 488. Holotype ♀, SWITZERLAND: Lugano (BMNH) [examined]. [Synonymized by Mound, 1968 : 45.]

Bagnall (1919) proposed the name *uzeli* for specimens misidentified by Uzel (1895) as *ulicis*. The male genitalia of *uzeli*, *anthyllidis*, *quadrimanus* and *brevipes* have been compared with *loti* (Text-figs 9 & 10). The endotheca bears a single pair of stout endothecal spines supported by canaliculi. The type-material of these four species and the unique female *thoracicus* have only one stout claw at the apex of the fore tibia as in *loti*, and not two as in *biuncus*. *O. loti* lacks lines of sculpture medially on abdominal tergites II to VIII.

Recorded by Priesner (1964) throughout Europe, *loti* apparently feeds in the flowers of *Lotus, Anthyllis, Ononis, and Trifolium.*

MATERIAL EXAMINED. Lectotype ♀, paralectotypes 2 ♂, 1 ♀, of *uzeli*, CZECHOSLOVAKIA: (Bohemia) (ex coll. Uzel). Holotype ♀, paratypes 1 ♂, 1 ♀, of *anthyllidis*, SCOTLAND: Aberdeen, on *Anthyllis*, viii.1925 (*R. S. Bagnall*). Holotype ♀, paratypes 2 ♂, 3 ♀, of *quadrimanus*, ENGLAND: Kent, Tankerton, on *Ononis spinosa*, v.1931 (*R. S. Bagnall*). Holotype ♀, paratype ♂ of *brevipes*, SWITZERLAND: Lugano, vii.1929 (*J. J. Mann*). Holotype ♀ of *thoracicus*, ENGLAND: W. Grimstead, nr Salisbury, on *Ononis*, vii.1929 (*R. S. Bagnall*).

ENGLAND: from Sussex, Kent, London, Middlesex, Berkshire, Devon, Dorset, Yorkshire and Westmorland, on *Lotus*, *Anthyllis*, *Ononis* and *Trifolium*, vi–viii, 13 ♂, 16 ♀; SCOTLAND: Kincardineshire, Aberdeenshire, Inverness-shire and Morayshire, on *Lotus*, *Anthyllis*, *Ononis* and *Trifolium*, v–vii, 33 ♂, 60 ♀; AUSTRIA: Carinthia, Ossiach, on *Trifolium*, 1 ♀, 4.viii.1926 (*V. F. Eastop*); FRANCE: E. Pyrenees, l' Hospitalet, on *Lotus*, 1 ♀, viii.1926 (*R. S. Bagnall*); from Bois de Laye, Beauregard, Rhone, and other localities, on *Lotus*, *Ononis*, *Anthyllis*, and other plants, 10 ♂, 59 ♀, iv-ix.1927 (*O. John*); GERMANY: Harz, 2 ♀, vii-viii (*H. von Oettingen*); YUGOSLAVIA: Zagreb, Sabac, Maribor, Valjevo, Dugo Selo, Ljubljanic, Kragujevac, Svetozareva, and Vrsac, 3 ♂, 31 ♀, v-ix (*G. D. Morison* leg.); CZECHOSLOVAKIA: Slovakia, grasses, clover and *Vicia cracca*, 11 ♀, 30.v.1964 (*V. F. Eastop*); DENMARK: Haderslev, on *Anthyllis*, 2 ♀ (*J. Maltbaek*).

Odontothrips meliloti Priesner

(Text-figs 16 & 17; Map 2)

Odontothrips meliloti Priesner, 1951 : 358. [No data given].
Odontothrips meliloti Priesner; Priesner, 1964 : 67.

The females of *meliloti* are very similar to *ignobilis* and can only be distinguished by the absence of lines of sculpture on the median area of the pronotum. The male genitalia bear from three to four pairs of endothecal spines, the distal two or three pairs set apart from the basal pair, which are usually slightly larger (Text-figs 16 & 17).

No data accompanied the original description but Priesner (1964) records *meliloti* from Central and Southern Europe on *Melilotus albus* and *M. officinalis*.

MATERIAL EXAMINED. ENGLAND: Surrey, Ham, on *Melilotus*, 19 ♂, 15 ♀, 12.vi. 1966 and vi.1970 (*L. A. Mound*); Somerset, on *Ononis repens*, 1 ♀; London, Stoke Newington, on *M. albus*, 2 ♂, 3 ♀, 25.viii.1946 (*G. D. Morison*); FRANCE: Bois d' Oingt, 10 ♂, 31 ♀, 5.vi.1927 (*O. John*); no locality given, on Papilionaceae, 1 ♂, 3 ♀, 8.ix.1927 (*O. John*); GERMANY: Harz, on *M. officinalis*, 3 ♂, 3 ♀, 24.vii.1951 (*H. von Oettingen*); S. Hessen, Zwingenberg, in flowers of *M. albus*, 3 ♂, 29.vi.1961 (*R. zur Strassen*) (SMF); CZECHOSLOVAKIA: Pourdrany, 1 ♂, 1 ♀, (*J. Pelikan*) (USNM); U.S.S.R.: Georgien, Tbilisi, 1 ♂, 12.viii.1968 (*R. zur Strassen*) (SMF).

Odontothrips meridionalis Priesner

(Text-fig. 18; Map 2)

Odontothrips ulicis var. *meridionalis* Priesner, 1919 : 122. Syntypes 7 ♂, 15 ♀, ALBANIA: Durazzo, flowers of *Spartium*, 18 & 27.v.1917 (Priesner coll.) [2 ♂, 6 ♀, syntypes examined].
Odontothrips meridionalis Priesner; Priesner, 1920 : 55.
Odontothrips meridionalis Priesner; Priesner, 1964 : 67.

Although the females of *meridionalis* are not readily distinguishable from *meliloti*, *karnyi* and *retamae*, the males are distinct in the chaetotaxy of the ninth abdominal tergite. The medial pair of setae are short and very stout (Text-fig. 18). The male genitalia (Text-fig. 18) bear from two to three pairs of stout endothecal spines, the distal pair set apart from the basal one or two pairs.

Odontothrips meridionalis is here recorded from Albania, Turkey and Cyprus, apparently feeding in the flowers of *Spartium*.

MATERIAL EXAMINED. Syntypes 2 ♂, 6 ♀, ALBANIA: Durazzo, on *Spartium*, 27. v.1917 (*Karny*) (Priesner coll.).

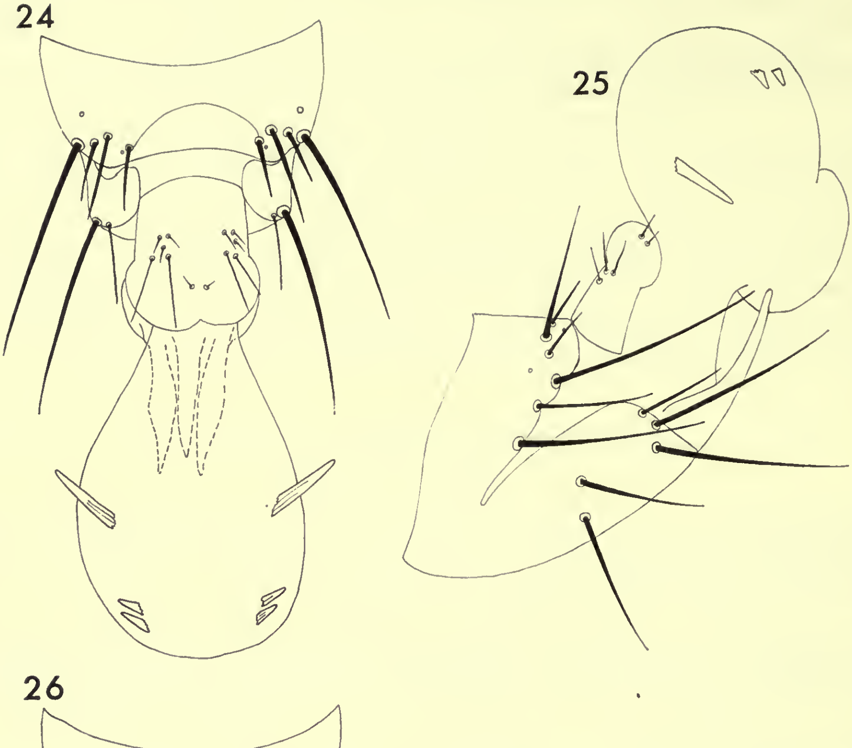
TURKEY: on *Spartium*, 1 ♂, 3 ♀, 2.vi.1949 (Priesner coll.). CYPRUS: Mt. Troodes, 9 ♀, vii.1937 (*G. A. Mavromoustakis*); Episcopi Forest, *Pinus maritima*, 1 ♀, iv.1954 (*G. A. Mavromoustakis*); no locality or host, 2 ♂, 9 ♀, (*G. A. Mavromoustakis*) (USNM).

Odontothrips moerens Priesner

Odontothrips moerens Priesner, 1927 : 64. Syntypes 4 ♀, GUINEA: Camayenne (Priesner coll.) [2 ♀ syntypes examined].

This species, like *pictipennis* (Text-fig. 1), has the base of the sixth antennal segment reduced. The fore tibiae each bear a single stout claw at the apex. The fore wings are almost entirely light brown and bear 4 + 11 + 2 setae on the upper vein and 14 to 18 on the lower vein. Antennal segment three is not markedly paler than segment two as in the Palaearctic *Odontothrips*.

O. moerens is known only from females collected in Guinea.



FIGS 24–27. Male genitalia and terminal abdominal segments: 24 & 25, *ulicis*, dorsal and lateral. 26 & 27, *cytisi*, dorsal and lateral.

MATERIAL EXAMINED. Syntypes 2 ♀, GUINEA: Camayenne (*Silvestri*) (Priesner coll.).

Odontothrips ononidis Bagnall

(Map 2)

Odontothrips ononidis Bagnall, 1934*b* : 490–491. Syntypes 4 ♀, FRANCE: St. Georges de Didonne, on *Ononis natrix* (BMNH) [examined].

Described from females only, *ononidis* cannot at present be distinguished from large specimens of *meliloti*. The fore wings bear 4 + 15 + 2 on the upper vein and 19 on the lower vein.

MATERIAL EXAMINED. Syntypes 4 ♀, FRANCE: St. Georges Didonne, on *Ononis natrix*, 15.vii.1914.

Odontothrips paraconfusus Pelikan

Odontothrips paraconfusus Pelikan, 1958 : 284–286. Holotype ♀, CZECHOSLOVAKIA: Cejc, on 'Steppenvegetation des xerothermen Lossbhanges', 8.vi. 1950 (Akademie der Wissenchaften, Brno) [not examined].

This species is apparently similar to *meridionalis* and *meliloti* but may be distinguished by the presence of two small claws at the apex of the fore tibia.

Odontothrips phaleratus (Haliday)

(Text-figs 11, 12 & 13; Map 4)

Thrips phalerata Haliday, 1836 : 447. Syntypes of both sexes, GREAT BRITAIN: borders of cornfield, ? *Lathyrus pratensis* (*A. Haliday*) (depository unknown) [not examined].

Odontothrips phalerata (Haliday) Amyot & Serville, 1843 : 643.

Physopus phalerata (Haliday); Uzel, 1895 : 112.

Odontothrips phalerata (Haliday); Karny, 1907 : 45.

Odontothrips anisomeris Bagnall, 1924 : 271. Syntypes of ? females only, ENGLAND: Surrey, Boxhill, on *Vicia* sp., May 1924; Yorkshire, Speeton, June 1924; Durham, Gibside, on *Lathyrus pratensis;* SCOTLAND: nr Perth, on *Vicia cracca*, June 1924 (All *R. S. Bagnall*) [18 ♀ from Durham & Surrey in BMNH examined]. [Synonymized by Bagnall, 1928 : 97.]

The females of *phaleratus* are very similar to *intermedius;* the males however may be distinguished from other species by the presence of median projections on the posterior margins of sternites IV to VII (Text-fig. 13). The male genitalia are bilobed and lack endothecal spines (Text-figs 11 & 12).

O. phaleratus apparently feeds in the flowers of *Lathyrus pratensis*, *Vicia cracca* and *V. sepium*. Priesner (1964) records this species from Great Britain and throughout Europe.

MATERIAL EXAMINED. Syntypes of *anisomeris*, 18 ♀, ENGLAND: Surrey, Boxhill, on *Vicia* sp. and Durham, Gibside, on *Lathyrus pratensis*, vii.1924 (*R. S. Bagnall*).

ENGLAND: Cheshire, Middlewood, on *Lathyrus pratensis*, 3 ♀, 6.vi.1920 (*H. Britten*); various localities, on *L. pratensis*, 6 ♂, 20 ♀, 1950–1060 (*G. D. Morison*); WALES: Llandona, Anglesey, sweeping, 2 ♂, 18.v.1961 (*V. F. Eastop*); SCOTLAND: Inverness-shire, Fort William, on *L. pratensis*, 1 ♂, 1 ♀ (*R. S. Bagnall*); various localities, on *L. pratensis*, 40 ♂, 72 ♀, 1950–1970 (*G. D. Morison*); FRANCE: Bois d'Alix, sweeping *Scirpus lacustris* (Cyperaceae), 2 ♀, 27.vii.1927 (*O. John*); Flecher, sweeping, 3 ♀, 21.viii.1927 (*O. John*); SWITZERLAND: Zurich, on *Fraxinus* (Oleaceae), 1 ♀, 12.viii. 1966 (*V. F. Eastop*); Corinthia, Ossiach, 1 ♀, on *Vicia cracca*, 13.viii.1966 (*V. F. Eastop*); GERMANY: Hessen, Reidelbach, Taunus, on *Juniperinus communis* (Cupressaceae), 1 ♂, 5.v.1964 (*R. zur Strassen*) (SMF); YUGOSLAVIA: on *Triticum sativum* (Gramineae), 4 ♀, 3.vi.1958 (*N. Tanasijevic*); Lesie, nr Bledu, 1 ♂, 29.vii.1967 (*V. F. Eastop*).

Odontothrips phaseoli Kurosawa

Odontothrips phaseoli Kurosawa, 1941 : 36–37, 43–44. Holotype ♂, CHINA: Manchuria, K-o-shan, in flower of red bean, 29.vii.1937 (*S. Kuwayama*) (National Institute of Agricultural Science, Tokyo) [examined].

The unique male of *phaseoli* apparently lacks tarsal hooks and tubercles and has a single fore tibial claw as in *phaleratus* and *intermedius*. Kurosawa states that *phaseoli* may be distinguished from *phaleratus* by the small tooth on the fore tibia as well as the absence of the projection on the sternites IV to VII of the abdomen.

Odontothrips phlomidinus Priesner

(Map 5)

Odontothrips phlomidinus Priesner, 1954 : 50–51. Syntypes 4 ♀, PERSIA: Ardekan Mountains, in flowers of yellow *Phlomis* sp. (Priesner coll.) [2 ♀ examined].

This species is described from four females collected in Persia and these apparently lack small hooks or tubercles on the distal tarsal segment of the fore limb. The fore wings are pale except at the extreme apex as in *elbaensis*, from which it may be distinguished by the absence of lines of sculpture medially on the pronotum and abdominal tergites II to VIII.

MATERIAL EXAMINED. Syntypes 2 ♀, PERSIA: Ardekan Mountains, 9–10,000 ft, Northern Fars, on yellow flowers of *Phlomis* sp., (*Kuh Barn i Firuz*) (Priesner coll.).

Odontothrips pictipennis Hood

(Text-figs 1 & 3)

[*Euthrips phalerata* (Haliday); Morgan, 1913 : 1–3. Misidentification.]
Odontothrips pictipennis Hood, 1916 : 117. Syntypes 2 ♀, U.S.A.: Virginia, Great Falls, on *Azalea nudiflora*, May 1915 (*W. L. McAtee*) (USNM) [not examined].
Odontothrips morgani Bagnall, 1929 : 49. Syntypes 2 ♀, U.S.A.: Florida, Quincy, on *Plantago virginica* (*H. F. Wilson*) (USNM) [not examined]. [Synonymized by Stannard, 1968 : 329].

The name *pictipennis* was erected by Hood (1916) for specimens misidentified by Morgan (1913) as *phalerata*. The fore wings bear 4 + 8 to 11 + 2 setae on the upper vein and 12 to 15 setae on the lower vein. The base of the sense cone on the sixth antennal segment is reduced (Text-fig. 1). The male genitalia are bilobed and lack endothecal spines (Text-fig. 3).

This species is apparently indigenous to North America and is found in herbs such as violets and strawberries.

MATERIAL EXAMINED. U.S.A.: New York, Ithaca, on *Carya*, 2 ♀, 17.v.1938

(*J. D. Hood*) (USNM); Illinois, Mark, on strawberry blossom, 2 ♂, 29.iv.1948 (INHS); Illinois, Fountain Bluff, Gorham, 1 ♂, 30.v.1954 (*L. J. Stannard*) (INHS).

Odontothrips retamae Priesner **stat. n.**

(Text-figs 22 & 23; Map 2)

[*Odontothrips karnyi* Priesner; Enderlein, 1929 : 42–44. Misidentification.]
Odontothrips karnyi var. *retamae* Priesner, 1933 : 192. Syntypes of ? both sexes, Canary Islands: on various Papilionaceae, April to May (*E. Titschack*) (Priesner coll.) [not examined].

Enderlein (1929) misidentified specimens from the Canary Islands ex *Retama* as *karnyi* Priesner. Priesner, when referring to these specimens and further material

Map 3. Distribution of *Odontothrips ulicis* and *cytisi*.

collected by Titschack, proposed the name '*karnyi* var. *retamae* Enderlein (*in schedis*)'. Material from the series from which Priesner chose syntypes, and further specimens from various Papilionaceae in the Canary Islands and Morocco, have been examined and compared with *karnyi* sensu stricto. Although the females are not readily distinguishable, the males are distinct. *O. retamae* male genitalia bear six or more pairs of needle-like spines on the endotheca (Text-figs 22 & 23). Some of the females examined have a complete comb of microtrichia on the posterior margin of the eighth abdominal tergite as described by Priesner (1933), but this is very weakly developed medially. The fore wings bear 14 to 21 setae on the lower vein.

This species is here recorded from the flowers of various Papilionaceae, particularly of the tribe Genisteae, in the Canary Islands and Morocco.

MATERIAL EXAMINED. CANARY: Gran Canaria, Los Tilos, on *Cytisus* sp., 6 ♂, 14 ♀, 8.iv.1931 (*E. Titschack*) (Priesner coll.); Gran Canaria, San Mateo, 3,500 m, on *Adenocarpus foliosus* flowers, 3 ♂, 8 ♀, 7.iv.1960 (*R. zur Strassen*); Tenerife, Barr de Masca, on flowering *Retama monosperma rhodorhizoides*, 9 ♂, 15 ♀, 20.iii.1964 (*R. zur Strassen*); Tenerife, Las Canadas, 2,250 m, on flowering branches of *Spartocytisus nubigenus*, 10 ♂, 15 ♀, 17.iv.1963 (*R. zur Strassen*); MOROCCO: Aknoul, on legumes, 4 ♂, 15 ♀, 6.iv.1960 (*Drea & Kramer*) (USNM).

MAP 4. Distribution of *Odontothrips phaleratus* and *intermedius*.

Odontothrips ulicis (Haliday)

(Text-figs 6, 24 & 25; Map 3)

Thrips ulicis Haliday, 1836 : 446. Syntypes of ? both sexes, GREAT BRITAIN: ex flowers of *Ulex europaeus*, *Crocus* and corn [lost].
Odontothrips ulicis (Haliday) Amyot & Serville, 1843 : 643.

The females of this species are not readily distinguishable from *cytisi*, although the hind vein of the fore wing normally bears a row of 17 to 23 setae, whereas *cytisi* has 14 to 18 setae. The males of *ulicis* lack the stout processes on the postero-lateral margin of the ninth abdominal tergite found in *cytisi* and other species of *Odontothrips*. The male genitalia bear three pairs of endothecal spines (Text-figs 24 & 25), with the basal pair nearly twice as long as the distal two pairs.

O. ulicis is a British species, also known from a single record in France, and feeds in the flowers of *Ulex europaeus*.

MATERIAL EXAMINED. ENGLAND: Northumberland, Ovingham, on *Ulex europaeus*, 2 ♂, 4 ♀, 15.iv.1916 (*R. S. Bagnall*); Surrey, Mitcham Common, *Ulex* flowers, 6 ♀, 25.iv.1965 (*B. R. Pitkin*): Hants, nr Brockenhurst, on *Ulex*, 3 ♂, 4 ♀, 16–19.iv. 1965 (*B. R. Pitkin*); Devon, Salcombe, on *Ulex*, 11 ♀, 27.1965 (*L. A. Mound*); SCOTLAND: Aberdeen, Bucksburn, *Ulex* flowers, 4 ♀, 15 ♂, 24.v.1966 (*L. A. Mound*);

MAP 5. Distribution of the *aemulans* group.

various localities on *U. europaeus*, 19 ♂, 9 ♀, 1950–1964 (*G. D. Morison*); Dyce, Gorse, 4 ♀, vi.1968 (*L. A. Mound*). GREAT BRITAIN; 58 ♂, 117 ♀ (*G. D. Morison*); IRELAND: Roscommon, Ballymoe, on *Ulex*, 2 ♀, 12.vi.1968 (*B. R. Pitkin*).

Odontothrips viciae Priesner

Odontothrips viciae Priesner, 1951 : 356. Syntypes 4 ♀, ISRAEL: Palestine, Zichron, on *Vicia* sp. (Priesner coll.) [2 ♀ examined].

This species of *Odontothrips* is related to *aemulans*, *confusus*, *dorycnii* and *edentulus* but appears to be unique in that the fore tarsus has a curved terminal claw. *O. viciae* is known only from the type-series of four females ex *Vicia* from Israel.

MATERIAL EXAMINED. Syntypes 2 ♀, ISRAEL: Palestine, Zichron, on *Vicia* sp., 22.ii.1938 (*E. Rivnay*) (Priesner coll.).

Odontothrips vuilletia Bagnall

(Map 2)

Odontothrips vuilletia Bagnall, 1934b : 489–490. Holotype, FRANCE: Pyrenees, Cauterets, on *Astragalus monospessulanus*, 25.v.1913 (*M. Vuillet*) [lost].

The unique female on which this species was described has apparently been lost (Mound, 1968) but in the original description Bagnall states that *vuilletia* was related to *ignobilis*, a species which is known to occur in the Pyrenees.

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